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PREFACE

In recent years European research and development (R&D) policy, and its possible links to aspects of economic globalization, have been at the forefront of the work of the European Parliament and its Committee on Research, Technological Development and Energy.

The 'Euro-lethargy' which set in at the beginning of the 1980s seemed to have been overcome by the impetus to growth and innovation provided by the Single Market initiative, but now in the mid-1990s the economic order in Europe is now once again coming in for critical observation. Problems of international competitiveness are being highlighted, and these need to be tackled, among other instruments, by appropriate R&D policy measures.

This expert opinion surveys the economic trends towards globalization and the growth of international competition, and demonstrates the implications which these factors have for a reformulation of European Union R&D policy (see the Community's 5th Research Framework Programme).

The Directorate-General for Research, at the request of the Committee on Research, Technological Development and Energy, has commissioned an external study on "Globalization and the Role of R&D policy'! The aim of this study is to compile background material for future initiatives of the European Parliament, and specifically for the development of an action programme in this policy area.

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VORWORT

Fur das Europaische Parlament bzw. seinen Ausschuß für Forschung, Technologische Entwicklung und Energie standen in den vergangenen Jahren Fragen der Europaischen Forschung- und Entwicklungspolitik (F&E) und mögliche Verbindungen zum Themenkreis "Globalisierung der Wirtschaft" im Vordergrund der Arbeit.

Nachdem die Anfang der 80er Jahre beschworene "Eurosklerose" durch die von der Binnenmarktinitiative ausgehenden Wachstums- und Innovationsimpulse überwunden schien, wird Mitte der 90er Jahre die wirtschaftliche Verfassung Europas erneut kritisch beleuchtet. Es wird auf Schwachen in der internationalen Wettbewerbsfähigkeit hingewiesen, die u.a. durch geeignete Maßnahmen der F&E-Politik iibenvunden werden sollen.

Dieses Gutachten gibt einen Überblick iiber die wirtschafllichen Globalisierungstendenzen und den zunehmenden internationalen Wettbewerb und zeigt Implikationen für eine neu zu konzipierende F&E-Politik der EU auf (siehe 5. Forschungsrahmenprogramm der Gemeinschafl).

Die Generaldirektion Wissenschaft hat - auf Anforderung des Ausschusses fur Forschung, technologische Entwicklung und Energie - eine externe Studie zum Thema "Globalisierung und die Rolle der F&E-Politik" in Auftrag gegeben. Die Zielvorgabe dieser externen Studie ist, Hintergrundmaterial fur zukünftige Initiativen des Europaischen Parlaments zusammenzustellen, namlichfur die Entwicklung eines Aktionsplans in diesem Politikbereich.

AVANT-PROPOS

Au cours des dernieres annees, les questions liées a la politique europkenne de recherche et de developpement (R & D) et Ieur liaison éventuelle avec les questions relatives a la mondialisation de l'économie ont ete a I'avant-plan des travaux du Parlement européen et de sa commission de la recherche, du developpement technologique et de I'energie.

Alors que la mise en place du marche interieur avait eu pour effet de stimuler la croissance et l'innovation et semblait ainsi avoir triomphe de l'"eurosclérose" apparue au debut des annees 80, I'etat de l'economie europeenne est, au milieu des années 90, de nouveau placé sous le feu des projecteurs. Des lacunes sont constatées en matikre de compétitivité internationale, que des mesures appropriees, prises notamment dans le domaine de la politique de R & D, devraient permettre de combler.

Cette expertise donne un aperçu des tendances economiques de la mondialisation et de l'intensification de la concurrence internationale et montre les incidences que doit avoir une politique renovee de I'UE en matiere de R & D (cf. cinquieme programme-cadre de recherche de la Communaute).

A la demande de la commission de la recherche, du developpement technologique et de l'énergie, la Direction generale "Études" a confié a l'extérieur l'élaboration d'une étude consacrée a la mondialisation et au rôle de la politique de R & D. Cette etude a pour objet de reunir le materiel de base pour les initiatives futures du Parlement européen, a savoir pour I'etablissement d'un plan d'action dans ce domaine.

DIRECTORATE-GENERAL FOR RESEARCH

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EXECUTIVE SUMMARY

Since the 1980s global competition has intensified as foreign direct investment increased strongly, new countries opened up as host countries (or became influential as source countries) and innovative forms of interfirm cooperation were established. Rising foreign direct investment could stimulate economic growth worldwide to the extent that it contributes to technology spillovers, international technology trade, improved use of know-how and a higher overall investment output ratio plus a higher marginal product of capital worldwide. The spatial distribution of foreign investment flows is m turn influenced by regional or local clusters of R&D centers and the availability of human capital or other factors which can be profitably combined with firm specific advantages important for multinational companies (MNCs). Moreover, public support for R&D and the quality of the education system also play a role for attracting MNCs.

In the 1980s and early 1990s international competition intensified in the OECD countries, but also worldwide. On the one hand, newcomers from Asian NICs entered medium and advanced technology fields, on the other hand the US, France and the UK as well as Russia reduced their emphasis on military research and development (R&D) after 1990. Hence, the end of the Cold War led to intensified competition m markets for civilian products. The ratio of civilian R&D to GDP has increased in most countries worldwide and there are prospects for a rapid increase of R&D outlays in some NICs and the PR China at the turn of the century. Moreover, the internet has reinforced access to new technological knowledge.

The link between globalization and foreign direct investment is important for the EU as is the interdependency between foreign investment and trade in a world of many newcomers fiom Asia and eastern Europe. Multinational companies contribute to economic development but also impose adjustment pressure on governments in the EU which compete for mobile investment. However, while many MNCs try to shop around for the highest subsidies and tax breaks initially a given commitment to investing m certain countries can help to establish new standards m the field of social policy and environmental policy. Reputation for products built up m leading markets will not allowe to be watered down easily in other markets which m principle could be served with products of minor quality. More ambivalent could be the environmental role of MNCs with respect to using different production process across countries where competition pressure is likely to stimulate MNCs to prefer countries with soft environmental standards.

Theoretical aspects of high technology policy deserve more attention and a special EU research program on this might be useful. Based on recent theoretical advances it is obvious that the combination of rising product differentiation and technology intensity with scale economies and technological spillover effects are import to consider. Here the single market reinforces scale economies; in this respect the economic opening up of eastern Europe also is important since there are new dynamic markets emerging and new opportunities for R&D subcontracting and cooperation. Eastern Europe offers an interesting pool of skilled researchers.

It will be important to take into account the links between globalization, employment dynamics and innovations. Product and process innovations clearly are crucial for productivity increases and economic growth. However, important is also the rapid diffusion of new technologies and an optimum use ofbest-practice technologies. With respect to the latter Germany and other continental EU countries suffered fiom a critical backwardness vis-a-vis the US, namely about 1/3 according to

a recent study by McKINSEY. Moreover, application of such technologies often are in sectors different from the innovative sector. Technology diffusion as a percentage of total embodied technology clearly was dominated by the service sector in the G-7 group in 1993. While the US, the UK, Japan and Italy recorded shares of more than 50%, France, Canada and Germany achieved only 44, 42 and 43%, respectively. In particular Germany as a country with an underdeveloped service sector thus foregoes opportunities for higher economic growth and employment creation. In the mid-1990s the share of services in GDP was about 10 percentage points lower in Germany than in the US, the differences in the respective shares of employment in private sector services were of a similar magnitude. This apparent gap in the service sector is a major structural deficit in Germany and overcoming obstacles to the expansion of this sector is a major policy challenge. This, however, could be difficult to meet since the high percentage of long term unemployed - often former workers and employees from industrial firms - will rarely have the matching skills required for new jobs in service companies. Moreover, workers from the manufacturing sector which, being a high capital intensity-high productivity sector, used to pay rather high wages, will often find it unacceptable to voluntarily switch to a new job in the less capital intensive service sector which often will pay lower wages but offer greater job security.

Germany and many other continental EU countries suffer from high unemployment rates which largely reflect an underdeveloped service sector, insufficient R&D expenditures and lack of training and education as well as inadequate diffusion policies. Labor market rigidities and insufficient wage dispersion also *impair* regaining full employment. Part of the existing productivity gap in continental EU countries vis-a-vis the US is apparently related to underdeveloped stock markets and rather poor capital productivity compared to the US.

The rapid growth in foreign direct investment in the 1980s has accelerated the transfer of international technology since technology trade is mainly intra-company trade (e.g. between parent company and subsidiaries) or license swapping between multinational companies (MNCs). A high rate of product innovation allows firms to charge higher prices in world markets and a high rate of process innovation facilitates the widening of markets and the exploitation of dynamic scale economies. Innovativeness is, therefore, not only a key to international competitiveness but to firms' ability to pay high real wages in EU countries.

European R&D policy has to be considered in both a national, a EU-wide and a global perspective. Basic evaluation of EU R&D Framework Programme and the proposed task forces suggests that some progress in European innovation policy has been achieved, but EU firms are - compared to the US - still underrepresented in the new dynamic technology fields. More policy emphasis should be put the role of small and medium-sized firms on the one hand, on the other hand, the challenges for international organizations are crucial. With more and more members the role of European Patent Agency is becoming more important, while it becomes more difficult to maintain efficiency. Crucial is also the role of the WTO which has a focus on trade-related intellectual property rights and some aspects of foreign direct investment. One may, however, raise the question whether the World Intellectual Property Organization should not play a stronger role and incorporate full responsibility for foreign direct investment which is almost fully complementary to international technology trade. International cooperation could become increasingly difficult in the era of globalization, however, adequate division of tasks between national governments, supranational institutions and international organizations will be a crucial *step* towards emerging global network governance.

The role of the stock market could also increase because the age of high technology competition at the turn of the century will reduce the relative importance of banks in financing innovative firms. European monetary union creates new opportunities for reinforcing the role of stock markets on the one hand, and, on the other hand, for more securitization. The hesitant steps on the continent to establish new stock markets for young firms should be encouraged politically, but there is also a need to stimulate the venture capital business in Euro countries and other EU countries. Asymmetric information problems between the innovator and the bank are typical of innovation projects so that insufficient access to (cheap) capital could limit the innovativeness of *firms* in the EU. The role of equity capital should be strengthened in the late 1990s in Europe. With workers facing a weaker bargaining position m the new environment of economic globalization one may consider tax incentives for workers encouraging them to allocate savings to investment funds (of a certain minimum rating). The role of capital markets could also be reinforced by reforming the social security systems, namely by partly replacing the current pay-as-you-go systems with capital funded security programs. With monetary union growth-enhancing policy strategies of EU countries could become particularly important as the external value of the Euro can thus be strengthened. Removing impediments to growth and improving conditions for investment and entrepreneurs thus is crucial.

For the EU a high overall attractiveness for outside investors is of prime importance in the future when the quest for increasingly mobile real capital will intensify. This holds not only because high foreign investment inflows raise the overall investment output ratio but also because modernization and network effects fiom foreing investment contribute to EU competitiveness. Foreign direct investment abroad in turn could strengthen EU competitiveness if a similar complementarity between exports and foreign investment were observed as in the case of US foreign investment. Whether the net employment effect of foreign investment outflows is positive for the source country much depends on whether world demand has to be assumed as given or inelastic, respectively. If both the source and the host country record positive output and employment effect that reinforce the profitability of innovative firms one may expect a positive impact of rising global foreign investment flows on R&D. Globalization can also stimulate R&D by facilitating firms to realize economies of scale over a wider range of international markets. To the extent that globalization means a shortening of innovation cycles technology oriented firms could face pressure to quickly serve national markets with differentiated customer taylored products so that the Vernon approach to trade and foreign investment has to be modified; the traditional product cycle model of foreign investment argues that innovations *mainly* occur in countries with high per capita income that will serve foreign markets by exports first - only later, m the standardization stage, will production be shifted abroad in order to capture cost advantages important for price sensitive standardized products.

Multinational companies play an increasing role m a world m which imperfect markets for information require firms to engage in foreign direct investment as a means of safeguarding technological leads and ensuring adequate appropriability of innovation rents m world markets. According to DUNNING and other authors firms will consider foreign investment as a preferable alternative to serving foreign markets via exports and licences if firm internal transaction costs are relatively low (compared to arm's length transactions) and if such investment is the best way to ensure that the benefits from innovation can profitably be appropriated. Firm specific advantages, typically based on technological or organizational leadership, are the basis for sucessfully setting up production abroad - ie in a country in which the indigenous firms enjoy natural advantages with respect to knowledge about customers' preferences and locations as well as to access to political support for business projects. Production abroad can be not only a way to exploit technological leadership but also a strategy of

product differentiation in markets where consumers have a preference for differentiated home-produced goods. The dynamics of the EC single market have shown an increase in intra-EU corporate mergers and acquisitions which can be understood as both reflecting the need for exploiting economies of scale and the need for stronger product differentiation under local production. Firms often will not establish fully developed subsidiary abroad, rather the headquarter company will offer certain functions (eg R&D, financing) as a pool resource for all subsidiaries. Thus it will be interesting to analyze under which conditions R&D centers are mobile internationally. Indeed, one should distinguish between immobile and mobile Schumpeterian industries, where the latter stands for technology intensive sectors. In some industries R&D indeed can be set up in many countries so that foreign subsidiaries can became a means to tap technologies developed abroad. The presence of US or Asian technology-oriented subsidiaries in the EU in turn could contribute to the technological dynamism of Western Europe. In oligopolistic world markets oligopolistic rivalry could also be a prime motive for foreign investment.

With a global tendency to higher civilian R&D/GDP ratios there are strong incentives for technology-oriented firms to engage in multinationalization. National governments are facing an increasingly multinational world economy characterized by high capital mobility, low barriers to trade and an intensified quest for mobile production factors; with governments often acting in a rather isolated manner national governments face mcreasing problems in effectively implementing economic policy - including R&D policies.

Technological competition has increased for various reasons, including the rise of the share of civilian R&D in the US. the UK, France, Russia and other countries. Moreover, with new technology fields developing and Asian as well as post-socialist east European economies emerging as new competitors for EU countries in labor intensive and medium technology intensive industries there is a new tendency towards mcreased high technology competition in OECD countries. Since high technology markets are rather small, the reorientation of US R&D ressources is stimulating US firms to aggressively move into medium technology markets so that EU firms face new problems in earning Schumpeterian rents in the world market which are the basis for self-financed innovation projects. With innovation cycles shortening and newcomers fiom Asia and Eastern Europe moving into established markets of EU firms there is a double problem for European industry. An interesting challenge also lies in the fact that innovation increasingly is linked to the service sector -including network industries - which also was among the leaders of globalization in the 1980s and early 1990s.

The positioning of the EU industry in the global world economy is crucial in the coming years. Most important will be the ability to attract sufficient foreign direct investment inflows fiom technology intensive source countries and to step up EU foreign direct investment outflows into countries with a dynamic technological background in America, Asia (plus Australia) and eastern Europe.

Improving the links between research and industry on the one hand, and, on the other hand, mobilizing entrepreneurship of universities and specialized research institutions could be important steps for a bigger impact of R&D in terms of commercial success of scientific progress.

Globalization of the economy means strongly increasing international competition. Price transparency is increasing for technological reasons and transportation costs are falling so that EU countries are facing stronger competition in labor intensive products. However, there is also an increasing EU-external supply of technology intensive commercial goods since the US and Russia have reoriented

military R&D towards civilian industries. Moreover, Asian NICs and some Latin American NICs are catching-up vis-8-vis Europe because of rising R&D GDP ratios and improved education systems. The mtemet has contributed to accelerating the global diffusion of know-how, but the internet also offers new opportunities for EU countries: it allows creation of innovative virtual *firms* and of electronic commerce. Even more important will be opportunities for *firms* to internationalize at reduced costs and to rely on powerful intranets for coordination of *firms*.

It is important for the EU to reconsider the role of R&D policy in the future and better evaluate policy strategies at the national level. Encouraging transeuropean research networks as well as co-financing mtemational benchmark studies for policy evaluation could be important impulses fiom the EU level. Prudent policy guide lines and improved policy transparency plus special support for technology-oriented start-up companies could also be particularly important in the future. Problems of patent protection and education policies as well as opportunities of mobilizing the innovative potential of universities in the informaton society will have to be considered, too.

Twelve main policy conclusions emerge:

- Globalization means intensified international interdepence as stronger links via tade, foreign investment - in a broad senes portfolio capital flows plus foreign direct investment - and the internet are increasing among OECD countries and worldwide. Globalization will continue after the turn of the century so that there are important long term policy issues associated with this new quality of factor mobility. This mobility has strongly increased for real capital and skilled labor, m the future the internet provides a new platform for making semi-skilled labor more mobile worldwide. Financial market integration is likely to proceed faster than the integration of the real sphere of the economy. Instabilities in national and international financial markets could become an impediment to sustained growth m the world economy. Such instabilities and high unemployment m many industrialized countries as well as poverty in LDCs are main areas of long term policy concern.

- For EU countries globalization means intensified international technology competition and thus a need for further specialization. Accelerated innovation worldwide implies higher growth and, possibly, major environmental problems. Additional govemment co-financed R&D programs with an ecological focus and measures to internalize negative external effects of growth therefore are required. As know-how and knowledge become more accessible around the world in the internet era EU foreign commercial policy might on the one hand support internet development initiatives m developing countries but also should emphasize that EU countries will keep their markets open for "outsiders" offering increasingly products with a higher technology content. It will be difficult to maintain such EU promises if full employment in western Europe is not restored and ifnot successll initiatives for high-technology leadership are launched in the EU. Globalization means a new international division of labor and know-how, where EU countries certainly will have to intensify R&D efforts and improve the diffusion process.

- National govemments plus trade unions and employer organizations are primarily responsible for employment developments and high unemployment rates, respectively. High unemployment rates cause resistance of workers against technological progress which is a problem for EU countries eager to improve international competitivenessvia technological modernization and innovation. Insufficient wage dispersion in many continental EU countries can be observed

where relatively high gross wages for unskilled labor are a major problem in continental EU countries. With reduced income tax rates for low income workers a longer period of underproportionate wage increases for unskilled workers might be easier to accept on the side of trade union. With more dispersion higher employment and - in the medium term - higher average wage growth would result. This in turn would stimulate aggregate demand and encourage further investment and output growth.

- Expenditures on training and schooling are insufficient in many EU countries given the need to face increasing competition in skill-intensive import goods from eastern Europe and Asia. Given high wages in most EU countries high productivity of labor is required if further increases of the unemployment rate are to be avoided. Continuous retraining and special education programs of firms - partly based on the internet - are options to be strongly considered.

- Capital productivity in EU countries is lower than in the US which points to inefficiencies in European capital markets. The Euro will create more integrated capital markets but it remains doubtful that there will be strong benefits for Europe if national tax legislation is not harmonized to some extent and if the political will to reform social security systems on the continent is not reinforced. Moving at least partly away from the pay-as-you go systems in most continental EU countries to a new capital funded pension system with strong incentives for workers to invest into investment funds would be an important impulse for higher capital productivity and ultimately more employment.

- R&D spending should be raised in Western Europe and the efficiency of R&D programs be increased.

- One cannot always avoid double spending in major R&D areas if one is to have the benefits of competition in R&D. Within the internal markets international M&As will raise the pressure on member governments to consider bilateral or multilateral joint R&D programs; and to persue more spcialization in R&D support.

- Encouraging diffusion of innovations seem to be quite important for growth and international competitiveness. New internet options should be envisaged for improving dissemination of information about innovations.

- The university system could be reformed, especially in countries with dominant state-funded universities. New private universities with a strong focus on advanced computer, internet and telecom technologies could be created to encourage a stronger orientation of university research towards the needs of the business community and society.

- Universities should be judged not only in terms of the number of students and scientific merit of professors but also with reference to the number of firms launched by alumni. Universities should be encouraged to establish a proven track record in this field.

- Given the small share of newly created firms in the EU which are technology-oriented one might consider special programs to stimulate the cration of new firms in novel technology fields. However, government money is in effect rarely needed when venture capital markets and stock

markets could develop a higher profile in most EU countries. Capital market policies are important as an indirect way to stimulate R&D in the community.

- EU research is not sufficiently specialized and innovations of EU firms often not in the most dynamic patent classes. Some informal coordination of national R&D policies could be useful in the future and the creation of EU-wide R&D networks could be encouraged. However, creating an EU-wide R&D network should - disregarding specific exceptions not be considered if there is no alternative competing network within Western Europe. EU firms could be encouraged to tap the R&D potential m eastern Europe and Russia where skilled personell often is available at low costs. At the bottom line it is clear that facing globalization of economic relations EU countries have to improve education, training and R&D efforts in order to maintain a global technological leader status. Low equity-capital ratios of firms in many EU countries raises doubts about the EU's ability to successllly exploit new innovation fields where provision of risk capital is important for survival and expansion of newcomers - more international benchmarking studies are necessary m the future, and one may recommend regular benchmarking in all major policy fields. While Europe's established firms are well organized (problem of vested interests) innovative newcomers and young firms are less organized and less supported by the banking system and the political system. Finally, one may notice that high unemployment rates not only discourage investment and innovation because record unemployment imposes limited prospects for new income growth and hence opportunities for higher growth. High unemployment rates also reinforce resistances of workers against technological progress. Restoring full employment in EU countries thus would stimulate economic growth and international competitiveness directly and indirectly.

The theoretical justification for high technology policy stems fiom an inherent market failure. High technology involves the production and commercialization of new economic knowledge. New knowledge is inherently different from the more traditional factors of production of labor, capital and natural resources, which are known and have a relatively certain economic value. By contrast, the production of new knowledge suffers fiom three major sources of market failure – indivisibilities, uncertainty and externalities.

The market failure aspects involved in knowledge-based economic activity provides a fundamental justification for govemment intervention, particularly to support what would otherwise be an under-production of that activity. However, a key practical consideration of technology policy institutions is how to avoid what has become known in the literature as regulatory capture. The main goals of creating such institutions are the avoidance of regulatory capture, that is having those policy makers with a mandate to devise and implement technology policy be captured by particular interest groups. Administrative procedures to diminish the influence of political rent-seeking activities fall under the heading of providing accountability, independence, and transparency.

The traditional or neoclassical approach to growth theory focused on the linkages between the inputs of labour and capital on the one hand, and output on the other in a production model fiamework. Economic growth was then explained either by increases in the quantity of the inputs or by the productivity of the inputs. Any residual or unaccounted growth was attributed to exogenous technological change, which was largely considered to be "manna fiom heaven".

The concept of endogenous growth embraces a diverse body of theoretical empirical work that emerged in the last decade. The new approach to growth theory emphasises that economic growth is an endogenous outcome of an economic system. The implications for government policy in the development of high technology under the endogenous growth theory are strikingly different fiom those under the traditional neoclassical growth theory. The role of government in the traditional neoclassical growth theory is limited and minimal. The returns fiom investment in new knowledge are appropriated by those firms and individuals undertaking those investments, so that there is no reason for governments to intervene in high-technology markets.

By contrast, in the new growth theory there is a compelling reason for government to undertake a vigorous and active policy in shaping high technology. This is due to the existence of knowledge externalities in the form of knowledge spillovers. By supporting the creation of new knowledge, linkages which generate the spillovers of that knowledge, and the commercialization of knowledge, government policy can correct the market failure inherent in knowledge-based economic activity.

The most important economic challenge confronting Europe is to restructure economic activity out of industries based on the traditional factors of production and into those industries that are knowledge based. The traditional view about the process of structural change is that the large enterprises are the driving force of such structural change. Large organizations have command over vast R&D resources. However, a compelling body of evidence spanning a broad range of countries suggests that small and new firms play a crucial role in triggering structural change. The reason that small and new firms are a driving force behind structural change is that people start firms to pursue ideas that otherwise would not be pursued by the incumbent firms. New firms serve as agents of change, away fiom the status quo and towards new activities that are controversial and uncertain.

Part of the reason why the competitive advantage of Europe has shifted away fiom the traditional industries and towards knowledge-based industries is the emergence of firms fiom Eastern Europe and the NICs. On the one hand, firms fiom Eastern and Central Europe, as well as the NICs have access to considerably less expense labour. On the other hand, the skill and human capital levels in at least some of these countries are quite high. The challenge to Europe posed by the new competition is whether to resist that new competition in traditional moderate technology industries m the form of barriers and protection, or whether to acknowledge that the events of 1989 triggered a long-term shift m the competitive advantage of the high-cost (Western) Europe to knowledge-based economic activities.

The greatest challenge for achieving efficient R&D policies in Europe is to reduce the barriers impeding the mobility and commercialization of new knowledge. Europe has not performed well in appropriating the returns from the investments made in new knowledge, both in terms of R&D and human capital. Part of this challenge lies in shifting policies away fiom targeting outputs and outcomes to targeting knowledge inputs. A second part involves complementary institutions such as finance and labour markets, which influences the ability of firms and individuals to commercialize their new knowledge.

In recent years, one important characteristic of labor markets in Anglo-Saxon countries at least has been the pronounced widening in skill differentials. The long-standing shift in favor of skilled labor and away from unskilled labor would appear to have accelerated in the last two decades. The supply of skill has increased less rapidly and unskilled wages have declined relatively (and in the U.S.

absolutely). There is little disputation in the U.S. and the U.K. as to the dominance of the relative demand shifts favoring the higher skilled, though there is more ambiguity in continental Europe given intervals of rising skilled worker unemployment. The controversy instead has to do with the sources of these relative demand shifts.

The two candidates are increased international trade and skill-biased (i.e. unskilled-labor saving) technological change, each of which falls under the rubric of "globalization." In both the U.S. and the U.K., decompositions of the aggregate change in, say, nonmanual employment have indicated that within-industry movements dominate between-industry shifts. If international trade were the culprit, one might have expected the opposite, given the uneven incidence of international trade across sectors of the economy. Separate trade analyses, exploiting data on the factor content of importing/exporting industries as well as (preferred) price effect studies have revealed that the contribution of trade to these relative demand shifts and thence earnings inequality - the immiseration effect of trade - has indeed been rather modest. In short, after FREEMAN (1995, 30), it can be said that the wages of the unskilled in developed economies are not set in Beijing. Be that as it may, there has been a level of discomfort with the technological change story because support for it has been indirect; that is, it has been conventional to measure technological change as a residual.

Of late, however, there have been a series of empirical attempts to peer inside the technology black box The use of proxies for technology have yielded more direct support for this explanation. But the evidence is not overwhelming, and the suggestion is that the technological change story may in the future have to share more equal billing with other explanations such as deregulation. Inequality clearly has a number of other nontrade sources, and technological change may be brought in train by increased competition (the endogeneity dimension).

On the issue of gauging labor market responses, it seems unlikely that standard indices of flexibility much assist our understanding of the issues raised by globalization in general and tecnological change in particular. Here the need is to study adjustment at the plant level. Studies exploiting such data have revealed considerable plant heterogeneity in both labor reallocation and the process of skill upgrading. The search for more systematic patterns in the establishment data should of course facilitate our understanding of technological change and of the role of trade as well as of appropriate labor market responses.

In general, the historical record is that the market responds rather well to changing demand. Another practical result is the strong complementarity between schooling and training which should continue to guide policy over the long run. But as for those marginalized by technological changes, however, reliance on markets is not enough and the notion of universal complementarity confirmed in the negative. Such disadvantaged workers do need assistance. Given the present state of our knowledge on what works for the disadvantaged, income maintenance and incremental measures are indicated.

Globalisation of research and development (R&D) since long is a major topic for academic researchers. The exchange of new ideas during international conferences and the collaboration across boarders in such prestigious projects as in high energy physics, nuclear fusion or space research is reality since several decades. The same is true in areas such as genetic engineering or oceanography but probably there less obvious as no joint large-scale facilities are required. Global R&D for the business community is now considered a major important topic than some twenty or thirty years ago. For decision makers in govemments globalisation seems to be more a problem than an opportunity

as the territorial boundaries and the respective legal systems cannot easily be surpassed (with the exception of the European Union).

MNCs, following these structural changes in technology, can combine their priority decision with a location decision and pursue some parts of R&D in one country, other parts in another. Those locations, maybe states or regions within countries, get more or less attractive if competence centres or networks between existing firms and public institutions, and favourable fiame conditions m combination offer competitive advantages against others. By favourable fiame conditions we mean both hard facts (country or state legislation, availability of skilled labour force etc.) as well as soft factors (such as nice housing opportunities, developed traffic systems for the long distance but also for *daily* use, touristic and other leisure opportunities, school teaching in several languages, and many more).

Thus, the presence of MNCs with distributed R&D facilities is a matter of fact. Globalised R&D is increasing fiom a low level m most countries. The net outflow of R&D is a concern for some countries but whether it is better to make 'Inational" companies work abroad and participate m foreign national systems or to invite foreign companies to the own territory remains largely open. Technology spill-overs and knowledge flows certainly accrue m both cases and the debate of the net R&D flows and their benefits is largely a question of employment within the national territory and also tax revenues fiom local R&D, production and services.

Most industrialised countries are in the process of becoming a service economy. Most obvious is the structural change in employment: Even those economies suffering fiom dramatic unemployment in manufacturing can have at the same time monotonously increasing jobs m the service sector. But this restructuring does not mean that manufacturing industry will soon seize to exist. As a rule of thumb one may assume that most of the new service firms use capital goods to provide their services. The challenge for machinery industry is, then, whether or not it provides the "right" machinery for the service society of the future, which will enhance its competitiveness m the manufacturing sector.

In the near future, it *can* hardly be expected that a rapid expansion of R&D-intensive sectors will be enough to solve the unemployment problems of highly developed industrialised nations. But, still, the technology-mtensive sectors may also benefit fiom the *shift* towards service industries. Know-how-intensive service providers m particular are rapidly gaining ground and already now provide jobs for many. Their success is increasingly dependent upon innovation and the use of new technologies. This in turn generates new markets for technology producers, particularly for information and communication technologies, infrastructure facilities for the transport and communication sectors and medical technology. Technological advances are geared increasingly to the service sectors needs.

The globalisation of industry has, in turn, sharply stimulated the demand for services (transportation, finance, distriiution, research and engineering) and accelerated the trend towards tertiarisation. The "service society" generates also new demands on technology policy. In general, this should result in a continued *shift* away fiom promoting the production of new technologies and towards promoting their use and dissemination. Ties to the technology supply should remain intact.

The trends towards a "service economy" also has consequences for the demands on technical performance: Business-directed services continually need impulses fiom innovative areas in the industrial sector m order to develop an ongoing basis. Advanced services are needed if research and

development, marketing, financing, production, and the like are pursued. This sector reinforces the growth impulses coming from industry and strengthensthe industrial base within its service products. On the other hand, innovative contriiutions within the value added change are shifting fiom hardware production to software and services. There are expensive areas in the service sector that are not dependent upon technology production locations but require advanced technological solutions to fulfil their primary role. In this regard, it is also essential, that greater attention be paid to potential applications for, and the optimal combination of technology in the expanding service sector.

If not the functional specification but the qualification of the employees serves at a benchmarking criterion for the human-capital intensification, then for major OECD countries one arrives at the following assessment. In the first half ofthe nineties one has to confirm a trend claimed already earlier that the share of employees with a higher education degree (university, polytechnical or related schools) and the share of academic staff (university degrees only) is increasing in the manufacturing sector and in the service industries. This means that there is tendency to employ relatively more highly qualified persons both in the service sector, which is expanding, and in the manufacturing sector with a loss ofjobs.

If we now, in summing up, consider the economies as a whole, that is, if we judge on both the manufacturing and the non-manufacturing sector, then the significance of human capital for economic growth can be diagnosed without doubt. Roughly speaking about half of the manufacturing and the service sectors are human-capital or knowledge-intensive; both figures increase in recent years. Therein the service sector is more and more dominating fiom year to year and thus, the sectoral change towards a knowledge intensive economy is spurred by the sectoral change towards a service economy in addition to the increases within each of the sectors. These seem to be two sides of the same coin.

If it is right, that there is more growth in overlapping, transdisciplinary fields of technology as compared with the core of the traditional technological areas, then it becomes apparent that the future challenges for education and re-education and also vocational training cannot be mastered within the classical schools, faculties, disciplines and circles alone. Future skill requirements go in the direction of interdisciplinary knowledge and life-long learning. This brings the question onto the agenda, whether our traditional institutions for education are sufficiently fit to train the next generation of employees.

The term "science" is understood to cover the creation, discovery, examination, classification, reorganisation and dissemination of knowledge on physical, biological or social subjects. "Technology"is science application know-how. As such, it belongs to a large group of like activities which embrace the creation and use of artefacts, crafts and items of knowledge as well as various forms of social organisations. Technology does not only signify the application of scientific results, but any purposive treatment, method, working method and skill in the exploitation of scientific knowledge together with the products of so doing.

The significance of the "research" process in the materialisation of the innovations nowadays is uncontested. According to the rules of present day research statistics, a distinction must be made between fundamental research, applied research and experimental development **(OECD, 1993).** The three subsequent differentiated concepts are often combined under the heading "research and development (R&D)".

A series of smaller European countries is strongly oriented towards general universities and other non-oriented research and does spend comparatively little money on oriented research. The Netherlands, Italy, Sweden and Germany also belong to this group with a share of less than 50 per cent dedicated for oriented research. The other EU countries and notably the United Kingdom and France spent relatively little on general basic research and put more emphasis on oriented research (in case of the two last-mentioned countries, for armament *also).* Thus, we have to conclude, country-specific patterns of spending in basic research persist even within the European Union. Reportedly the United States government with its large share of defence research spends least on general basic research, whereas Japan with a small defence R&D budget resembles the pattern of Germany.

For the average of the EU 15 countries between 40 and 50 per cent of government R&D appropriation is dedicated towards non-oriented research, whereas the European Commission nearly exclusively is engaged in oriented research. What we observe here is a clear distribution of labour between national European governments and the Commission which hardly contributes to non-oriented basic research.

Basically, the relationship between non-industrial research institutions and industry should be described as "interaction" in contrast to the older concept of "transfer". Knowledge is not only transferred one way, fiom research institution to industry, but there exists a flow of know-how in the opposite direction.

As older studies have shown, basic science contributes to the progress of technology in a decisive way. However, it is difficult to trace the ways and to measure this impact precisely. As difficult as a definition of science vs. technology is the specification of knowledge-flows between academia and industry. As in many cases there is a large time-lag between scientific discoveries and their introduction into technology, there is furthermore the necessity to provide a sufficiently long observation period, a requirement which is often overlooked in questionnaire surveys.

The respective literature points to observations that the scientific input into innovation heavily depends on the industrial sector concerned and the technical area considered. Therefore, what maybe found in case studies maybe "stained" by the industrial sector of the case study. Some of the discrepancies which are reported on the subject are likely to disappear if account is taken for all these complex influence factors.

Another important contribution to the linkage between research and industry is the existence of spill-overs. Knowledge created within an institution spills over for use by other institutions. This is so among enterprises and among academic institutions but also between the research and industrial sector. Enterprises and also individuals have access to knowledge external to them without any institutional transfer mechanisms. The empirical evidence clearly suggests that R&D and other sources of knowledgement not only generates these externalities, but studies also suggest that such linkages tend to be geographically bounded within the region where the new economic knowledge was created. That is, the new knowledge may spill over across firms and economic agents but the geographic extend of such knowledge linkages tends to be bounded and, thus, the specific national structures come as no surprise.

Despite the general consensus that knowledge linkages within the given locations stimulates innovative activity, there is little consensus as to exactly how this occurs if we think of the difficulties m establishing links between research and industry per sector and per nation. From this the desire of MNC headquarters to participate simultaneously in several national innovation systems, is perfectly understandable, even if the maintenance of several R&D labs in various countries is costly.

Science-based firms, the most interesting type in the context of globalisation, are located in the sectors of chemical, electrical and electronic engineering following. These science-based industries rely heavily on the R&D activities of firms which largely profit fiom the rapid development of the underlying sciences in universities and elsewhere. The science-based firms develop a high percentage of process technology in their own laboratories. From this the share of large companies is relatively high as there are minimum levels or thresholds for a size to be relevant for performance in-house R&D. On the other hand a number of high technology start-up companies fall into the science-based sector.

Generally, science-dependent areas are international areas and there is little distinction between countries. The science dependence of technology is an intrinsic feature of technology. Yet, the difference between the countries lies m the fact that some national innovation systems are more active m some of the science-based sectors than others and thus - without considering the discipline specific breakdown - look m a macro perspective as if they were more or less science-dependent. So we have to differentiate between the intrinsic properties in science and technology and the extent of activities which may differ between the countries.

Coming back to the position of the EU, we have to express clearly that in Europe the same areas are science-dependent as elsewhere in the world. However, the weaker performance of some (continental) EU countries m science-dependent sectors originates fiom the fact that they are less active there m comparison with non-science-dependent sectors. Thus, we may reduce the issue to a matter of profiling activities and not to any basic inefficiency in Europe.

Contemporary R&D policy has moved away fiom the inappropriate idea that the state could direct basic research over technological developments right down to individual national innovations. Equally outmoded is the idea that the State could be satisfied with the role of a subsidiary supporter of basic research and leave the control of technology to anonymous market processes. R&D policy for the start of the 21st century requires a middle way. An active role for the government as an intermediary between social players (companies, associations, interest groups, science communities, consumers, media, employers, and employees, etc.).

For the European R&D policy, this intermediary role must also take into account the fact that it is restricted m its scope fiom below. The activities of the European Communities must always be seen in contexts with the efforts of national policies and, in addition in some member countries, with below-national policies in federal states that promote research on a regional basis.

To the extend that a supply side R&D policy prevailed in the European Union we have to emphasis that science-based innovation is important in many cases but not in all. In global innovation, down-stream related processes such as effective national lead-markets and demand stimulation and articulation are also important. In this sense, it is recommended that R&D policy should try to warrant that those lead-markets be in the European Union where strong global players are active in.

In so far as by non-R&D measures the rapid and stable development of those markets can be facilitated, R&D policy should jomm with other European policies in order to achieve the maximum benefit.

Avoiding naive policy planning which was sometimes pursued in the seventies, also means not to set up large planning bodies and to abstain fiom mechanical shaping and controlling of science and technology institutions. Instead, the characteristics of an advanced science and technology policy on the European level should be based on the assumption that decision making occurs through negotiations of many diverse actors on various hierarchical levels. The top down approach is not useful at the turn of the century: players have to seek alignment and consensus. The European Commission and the governments of member states shouldjointly behave as facilitators in offering two-way information channels and forums for the debates. If required the Commission should provide strategic information inputs using technology foresight, technology assessment and strategic policy evaluation in science and technology. In so doing, it should not rely on EC bodies and agencies but on - from the perspective of member states - unbiased organisations or multi-national groups of think tanks. It is always helpful to organise strategic information m terms of alternative scenarios that strategic choices become visible.

The promotion of inter-European trans-border co-operation is permanently considered a challenge. It should also include the exchange of persons by special subsidies. Because of different career structures m universities and firms and the social problems of mobility, the transfer of personnel will always be limited compared to other measures. It is thus an area of high impact elasticities if policy can trigger of more exchange.

AUSFÜHRLICHE ZUSAMMENFASSUNG

Seit den 80er Jahren ist eine erhebliche Verschärfung des globalen Wettbewerbs festzustellen, nachdem der Umfang ausliindischer Direktinvestitionen stetig zunahm, neue Liinder als Empfängerländer auf den Plan traten (oder als Geberliinder zunehmend an Einfluß gewannen) und sich innovative Formen der Unternehmens-zusammenarbeit herausbildeten. Das steigende Volumen ausländischer Direktinvestitionen konnte zu einer Belebung des Wirtschaftswachstums in aller Welt beitragen, da diese Investitionen zu technologischen Spillover-Effekten, Technologieaustausch auf internationaler Ebene, zu einer intensiveren Nutzung von Know-how und zu einem hoheren Verhaltnis von Gesamtinvestitionen und Ertrag sowie zu einem hoheren Kapital-Grenzprodukt weltweit beitragen. Die geographische Verteilung der **Auslandsinvestitionsstrome** wird ihrerseits durch regionale oder lokale Konzentrationen von F&E-Zentren und durch die Verfiigbarkeit von Humankapital oder anderen Faktoren beeinflußt, die sich auf rentable Weise mit konkreten spezifischen Vorteilen kombinieren lassen, die fiir multinationale Unternehmen **(MNCs) von** Bedeutung sind. Darüber hinaus spielen als Anziehungsfaktoren fiir multinationale Unternehmen auch die Forderung von F&E durch die offentliche Hand sowie die Qualitat des Bildungssystems eine Rolle.

In den 80er Jahren und Anfang der 90er Jahre verschärfte sich der internationale Wettbewerb nicht nur in den OECD-Ländern, sondern auch weltweit. Zum einen traten neue Akteure aus den neuen Industrieländern m den Bereichen der mittleren und Hochtechnologie aufden Plan, *nun* anderen ging seit 1990 in den USA, Frankreich und im Vereinigten Konigreich, aber auch in Rußland die Bedeutung der militarischen Forschung und Entwicklung (F&E) stetig zurück. Mit dem Ende des kalten Krieges wurde somit der Wettbewerb auf den Markten fiir zivile Güter immer härter. Der Anteil der zivilen F&E am BIP stieg in fist allen Ländern der Erde an, wobei sich auch in einigen Schwellenländern und m der VR China zur Jahrtausendwende ein rascher Anstieg der Aufwendungen fiir F&E abzeichnet. Hinzu kommt, daß der Zugang zu neuem technologischem Know-how durch das Internet wesentlich einfacher geworden ist.

Der Zusammenhang zwischen Globalisierung und ausländischen Direktinvestitionen ist für die EU genauso wichtig wie die wechselseitigen Abhängigkeiten zwischen ausländischen Investitionen und Handel in einer Welt, in der zahlreiche neue Akteure aus Asien und Osteuropa prasent sind. Multinationale Unternehmen leisten einen Beitrag zur wirtschaftlichen Entwicklung, setzen jedoch gleichzeitig die Regierungen innerhalb der EU, die versuchen, die verfügbaren Investitionsmittel ins Land zu holen, unter Anpassungsdruck. Viele multinationale Unternehmen versuchen zwar, die einzelnen Regierungen gegeneinander auszuspielen und sich auf diese Weise die hochsten Subventionen und Steuervorteile zu sichern, doch konnen von Investitionszusagen in einem bestimmten Land auch Impulse für die Schaffung neuer Standards in der Sozialpolitik und Umweltpolitik ausgehen. Unternehmen, deren Erzeugnisse sich m führenden Markten einen guten Ruf envorben haben, lassen sich diesen Ruf nicht ohne weiteres in anderen Markten venvassern, die im Prinzip mit geringenvertigen Produkten bedient werden konnten. Zwiespaltiger konnte sich die umweltpolitische Rolle der multinationalen Unternehmen in der Frage des Einsatzes von Land zu Land unterschiedlicher Fertigungsprozesse gestalten, wobei sich die multinationalen Unternehmen unter dem Druck des Wettbewerbs vermutlich eher fiir Länder mit niedrigeren Umweltstandards entscheiden.

Emgehender beriicksichtigt werden sollten theoretische Aspekte der Hochtechnologiepolitik, wobei ein spezielles Forschungsprogramm der EU hilfreich ware. Neuere theoretische Erkenntnisse zeigen, daß die Kombination aus einer zunehmenden Produktdifferenzierung und Technologieintensitat in Verbindung mit Größenvorteilen und technologischen Spillover-Effekten wichtige Gesichtspunkte darstellen, die es zu beriicksichtigen gilt. In diesem Zusammenhang tragt der Binnenmarkt zu einer Starkung der Gronenvorteile bei; hierbei ist auch die wirtschaftliche Öffnung Osteuropas von Bedeutung, da dort neue dynamische Markte entstehen, in denen sich neue Moglichkeiten fiir das Zuliefenvesen und die Zusammenarbeit im F&E-Bereich ergeben. Osteuropa verfiigt iiber einen attraktiven Bestand an erfahrenen Fachleuten im Forschungsbereich.

Ein wichtiger Faktor ist hierbei die Einbeziehung der Zusammenhänge zwischen Globalisierung, Beschäftigungsdynamik und Innovationen. Produkt- und Prozeßinnovationen sind eindeutig ein entscheidender Faktor fiir Produktivitatssteigerungen und wirtschaftliches Wachstum. Wichtig sind jedoch auch die rasche Verbreitung neuer Technologien und der optimale Einsatz bewährter technologischer Verfahren. In diesem letzteren Punkt ist festzustellen, daß Deutschland sowie andere EU-Staaten Kontinentaleuropas gegeniiber den USA einen kritischen Ruckstand aufweisen, der nach einer vor kurzem von McKINSEY durchgeführten Untersuchung rund 1/3 ausmacht. Außerdem konzentriert sich die Anwendung dieser Technologien häufig auf andere Bereiche als den Innovationssektor. Bei der Verbreitung von Technologie als prozentualem Anteil an der gesamten mvestitionsgebundenen Technologie dominierte 1993 in der G7-Gruppe der Dienstleistungssektor. Während in den USA, im Vereinigten Konigreich, Japan und Italien Anteile von mehr als 50% verzeichnet wurden, erreichten Frankreich, Kanada und Deutschland Anteile von nur 44, 42 bzw. 43%. Vor allem Deutschland als ein Land, in dem der Dienstleistungssektor unterentwickelt ist, vergibt damit die Chance auf ein hoheres Wirtschaftswachstum und die Schaffung von Arbeitsplatzen. Mitte der 90er Jahre lag der Anteil des Dienstleistungssektors am BIP in Deutschland um ca. 10 Prozentpunkte unter dem in den USA erreichten Wert, wobei die Unterschiede der betreffenden Arbeitsplatzzahlen im privaten Dienstleistungssektor ähnliche Größenordnungen erreichten. Diese erkennbare Schwache des Dienstleistungssektors muß als erhebliches strukturelles Defizit Deutschlands betrachtet werden. Die Überwindung der Hindernisse, die der Expansion dieses Sektors im Wege stehen, entwickelt sich zu einer zentralen politischen Herausforderung. Diese Herausforderung dürfte allerdings nur schwer zu bewaltigen sein, da der hohe Prozentsatz an Langzeitarbeitslosen - häufig ehemalige Arbeiter und Angestellte aus Industrieunternehmen - nur selten iiber die notwendigen Kenntnisse verfügt, die fiir neue Arbeitsplatze in Dienstleistungsunternehmen erforderlich sind. Außerdem sind Arbeiter aus der Fertigungsindustrie, in der aufgrund der hohen Kapitalintensitat und hohen Produktivitat vergleichsweise hohe Lohne gezahlt wurden, haufig nicht bereit, freiwillig eine neue Arbeitsstelle m dem weniger kapitalintensiven Dienstleistungssektor anzunehmen, der häufig niedrigere Gehalter zahlt, aber eine hohere Arbeitsplatzsicherheit bietet.

Deutschland sowie weitere EU-Staaten des Kontinents leiden unter hohen Arbeitslosenquoten, die im Wesentlichen Ausdruck des unterentwickelten Dienstleistungssektors, unzureichender F&E-Aufwendungen, der Mangel im Bildungs- und Berufsbildungssystem sowie ungeeigneter Weiterverbreitungspolitiken sind. Restriktive Arbeitsmarktregelungen und eine unzureichende Gehaltsstreuung erweisen sich gleichfalls als Hindernisse aufdem Weg zur Vollbeschaftigung. Die bestehende Produktivitatslucke der EU-Staaten im Vergleich zu den USA steht dariiber hinaus offensichtlich m Zusammenhang mit den unterentwickelten Borsen und der im Vergleich zu den USA relativ schwachen Kapitalproduktivitat.

Das rasche Wachstum der auslhdischen Direktinvestitionen in den 80er Jahren führte zu einem beschleunigten Transfer internationaler Technologien, da der Technologieaustausch sich in erster Linie als unternehmensinterner Austausch (z.B. zwischen Mutterunternehmen und Tochterunternehmen) oder als Lizenzaustausch zwischen multinationalen Unternehmen (MNC) vollzieht. Dank der hohen Produktinnovationsgeschwindigkeit konnen die Firmen auf den Weltmiirkten hohere Preise verlangen, während die hohe Prozeainnovationsgeschwindigkeit zur Öffnung der Märkte und Nutzung dynamischer Größenvorteile beitragt. Die Innovationsfreudigkeit ist daher nicht nur em Schlüssel zur internationalen Wettbewerbsfähigkeit, sondern auch zur Fähigkeit der Unternehmen, in den Lhdern der EU hohe Reallohne zu zahlen.

Die europaische F&E-Politik muß sowohl unter nationalen als auch unter EU-weiten und globalen Aspekten näher untersucht werden. Eine grundlegende Beurteilung des F&E-Rahmenprogramms der EU und der vorgeschlagenen Task Forces läßt erkennen, daß in der europäischen Innovationspolitik gewisse Fortschritte erzielt worden sind, daß die Unternehmen der EU - im Vergleich zu den USA - jedoch m den neuen dynamischen Technologiefeldern nach wie vor unterreprasentiert sind. Zum einen müßte der Schwerpunkt der Politik besonders auf die Rolle kleiner und mittlerer Firmen gelegt werden, zum anderen stehen die internationalen Organisationen von betrachtlichen Herausforderungen. Angesichts ihrer wachsenden Mitgliederzahl gewinnt die europaische Patentbehorde an Bedeutung, während die Aufrechterhaltung einer effizienten Funktion sich zugleich als immer schwieriger erweist. Von entscheidender Bedeutung ist auch die Rolle der WTO, deren Schwerpunkt aufmit dem Handel zusammenhängenden gewerblichen Schutzrechten und bestimmten Aspekten ausländischer Direktinvestitionen liegt. Hier stellt sich jedoch die Frage, ob die World Intellectual Property Organization nicht eine starkere Rolle spielen und die volle Verantwortung für ausländische Direktinvestitionen übernehmen sollte, die den internationalen Technologiehandel in fast vollem Umfang komplementar ergänzen. Die internationale Zusammenarbeit konnte sich jedoch in der Ära der Globalisieruug als zunehmend schwierig erweisen, weshalb eine angemessene Aufgabenteilung zwischen nationalen Regierungen, supranationalen Einrichtungen und internationalen Behorden ein entscheidender Schritt hin zur Dominanz der entstehenden globalen Netze ware.

Auch den Aktienmärkten konnte eine wichtigere Rolle dann, da im Zeitalter des High-Technology-Wettbewerbs vor dem Jahr 2000 die relative Bedeutung der Banken bei der Finanzierung innovativer Firmen zurückgeht. Durch die Europaische Währungsunion entstehen neue Chancen fiir eine Starkung der Rolle der Aktienmärkte einerseits sowie fiir eine weitergehende Notierung von Unternehmen andererseits. Die zogerlichen Schritte, die Kontinentaleuropa beim Aufbau neuer Aktienmärkte fiir junge Unternehmen unternimmt, mussen politisch gefordert werden, wobei sich zugleich auch die Notwendigkeit ergibt, den Risikokapitalsektor in den Liindern des Euro sowie in weiteren EU-Ländern zu stärken. Probleme, die aus einem Mißverhältnis der Informationen zwischen Innovator und Bank herrühren, sind typisch fiir Innovationsvorhaben, d.h. ungenügende Zugangsmoglichkeiten zu (billigem) Kapital konnten die Innovativitat der Unternehmen in der EU nachhaltig behindern. Am Ende der 90er Jahre muß in Europa auch die Funktion des Eigenkapitals gestarkt werden. Nachdem die Verhandlungsposition der Arbeitnehmer im neuen Umfeld der wirtschaftlichen Globalisierung zunehmend schwacher wird, kamen unter Umständen steuerliche Anreize in Betracht, mit denen für Arbeitnehmer Anreize zur Anlage von Ersparnissen in Investmentfonds (mit einer bestimmten Mindesteinstufung) geschaffen werden. Die Rolle der Kapitalmärkte konnte auch durch eine Reform der Sozialversicherungssysteme gestarkt werden, und zwar, indem die gegenwartigen Quellenbesteuerungssysteme teilweise durch aus Eigenmitteln finanzierte Sozialversicherungsprogramme abgelost werden. Im Zuge der Währungsunion konnten

sich wachstumsfördernde Verfahrensstrategien der EU-Länder als besonders wichtig erweisen, da auf diese Weise auch der Aullenwert des Euro gefestigt werden kann. Der Abbau von Wachstumshindernissen und die Schaffung günstigerer Voraussetzungen fiir Investitionen und Unternehmertum sind somit von entscheidender Bedeutung.

Eine hohe Attraktivitat fiir Fremdinvestoren ist fiir die EU speziell in Zukunft von besonderer Bedeutung, wenn sich der Bedarf an zunehmend mobilerer Kapitalsubstanz intensiviert. Dies trifft nicht nur zu, weil der Zustrom umfangreicher ausliindischer Investitionsmittel zu einem Anstieg des Verhältnisses von Gesamtinvestitionen und Ertrag führt, sondern auch, weil die Modernisierung und die Vernetzungseffekte, die auslandische Investitionen mit sich bringen, einen Beitrag zur Wettbewerbsfähigkeit der EU leisten. Auslandische Direktinvestitionen aullerhalb der EU konnten ihrerseits zu einer Stärkung der Wettbewerbsfähigkeit der EU beitragen, falls zwischen Ausfuhren und Auslandsinvestitionen eine ähnliche Komplementaritat wie bei den ausländischen Investitionen der USA festzustellen ist. Ob der Nettobeschäftigungseffekt des Abflusses auslandischer Investitionen sich positiv aufdas Geberland auswirkt, hängt weitgehend davon ab, ob die weltweite Nachfiage als unveränderlich vorgegeben bzw. starr angenommen werden mull. Wenn sowohl im Geber- als auch im Empfängerland positive Auswirkungen auf Produktion und Beschäftigung zu verzeichnen sind, durch die die Rentabilitat innovativer Firmen gestarkt wird, darfhieraus eine positive Wirkung der wachsenden globalen **Auslandsinvestitionsstrome** auf die F&E-Tätigkeit erwartet werden. Die Globalisierung tragt zugleich zur Belebung der F&E-Tätigkeit bei, da die Firmen hierdurch leichter Größenvorteile in einem breiteren Spektrum internationaler Markte erzielen konnen. Insoweit die Globalisierung einer Verkürzung der Innovationszyklen gleichkommt, konnte fir technologieorientierte Firmen die Notwendigkeit entstehen, nationale Markte mit unterschiedlichen, kundenspezifisch angepaßten Produkten zu bedienen, weshalb das Vernon-Konzept fiir Handel und ausländische Investitionen hier modifiziert werden mull; das herkommliche Produktzyklenmodell der ausländischen investitionen besagt, daß Innovationen m erster Linie m Ländern mit hohem Pro-Kopf-Einkommen vorgenommen werden, die auslhdische Markte zunachst durch Exporte bedienen - während erst später, in der Standardisierungsphase, die Produktion ins Ausland verlagert wird, um die Kostenvorteile nutzen zu konnen, die bei preisempfindlichen standardisierten Produkten eine wichtige Rolle spielen.

Multinationale Unternehmen spielen eine zunehmend wichtigere Rolle in einer Welt, in der die Unternehmen aufgrund der Unvollkommenheit der Informationsmärkte gezwungen sind, als Mittel zum Erhalt ihrer technologischen Führungsstellung und zur Gewährleistung einer angemessenen Verwendbarkeit von Innovationsertragen auf den Weltmiirkten ausliindische Direktinvestitionen zu tatigen. Nach DUNNING und anderen Autoren betrachten die Unternehmen ausliindische Investitionen als zu bevorzugende Alternative zur Bedienung von Auslandsmärkten uber Exporte und Lizenzen, wenn die unternehmensinternen Transaktionskosten relativ niedrig sind (im Vergleich zu Transaktionen unabhiingiger Partner) und wenn diese Investitionen die beste Moglichkeit für eine rentable Verwendung der Gewinne aus Innovationen darstellen. Gefestigte spezifische Vorteile, die typischerweise aufemer technologischen oder organisatorischen Führungsstellung aufbauen, sind die Grundlage für die erfolgreiche Einrichtung von Fertigungsstatten im Ausland, d.h. in einem Land, in dem die inländischen Firmen uber natürliche Vorteile hinsichtlich ihrer Kenntnisse uber Kundenpräferenzen und Standorte sowie uber Zugang zu politischer Unterstiitzung fir Geschäftsvorhaben verfügen. Die Fertigung im Ausland kann nicht nur eine Moglichkeit zur Nutzung einer technologischen Vormachtstellung bieten, sondern auch eine Strategie der Produktdifferenzierung in Markten darstellen, in denen die Verbraucher differenzierte, im Inland

erzeugte Waren bevorzugen. Aufgrund der Dynamik des EU-Binnenmarktes war eine Zunahme von Unternehmenszusammenschlüssen und -übernahmen innerhalb der EU festzustellen, worin die Notwendigkeit zum Ausdruck kommt, einerseits Größenvorteile zu nutzen und andererseits eine starkere Produktdifferenzierung in der lokalen Fertigung zu erreichen. Die Firmen gründen hadig keine vollständigen Tochterunternehmen im Ausland, sondern das Mutterhaus stellt bestimmte Funktionen (z.B. F&E oder Finanzierung) als gemeinsame Ressource für samtliche Tochterunternehmen zur Verfügung. Die Untersuchung, unter welchen Bedingungen eine internationale Mobilitat der FE-Zentren festzustellen ist, dürfte daher zu interessanten Ergebnissen führen. Grundsätzlich mull zwischen mobilen und immobilen Schumpeterschen Wirtschaftszweigen unterschieden werden, wobei letztere fiir technologieintensive Wirtschaftszweige stehen. In bestimmten Industriezweigen konnen F&E-Tätigkeiten in zahlreichen Liindern aufgebaut werden, wodurch ausliindische Tochterunternehmen genutzt werden konnen, um im Ausland entwickelte Technologien zu erschließen. Das Bestehen US-amerikanischer oder asiatischer, technologieorientierter Tochterunternehmen konnte wiederum zur Belebung der technologischen Dynamik Westeuropas beitragen. In oligopolistischen Weltmiirkten konnte sich die oligopolistische Rivalitat auch als eine Haupttriebkraft für ausliindische Investitionen erweisen.

Mit der weltweit zu beobachtenden Tendenz zu einem hoheren Verhaltnis von ziviler F&E und BIP entstehen für technologieorientierte Unternehmen starke Anreize, sich in der Multinationalisierung zu engagieren. Die einzelstaatlichen Regierungen sehen sich in zunehmendem Maße einer multinationalen Weltwirtschaft gegenuber, die durch eine hohe Mobilitat des Kapitals, niedrige Handelsschranken und einen ausgepragten Bedarf an mobilen Produktionsfaktoren gekennzeichnet sind; aufgrund der hadig relativ isolierten Handlungsweise der Regierungen stehen die einzelstaatlichen Regierungen vor zunehmenden Problemen bei der wirksamen Umsetzung der Wirtschaftspolitik - einschließlich der F&E-Politik.

Der technologische Wettbewerb verschärfte sich aus verschiedenen Gründen, unter anderem aufgrund des zunehmenden Anteils ziviler F&E-Investitionen in den USA, im Vereinigten Konigreich, Frankreich, Rullland und anderen Liindern. Da zudem neue Technologiefelder entstehen und die asiatischen wie auch die postsozialistischen Volkswirtschaften Osteuropas als neue Wettbewerber der EU-Staaten um arbeitsintensive und auf mittlere Technologie ausgerichtete Wirtschaftszweige auftreten, entsteht ein neuer Trend hin zu zunehmendem Wettbewerb im Hochtechnologiebereich m OECD-Ländern. Da die Hochtechnologiemärkte relativ klein sind, bedeutet die Umlenkung der amerikanischen F&E-Mittel einen Anreiz für US-Firmen, sich aggressiv in den Markten der mittleren Technologie zu engagieren, wodurch die EU-Firmen mit neuen Problemen bei der Erwirtschaftung Schumpeterscher Ertrage auf dem Weltmarkt konfrontiert werden, die die Grundlage für eigenfinanzierte Innovationsprojekte bilden. Da sich die Innovationszyklen zunehmend verkürzen und neue Akteure aus Asien und Osteuropa in die etablierten Markte der EU-Firmen eindringen, steht die europaische Industrie vor einem doppelten Problem. Eine interessante Herausforderung liegt auch in der Tatsache, daß die Innovationen in zunehmendem Maße am Dienstleistungssektor - einschließlich der Netzindustrien - hängen, der an der Globalisierung in den 80er und frühen 90er Jahren ebenfalls führend beteiligt war.

In den nachsten Jahren wird von entscheidender Bedeutung sein, welche Stellung sich die EU-Industrie m der globalen Weltwirtschaft sichert. Am wichtigsten ist die Fähigkeit, in ausreichendem Umfang ausländische Direktinvestitionen aus technologieintensiven Geberländern zu gewinnen und

die ausländischen Direktinvestitionen der EU in Länder Amerikas, Asiens (einschließlich Australiens) und Osteuropas aufzustocken, die einen dynamischen technologischen Hintergrund bieten.

Die Verbesserung der Verbindungen zwischen Forschung und Industrie einerseits und die Forderung des Unternehmertums an Universitaten und spezialisierten Forschungseinrichtungen andererseits waren wichtige Schritte, damit von F&E-Aktivitäten ein nachhaltigerer Einfluß in Form wirtschaftlichen Erfolgs wissenschaftlicher Fortschritte ausgeht.

Die Globalisierung der Wirtschaft bedeutet eine erhebliche Verschärfung des internationalen Wettbewerbs. Die Preistransparenz nimmt aus technologischen Gründen zu, wahrend die Transportkosten weiter sinken, so daß die Liinder der EU bei arbeitsintensiven Erzeugnissen vor noch härterer Konkurrenz stehen. Allerdings ist auch ein zunehmender EU-externer Zustrom technologieintensiver Waren zu verzeichnen, da die USA und Rußland ihre militarischen F&E-Aktivitaten auf zivile Erzeugnisse umgelenkt haben. Zudem holen die Schwellenliinder Asiens sowie bestimmte lateinamerikanische Staaten aufgrund ihrer steigenden F&E/BIP-Verhältnisse und der Verbesserungen im Bildungswesen gegenuber Europa weiter auf. Auch das Internet trug zur rascheren globalen Verbreitung von Know-how bei, allerdings bietet das Internet auch neue Perspektiven für die Liinder der EU: Es ermoglicht das Entstehen innovativer virtueller Firmen und des elektronischen Handels. Noch wichtiger sind die Moglichkeiten der Firmen, ihre Internationalisierung zu niedrigeren Kosten voranzutreiben und sich bei der Koordinierung der Unternehmen auf leistungsfähige Intranets zu stiitzen.

Fur die EU kommt es darauf an, die zukünftige Rolle der F&E-Politik zu uberdenken und die Politikstrategien auf nationaler Ebene genauer zu bewerten. Vielversprechende transeuropaische Forschungsnetze sowie die Kofinanzierung internationaler **Benchmark-Untersuchungen** zur Politikbewertung konnen wichtige Impulse auf EU-Ebene vermitteln. Durchdachte politische Leitlinien und eine bessere politische Transparenz sowie besondere Unterstützungsmaßnahmen fir technologieorientierte Unternehmen in ihrer Gründungsphase konnten sich in Zukunft ebenfalls als ausgesprochen wichtig erweisen. Die Probleme des Patentschutzes und der Bildungspolitik sowie Moglichkeiten zur Mobilisierung des innovativen Potentials der Universitaten in der Informationsgesellschaft mussen ebenfalls in Betracht gezogen werden.
Hieraus ergeben sich zwölf zentrale politische Schlußfolgerungen:

- Die Globalisierung bedeutet eine Intensivierung der wechselseitigen internationalen Abhangigkeiten, da sich zwischen den OECD-Staaten sowie auf weltweiter Ebene durch Handel, Auslandsinvestitionen - im weitesten Sinne die Portfolio-Kapitalstrome sowie ausländische Direktinvestitionen - und das Internet starkere Verflechtungen herausbilden. Die Globalisierung setzt sich nach dem Jahr 2000 fort, d.h. es zeichnen sich wichtige langfristige politische Fragen im Zusammenhang mit dieser neuen Qualitat des Faktors Mobilitat ab. Diese Mobilitat nahm bei Kapitalsubstanz und Facharbeitern bereits erheblich zu, und in Zukunft wird das Internet eine neue Plattform für eine weltweit immer größere Mobilitat angelernter Arbeitnehmer bilden. Die Integration von Finanzmärkten dürfte sich rascher als die Integration des realen Wirtschaftsumfelds vollziehen. Instabilitaten nationaler und internationaler Finanzmärkte konnten sich als Hindernis fiir ein anhaltendes Wachstum der Weltwirtschaft erweisen. Diese Instabilitaten und die hohen Arbeitslosenzahlen in zahlreichen Industrielandern

sowie die Armut in den Entwicklungsliindern sind als wichtigste Problembereiche zu nennen, an denen sich das langfristige politische Handeln orientieren muß.

- Fur die EU-Länder bedeutet die Globalisierung eine Verschärfung des internationalen technologischen Wettbewerbs und damit die Notwendigkeit einer weiteren Spezialisierung. Durch die Beschleunigung der Innovationen in aller Welt kann es zu einer Belebung des Wachstums, moglicherweise aber auch zu erheblichen Umweltproblemen kommen. Zusätzliche, von staatlicher Seite kofinanzierte F&E-Programme mit dem Schwerpunkt auf Okologie sowie Maßnahmen zur Internalisierung negativer externer Folgen des Wachstums sind daher unbedingt notwendig. Mit der zunehmenden Verfügbarkeit von Know-how und Wissen in aller Welt im Zeitalter des Internet konnte die Außenhandelspolitik einerseits Maßnahmen zum Aufbau des Internet m den Entwicklungsländern fördern, andererseits muß ein Schwerpunkt dieser Politik auch daraufliegen, daß die Liinder der EU ihre Markte für "Außenstehende" offenhalten, die m zunehmendem Maße Produkte mit hoherem Technologiegehalt anbieten. Es dürfte schwierig werden, diese Versprechungen der EU aufrechtzuerhalten, wenn in Westeuropa nicht die Ruckkehr zur Vollbeschaftigung gelingt und wenn die EU keine erfolgreichen Initiativen zur Sicherung ihrer Führungsstellung im Hochtechnologiebereich einleiten kann. Die Globalisierung bringt eine neue internationale Teilung von Arbeit und Know-how mit sich, bei der die Länder der EU mit Sicherheit ihre F&E-Bemühungen intensivieren und den Prozeß der Weitervermittlung von Know-how verbessern miissen.

- Die nationalen Regierungen sowie die Gewerkschaften und Arbeitgeberverbiinde tragen die Hauptverantwortung fiir die Entwicklung auf dem Arbeitsmarkt bzw. die hohen Arbeitslosenzahlen. Als Folge hoher Arbeitslosigkeit kommt bei den Arbeitnehmern Widerstand gegen den technischen Fortschritt auf, was fiir diejenigen Linder der EU zu einem Problem wird, die ihre internationale Wettbewerbsfähigkeit durch technische Modernisierungen und Innovationen verbessern wollen. Eine unzureichende Lohnstreuung ist in zahlreichen EU-Landern des Kontments festzustellen, wobei die relativ hohen Bruttolohne fur ungelernte Arbeitnehmer sich in den EU-Ländern des Kontinents als ernstliches Problem erweisen. Bei niedrigeren Einkommenssteuersatzen fur gewerbliche Arbeitnehmer der unteren Einkommensgruppen konnten die Gewerkschaften eher gewillt sem, eine längere Phase mit unterdurchschnittlichen Lohnsteigerungen für ungelernte Arbeiter zu akzeptieren. Bei einer hoheren Streuung wiirden sich eine hohere Beschäftigung und - mittelfristig - hohere durchschnittliche Lohnsteigerungen ergeben. Dies wiederum wiirde die Gesamtnachfiage anregen und sich positiv auf weitere Investitionen und das Produktionswachstum auswirken.

- Die Aufwendungen fiir Aus- und Weiterbildung sind in vielen EU-Liindern unzureichend, nachdem sie gezwungen sind, sich mit zunehmendem Wettbewerb bei arbeitsintensiven Importwaren aus Osteuropa und Asien auseinanderzusetzen. Angesichts der hohen Lohne und Gehalter in den meisten Ländern der EU muß eine hohere Arbeitsproduktivitat angestrebt werden, wenn em weiteres Ansteigen der Arbeitslosenzahlen vermieden werden soll. Standige Weiterbildungs- und spezielle Fortbildungsprogramme - die sich teilweise auf das Internet stutzen - in den Firmen sind Moglichkeiten, die in besonderem Maße beriicksichtigt werden miissen.

- Die Kapitalproduktivitat in den Ländern der EU ist niedriger als in den USA, woraus auf eine mangelnde Effizienz der Kapitalmärkte Europas geschlossen werden kann. Der Euro tragt zu

einer besseren Integration der Kapitalmärkte bei, allerdings ist zweifelhaft, ob dies in größerem Umfang Vorteile für Europa mit sich **bringt,** wenn nicht eine gewisse Harmonisierung der Steuergesetzgebung stattfindet und zugleich der politische Wille zur Reform der **Sozialversicherungssysteme** auf dem europaischen Kontinent gestarkt wird. Eine zumindest teilweise Umorientierung von dem in vielen EU-Ländern des Kontinents bestehenden **Quellenbesteuerungssystem** hin zu einem neuen, kapitalfinanzierten Rentensystem, das starke **Anreize** dafür enthält, daß die Arbeitnehmer **in** Investmentfonds investieren, ware ein wichtiger Impuls **fiir** eine hohere Kapitalproduktivitat und letzten Endes auch **fiir** die Schaffung von Arbeitsplatzen.

- Die F&E-Aufwendungen müßten in Westeuropa gesteigert werden, zugleich müßte die Leistungsfähigkeit der F&E-Programme erhoht werden.

- Doppelausgaben in den wichtigsten F&E-Bereichen lassen sich nicht immer vermeiden, wenn man die Vorteile des Wettbewerbs im F&E-Sektor nutzen will. Innerhalb der Binnenmärkte steigt durch internationale Akquisitionsleistungen der Druck auf die Regiemgen der Mitgliedstaaten, sich mit bilateralen oder gemeinsamen F&E-Programmen zu befassen und die Spezialisierung in der Forderung von F&E weiter fortzuführen.

- Die Weiterverbreitung von Innovationen zu fördern, diirfte für Wachstum und internationale Wettbewerbsfähigkeit ausgesprochen wichtig sein. Neue Moglichkeiten, die das Internet bietet, sollten zur Verbesserung der Verbreitung von Informationen uber Innovationen in Betracht gezogen werden.

- Das Universitatssystem konnte reformiert werden, vor allem in Ländern, in denen staatlich finanzierte Universitaten dominieren. Neue Privatuniversitäten mit ausgepragtem Schwerpunkt auf hochmodernen Computer-, Internet- und **Telekommunikationstechnologien** konnten aufgebaut werden, um die universitäre Forschung stärker an den Bedürfnissen der Geschäftswelt und Gesellschaft zu orientieren.

- Die Universitaten dürfen nicht **nur** anhand der Studentenzahlen und der wissenschafilichen Meriten der Professoren beurteilt werden, sondern auch anhand der *Anzahl* der Unternehmensgründungen durch Absolventen. Die Universitaten sollten dam angehalten werden, in diesem Bereich eine nachweisbare Leistungsbilanz zu erstellen.

- Angesichts des geringen **Anteils** technologieorientierter Unternehmensneugründungen in der EU wire zu iiberlegen, ob besondere Förderprogramme **fiir** die Gründung von neuen Unternehmen im Bereich neuer Technologien eingerichtet werden sollten. Allerdings ist ein finanzielles Engagement der Regierung nur selten notwendig, sofern Risikokapitalmärkte und Aktienmärkte **m** den meisten EU-Staaten ein ausgepragteres Profil entwickeln konnen. Die Kapitalmarktpolitik ist als indirekte Moglichkeit zur Forderung von F&E in der Gemeinschafi wichtig.

- Die Forschung **m** der EU **ist** nicht ausreichend spezialisiert, während Innovationen in EU-Firmen **haufig** nicht **m** den dynamischsten Patentklassen erfolgen. Eme formlose Koordination nationaler F&E-Politiken ware in Zukunft u.U. sinnvoll, wobei **die** Gründung EU-weiter F&E-Netze gefördert werden konnte. Der Aufbau eines EU-weiten F&E-Netzes sollte allerdings - unter Außerachtlassung spezieller Ausnahmefälle - nicht in Betracht gezogen werden, wenn in

Westeuropa kein alternatives Netz als Wettbewerber vorhanden ist. Die EU-Firmen könnten zur Erschließung des F&E-Potentials in Osteuropa und Rußland angehalten werden, da dort erfahrene Fachleute haufig zu niedrigen Kosten zur Verfügung stehen. Alles in allem steht eindeutig fest, dafi die Lander der EU angesichts der zunehmenden Globalisierung der Wirtschaftsbeziehungen die Aus- und Weiterbildungs- und F&E-Maßnahmen verbessern miissen, um ihre globale technologische Führungsstellung aufrechtzuerhalten. Aufgrund des niedrigen Eigenkapitalanteils der Firmen in zahlreichen EU-Ländern kommen Zweifel an der Fahigkeit der EU auf, neue Innovationsbereiche erfolgreich nutzen zu konnen, in denen die Bereitstellung von Risikokapital fiir das Überleben und die Expansion neuer Unternehmen von entscheidender Bedeutung sind; in Zukunft sind in diesem Bereich zusatzliche internationale Benchmarking-Untersuchungen notwendig, wobei sogar regelmäßige Benchmarking-Untersuchungen in allen wichtigen Politikbereichen empfehlenswert waren. Die etablierten Firmen Europas sind gut organisiert (das Besitzstandsproblem), wahrend innovative Neulinge und junge Unternehmen weit weniger organisiert sind und geringeren Rückhalt bei Banken und Politik finden. Abschließend ist festzustellen, daß hohe Arbeitslosenzahlen nicht nur abschreckend auf Investitionen und Innovationen wirken, da Arbeitslosenzahlen in Rekordhohe nur begrenzte Perspektiven fiir Ertragsanstiege eröffnen und somit nur geringe Chancen fir hoheres Wachstum bieten. Hohe Arbeitslosenzahlen schüren zugleich den Widerstand der Arbeitnehmer gegen technologischen Fortschritt. Die Riickkehr zur Vollbeschaftigung in den Landern der EU würde somit direkt wie auch indirekt zu einer Belebung des Wirtschaftswachstums und gleichzeitig auch der internationalen Wettbewerbsfähigkeit führen.

Die theoretische Begriindung fir die Hochtechnologiepolitik rührt aus einem inharenten Versagen des Marktes her. Hochtechnologie setzt die Produktion und kommerzielle Verwertung neuen wirtschaftlichen Wissens voraus. Neues Wissen unterscheidet sich schon seinem Wesen nach von den traditionelleren Faktoren der Erzeugung von *Arbeit,* Kapital und natürlichen Ressourcen, die bekannt sind und einen relativ gesicherten wirtschaftlichen Wert aufweisen. Im Gegensatz hierzu hat die Erzeugung neuen Wissens mit drei zentalen Ursachen fiir das Versagen des Marktes zu kampfen - Indivisibilitäten, Unsicherheiten und externe Faktoren.

In den Aspekten für das Versagen des Marktes im Zusammenhang mit wissensbasierten Wirtschailstatigkeiten steckt eine grundlegende Erklärung fiir staatliche Eingriffe, mit denen teilweise Maßnahmen unterstiitzt werden, die andernfalls auf eine Unterproduktion in diesem Wirtschaftszweig hinausliefen. Eine zentrale praktische Überlegung der Institutionen der Technologiepolitik besteht jedoch darin, wie der in der Literatur als Regulierungsfalle bekannte Zustand vermieden werden kann. Die wichtigsten Ziele bei der Schaffung derartiger Einrichtungen bestehen in der Vermeidung der Regulierungsfalle, d.h. daß die politischen Entscheidungstrager, die iiber ein Mandat zur Einführung und Umsetzung *einer* Technologiepolitik verfiigen, von bestimmten Interessengruppen vereinnahmt werden. Administrative Verfahren, mit denen der Einfluß politischer ertragsorientierter Maßnahmen verringert werden kann, sind in die Kategorien Verantwortlichkeit, Unabhängigkeit und Transparenz einzuordnen.

Der traditionelle bzw. neoklassische Ansatz zur Wachstumstheorie konzentrierte sich auf die Verknüpfungen zwischen den Eingangsgrößen Arbeitskraft und Kapital einerseits und den Ausgangsgrößen im Rahmen eines Produktionsmodells andererseits. Hierbei wurde das Wirtschaftswachstum entweder durch eine Zunahme der Menge der Inputs oder durch die Produktivitat der Inputs erklart. Verbleibendes oder nicht beriicksichtigtes Wachstum wurde

exogenen Technologieiinderungen zugeschrieben, die weitgehend als "Geschenk des Himmels" aufgefallt wurden.

Das Konzept des endogenen Wachstums schliellt einen vielfältigen Bestand an theoretischen empirischen Erkenntnissen mit ein, die im letzten Jahrzehnt entstanden sind. Das neue Konzept der Wachstumstheorie besagt, daß Wirtschaftswachstum ein endogenes Ergebnis eines Wirtschaftssystems ist. Die Konsequenzen fiir die staatliche Politik bei der Entwicklung der Hochtechnologie nach der Theorie des endogenen Wachstums unterscheiden sich erheblich von den Konsequenzen nach der traditionellen neoklassischen Wachstumstheorie. In der traditionellen neoklassischen Wachstumstheorie spielt die Regierung nur eine begrenzte, auf ein Minimum beschränkte Rolle. Die Rendite aus Investitionen in neues Wissen fließt denjenigen Firmen und Einzelpersonen zu, die diese Investitionen tatigen, d.h. es besteht kein Grund fiir die Regierungen, in Hochtechnologiemärkten zu intervenieren.

Im Unterschied hierzu besteht in der neuen Wachstumstheorie ein zwingender Grund dafür, daß die Regierungen eine konsequente und aktive Politik bei der Gestaltung des Hochtechnologiesektors verfolgen. Dies ist auf das Vorhandensein von wissensmäßigen externen Faktoren in Form von wissensmäßigen Spillover-Effekten zurückzuführen. Indem das Entstehen von neuem Wissen, Verkniipfimgen, die zur weiteren Ausstrahlung (Spillover) dieses Wissens führen, sowie die kommerzielle Verwertung dieses Wissens unterstiitzt werden, kann die staatliche Politik zur Korrektur des Versagens der Markte beitragen, das in wissensbasierten Wirtschaftstatigkeiten inhärent vorhanden ist.

Die wichtigste wirtschaftliche Herausforderung, mit der Europa heute konfrontiert ist, besteht in der Umstrukturierung des Wirtschaftsgefüges weg von Industriezweigen, die auf den herkommlichen Produktionsfaktoren aufbauen, hin zu wissensbasierten Industriezweigen. Die herkommliche Vorstellung von diesem Prozeß der strukturellen Veränderungen lautet, daß die Großunternehmen als Triebkräfte dieser strukturellen Veriinderungen fungieren. Großunternehmen verfügen iiber immense F&E-Ressourcen. Unzählige Anzeichen aus einer Vielzahl von Liindern deuten jedoch darauf hin, daß kleine und neue Unternehmen eine entscheidende Rolle als Auslöser struktureller Veranderungen spielen. Daß kleine und neue Unternehmen als treibende Kraft struktureller Veränderungen wirken, ist dadurch zu erklaren, daß die Menschen Firmen ins Leben rufen, um dort Ideen weiterzuverfolgen, die andernfalls von den bestehenden Firmen nicht verfolgt würden. Neue Firmen wirken als Katalysatoren von Veränderungen, die weg vom Status quo hin zu neuen Tatigkeitsfeldern führen, die noch umstritten und unsicher sind.

Ein Teil der Gründe dafür, warum der Wettbewerbsvorteil Europas sich von den traditionellen Industriezweigen weg- und hin zu wissensbasieren Industriezweigen verlagert hat, ist im Entstehen von Firmen aus Osteuropa und den Schwellenländern zu suchen. Zum einen stehen den Firmen aus Mittel- und Osteuropa sowie den Schwellenliindern Arbeitskräfte zu weit niedrigeren Kosten zur Verfügung. Zum anderen sind Know-how und Ausbildungsniveau des Humankapitals in zumindest einigen dieser Länder recht hoch entwickelt. Die entscheidende Frage, der Europa durch die neuen Wettbewerber gegenubersteht, lautet, ob die Wettbewerber in den herkommlichen Industriebereichen mit mittlerem Technologieniveau durch Einfuhrbeschränkungen und Schutzzolle ferngehalten werden sollen oder ob die Einsicht Platz greift, daß durch die Ereignisse des Jahres 1989 eine langfristige Verlagerung des Wettbewerbsvorteils im kostenintensiven (West-)Europa hin zu wissensbasierten Wirtschaftszweigen in Gang gekommen ist.

Die größte Herausforderung zur Verwirklichung einer effizienten F&E-Politik in Europa lautet, die Schranken abzubauen, die der Mobilitat und der kommerziellen Nutzung neuen Wissens im Wege stehen. Europa konnte bei der Ausschöpfung der Ertrage aus den in neues Wissen getatigten Investitionen keine übermäßig guten Ergebnisse erzielen, weder im Bereich von F&E noch im Bereich des Humankapitals. Em Teil dieser Herausforderung besteht darin, daß die politischen Schwerpunkte von den Produktionsergebnissen hin zum eingesetzten Wissen verlagert werden. Ein zweiter Teil bezieht sich auf komplementare Institutionen wie z.B. Finanz- und Arbeitsmärkte, durch die die Fahigkeit der Firmen und Einzelpersonen beeinflußt wird, ihr neues Wissen kommerziell zu verwerten.

In den letzten Jahren waren als ein wichtiges Merkmal zumindest der Arbeitsmärkte in den angelsächsischen Ländern zunehmend größere Unterschiede des Kenntnisstands festzustellen. Die seit langem anhaltende Verlagerung von ungelernter Arbeit hin zu fachlich qualifizierter Arbeit scheint sich in den letzten beiden Jahrzehnten beschleunigt zu haben. Der Erwerb von Fähigkeiten stieg weniger rasch an, während sich die Lohne ungelemter Arbeitnehmer relativ gesehen rückläufig entwickelten (in den USA sogar absolut). Im Vereinigten Konigreich wie auch in den USA ist die Dominanz der relativen Verlagerung der Nachfiage hin zu hoher qualifizierten Tatigkeiten kaum umstritten, auch wenn sich das Bild aufdem Kontinent aufgrund dessen, daß hier die Arbeitslosigkeit von Facharbeitem in gewissen Intervallen anstieg, zwiespältiger darstellt. Die Kontroverse hiingt vielmehr mit den Ursachen für diese relativen Nachfiageverschiebungen zusammen.

Die beiden Größen, um die es hierbei geht, sind der zunehmende internationale Handel und fachkräfteintensive technologische Änderungen (d.h. Änderungen, bei denen ungelernte Tatigkeiten wegfallen). Beide fallen unter die Rubrik "Globalisierung". Sowohl in den USA als auch im Vereinigten Konigreich ließen die Aufschlüsselungen der Gesamtverlinderungen, z.B. nichtmanueller Arbeitsverhältnisse, erkennen, daß die Bewegungen innerhalb eines Wirtschaftszweigs gegeniiber den Verlagerungen zwischen Wirtschaftszweigen dominieren. Falls die Ursache hierfür der internationale Handel ware, ware das Gegenteil zu erwarten gewesen, zumal das Aufkommen an internationalem Handel quer durch samtliche Wirtschaftssektoren sehr uneinheitlich ist. Aus separaten Wirtschaftsanalysen, in denen Daten nun Faktorgehalt der Einfuhr-/Ausfuhrindustrien ausgewertet wurden, sowie Untersuchungen zum (bevorzugten) Preiseffekt geht hervor, daß der Beitrag des Handels zu diesen relativen Nachfrageverlagerungen und damit zur Ungleichheit der Einkommen - der Verarmungseffekt des Handels - eigentlich relativ gering war. Kurz, nach FREEMAN (1995, 30) läßt sich feststellen, daß die Lohne der ungelernten Arbeitnehmer in den entwickelten Volkswirtschaften nicht in Peking bestimmt werden. Dennoch waren die technologischen Veriinderungen von einem gewissen Unbehagen begleitet, da die Unterstiitzung hierfür eher indirekt war; d.h. konventionellerweise werden die technologischen Veriinderungen als Restgröße gemessen.

In letzter Zeit wurden jedoch verschiedene empirische Versuche unternommen, um einen Blick in das Innere der "Black Box" der Technologie zu werfen. Die Verwendung von Ersatzindikatoren fiir die Technologie unterstrich diese Erklärung auf direktere Weise. Die Beweise sind allerdings nicht zwingend, und die Empfehlung lautet, daß die technologischen Änderungen in Zukunft eher auf gleicher Ebene wie andere Erlauterungen, z.B. die Deregulierung, stehen müßten. Das Ungleichgewicht ist eindeutig durch verschiedene weitere Ursachen außerhalb des Handels bedingt, wobei die technologischen Änderungen durch zunehmenden Wettbewerb (die Dimension der Endogenitat) bestimmt werden.

In der Frage der Beurteilung der Reaktionen des Arbeitsmarktes scheint es unwahrscheinlich, daß Standard-Flexibilitätsindizes für das Verständnis der Fragen besonders hilfreich sind, die sich aus der Globalisierung im allgemeinen und den technologischen Änderungen im besonderen ergeben. Hier ist eine Untersuchung der Anpassungsprozesse auf Ebene der Betriebsstatten notwendig. In Untersuchungen, in denen entsprechende Daten ausgewertet wurden, wurde eine weitreichende Heterogenitat der Betriebe sowohl bei der Arbeitszuteilung als auch beim Prozeß der Weiterentwickhmg der Fachkenntnisse erkennbar. Die Suche nach systematischeren Abläufen bei der Datenermittlung diirfte allerdings unser Verständnis für die technologischen Änderungen und die Rolle des Handels sowie die entsprechenden Reaktionen des Arbeitsmarktes erleichtern.

Grundsatzlich gestaltet sich die historische Bilanz so, daß die Markte recht gut auf Nachfrageschwankungen reagieren konnen. Ein weiteres praktisches Ergebnis liegt in der ausgepragten Komplementaritat zwischen Aus- und Weiterbildung, die sich langfristig als politische Leitlinie durchsetzen dürfte. Für diejenigen Kreise, die durch die technologischen Änderungen an den Rand gedrängt werden, ist die Rückbesinnung auf die Markte jedoch nicht genug, wobei der Begriff der universellen Komplementaritat hier im Negativen seine Bestatigung findet. Diese benachteiligten Arbeitnehmer benotigen zusatzliche Unterstiitzung. Angesichts des derzeitigen Kenntnisstandes, welche Maßnahmen sich als positiv fiir benachteiligte Kreise auswirken, gilt es, die Einkommen zu erhalten und schrittweise Maßnahmen einzuleiten.

Die Globalisierung von Forschung und Entwicklung (F&E) ist seit langem ein zentraler Gegenstand akademischer Forschungstatigkeit. Der Austausch neuer Gedanken im Rahmen internationaler Konferenzen und die grenzübergreifende Zusammenarbeit bei prestigetrachtigen Projekten wie Hochenergiephysik, Nuklearfusion oder Raumfahrtforschung ist bereits seit mehreren Jahrzehnten Realitat. Gleiches gilt auch fiir Bereiche wie Gentechnik oder Ozeanographie, allerdings vermutlich auf weniger augenfällige Weise, da hier keine groß angelegten Forschungseinrichtungen benotigt werden. Globale F&E gilt m den Untemehmen heute als ein wichtigeres Thema als vor zwanzig oder dreißig Jahren. Für die staatlichen Entscheidungstrager diirfte die Globalisierung eher ein Problem als eme Chance darstellen, da sich territoriale Grenzen und die entsprechenden Rechtssysteme nicht einfach überwinden lassen (mit Ausnahme der Europaischen Union).

Multinationale Unternehmen konnen im Gefolge dieser strukturellen Technologieiinderungen ihre Prioritatsentscheidungen mit einer Standortentscheidung kombinieren und einen Teil ihrer F&E-Arbeiten im einen Land, andere Teile in anderen Ländern durchführen. Diese Standorte, z.B. Bundesstaaten oder Regionen innerhalb der Linder, gewinnen bzw. verlieren je nachdem an Attraktivitat, wie die Kompetenzzentren oder Netze zwischen bestehenden Firmen und offentlichen Einrichtungen und günstige Rahmenbedingungen in Kombination miteinander Wettbewerbsvorteile gegeniiber anderen Untemehmen bieten. Unter günstigen Rahmenbedingungen sind sowohl die harten Fakten (Gesetzgebung auf staatlicher oder Liinderebene, Vorhandensein eines Facharbeiterstamms usw.) als auch "weiche" Faktoren (z.B. günstiger Wohnungsmarkt, hochentwickelte Verkehrssysteme fiir Femziele und fiir den taglichen Nahverkehr, Tourismus- oder andere Freizeitangebote, mehrsprachiger Schulunterricht usw.) zu verstehen.

Die Existenz von multinationalen Unternehmen mit verteilten F&E-Einrichtungen ist also eine Tatsache. Die globalisierte F&E entwickelt sich in den meisten Ländern aus sehr bescheidenen Anfängen heraus. Der Nettoabfluß von F&E gibt in etlichen Landern Grund zur Besorgnis, doch ob es besser ist, "nationale" Unternehmen im Ausland tatig werden zu lassen und in ausländischen

nationalen Systemen mitzuwirken, oder ob ausländische Unternehmen in das eigene Land geholt werden, bleibt weiterhin offen. Technologische Spillover-Effekte und Wissensstrome nehmen sicherlich in beiden Fallen zu, wobei die Frage der Netto-F&E-Ströme und ihrer positiven Auswirkungen im wesentlichen eine Frage der Lage auf dem Arbeitsmarkt innerhalb der Landesgrenzen sowie der Steuereinnahmen aus dem lokalen F&E-, Produktions- und Dienstleistungsbereich ist.

In den meisten Industrieländern vollzieht sich gegenwartig der Wandel hin zur Dienstleistungswirtschaft. Am auffallendsten ist der strukturelle Wandel auf dem Arbeitsmarkt: Selbst in Volkswirtschaften, in denen ein dramatischer Arbeitsplatzmangel im Fertigungsbereich herrscht, kann gleichzeitig die Zahl der Arbeitsplatze im Dienstleistungssektor stetig zunehmen. Diese Umstrukturierung bedeutet jedoch nicht, daß die Fertigungsindustrie in absehbarer Zeit zu bestehen aufhort. Als Faustregel kann davon ausgegangen werden, daß die Mehrzahl der neuen Dienstleistungsunternehmen Investitionsgüter fiir die Erbringung ihrer Dienstleistungen einsetzt. Die Herausforderung für die Fertigungsindustrie lautet also, ob sie die "richtigen" Maschinen fir die Dienstleistungsgeselschaft der Zukunft liefern kann und ob sie auf diese Weise ihre Wettbewerbsfähigkeit im Fertigungssektor verbessern kann.

Es kann kaum davon ausgegangen werden, daß eine rasche Ausweitung der F&E-intensiven Bereiche m naher Zukunft ausreicht, um die Beschaftigungsprobleme hochentwickelter Industrienationen zu lösen. Trotzdem konnen auch die technologieintensiven Wirtschaftsbereiche von einer Verlagerung hin zu den Dienstleistungsindustrien profitieren. Hier gewinnen insbesondere know-how-intensive Dienstleistungsanbieter an Boden und schaffen bereits heute in großer Zahl Arbeitsplatze. Ihr Erfolg ist in zunehmendem Maße von Innovationen und vom Einsatz neuer Technologien abhängig. Dies schafft wiederum neue Markte fiir Technologielieferanten, msbesondere fiir die Informations- und Kommunikationstechnologien, fiir Infrastruktureinrichtungen fiir den Transport- und Kommunikationssektor und für die Medizintechnik. Der technologische Fortschritt orientiert sich also in zunehmendem Maße an den Bedürfnissen des Dienstleistungssektors.

Die Globalisierung der Industrie führte ihrerseits fiir einer deutlichen Zunahme der Nachfiage nach Dienstleistungen (Transport, Finanzierung, Vertrieb, Forschung und Konstruktion) und beschleunigte den Trend hin zur Herausbildung des tertiären Sektors. Die "Dienstleistungsgesellschaft" bringt auch neue Aufgabenstellungen für die Technologiepolitik mit sich. Im allgemeinen diirfte dies zu einer kontinuierlichen Verlagerung weg von der Forderung der Entstehung neuer Technologien und hin zur Forderung ihrer Nutzung und Weiterverbreitung führen. Die Verbindungen zu den Anbietern dieser Technologie dürften intakt bleiben.

Der Trend hin zu einer "Dienstleistungswirtschaft" hat auch Folgen fiir die Nachfiage nach technischer Weiterentwickhmg: Unternehmensorientierte Dienstleistungen benotigen laufend Impulse aus innovativen Bereichen der Industrie, um sich ständig weiterentwickeln zu konnen. Hochentwickelte Dienstleistungen sind notwendig, wenn Forschung und Entwicklung, Marketing, Finanzierung, Fertigung und ähnliche Bereiche weiterentwickelt werden. Dieser Bereich intensiviert die Wachstumsimpulse aus der Industrie und stärkt die industrielle Basis der Erzeugnisse des Dienstleistungssektors. Andererseits verlagern sich innovative Beitrage innerhalb der Wertschöpfungskette von der Erzeugung von Produkten (Hardware) hin zu Software und Dienstleistungen. Im Dienstleistungssektor bestehen weite Bereiche, die nicht von Technologie-Fertigungsstandorten abhängig sind, sondern zur Erfüllung ihrer primaren Funktion hochentwickelte

Technologielosungen erfordern. In dieser Hinsicht kommt es auch entscheidend darauf an, daß den moglichen Anwendungsbereichen und der optimalen Kombination der Technologie im expandierenden Dienstleistungssektor mehr Aufinerksamkeit geschenkt wird.

Wenn nicht die Beschreibung der Tatigkeit, sondem die Qualifikation der Mitarbeiter zu einem Benchmark-Kriterium für die Verstarkung der Humankapitalintensitat wird, so kommt man fiir die wichtigsten OECD-Staaten zu dem nachstehenden Ergebnis. In der ersten Hälfte der neunziger Jahre läßt sich der bereits früher festgestellte Trend bestatigen, daß der Anteil der Mitarbeiter mit hoherem Bildungsabschluß (Universitat, Fachhochschulen oder ähnliche Fachschulen) und der Anteil von Akademikern (durchweg mit Universitätsabschluß) im Fertigungsbereich wie auch in der Dienstleistungsindustrie zunimmt. Dies bedeutet, daß sowohl im Dienstleistungsbereich, der stetig weiter expandiert, als auch im Fertigungssektor, in dem Arbeitsplatze verlorengehen, ein Trend zur Einstellung relativ höherqualifizierter Mitarbeiter festzustellen ist.

Wenn wir zusammenfassend die Volkswirtschaften als Ganzes beurteilen, d.h. wenn wir sowohl den Fertigungs- als auch den Nicht-Fertigungsbereich betrachten, so läßt sich zweifellos die Bedeutung des Humankapitals fiir das Wirtschaftswachstum feststellen. In etwa die Hälfte des Fertigungs- und des Dienstleistungsbereichs ist humankapital- bzw. wissensintensiv; beide Anteile nehmen seit einigen Jahren weiter zu. Hierbei dominiert der Dienstleistungsbereich von Jahr zu Jahr mehr, d.h. die sektorale Verschiebung hin zu einer wissensintensiven Volkswirtschaft wird - ergänzend zu den Zunahmen in diesen Bereichen selbst - durch den Wandel der Wirtschaftsbereiche hin zu einer **Dienstleistungswirtschaft** noch weiter beschleunigt. Es scheint sich hierbei also um zwei Seiten derselben Medaille zu handeln.

Wenn es stimmt, daß in uberlappenden, interdisziplinaren Technologiebereichen im Vergleich zum Kern der traditionellen Technologiebereiche ein starkeres Wachstum festzustellen ist, so wird daran deutlich, daß die zukünftigen Herausforderungen im Bereich der Aus- und Weiterbildung wie auch der Berufsausbildung von den klassischen Schulen, Bildungsstatten, -formen und -ebenen alleine nicht gemeistert werden konnen. Die in Zukunft benotigten Fachkenntnisse gehen in Richtung interdisziplinaren Wissens und lebenslangen Lernens. Damit stellt sich die Frage, ob unsere traditionellen Bildungseinrichtungen ausreichend dafür gerüstet sind, der nachsten Arbeitnehmergeneration zu einer angemessenen Ausbildung zu verhelfen.

Unter dem Begriff 'Wissenschaft" versteht man die Schaffung, Entdeckung, Untersuchung, Klassifikation, Reorganisation und Weiterverbreitung von Wissen zu physikalischen, biologischen oder gesellschaftlichen Themen. Unter "Technologie" ist das Know-how der Anwendung dieser Wissenschaft zu verstehen. Damit gehort sie zu einer großen Gruppe verwandter Tatigkeiten, die auf der Entwicklung und dem Einsatz von Erzeugnissen, Handwerksleistungen und Wissen sowie auf verschiedenen Formen gesellschaftlicher Organisationen aufbaut. Unter Technologie ist nicht nur die Anwendung wissenschaftlicher Erkenntnisse zu verstehen, sondern samtliche gezielt eingesetzten Abläufe, Verfahren, Arbeitsverfahren und Fertigkeiten bei der Nutzung wissenschaftlicher Erkenntnisse in Verbindung mit den hierbei entstehenden Produkten.

Die Bedeutung des "Forschungs"-Prozesses bei der gestaltlichen Darstellung der Innovationen ist heute unbestritten. Nach den Regeln heutiger Forschungsstatistiken ist zwischen Grundlagenforschung, angewandter Forschung und experimentellen Entwicklungen zu unterscheiden

(OECD, 1993). Die drei Konzepte, zwischen denen nachstehend unterschieden wird, werden haufig unter dem Oberbegriff "Forschung und Entwicklung (F&E)" zusammengefaßt.

Eine Reihe kleinerer Länder Europas konzentriert sich vor allem auf allgemeine universitäre und weitere, nicht auf konkrete Problemstellungen ausgerichtete Forschung und wendet vergleichsweise geringe Mittel für spezifische, aufkonkrete Problemstellungen ausgerichtete Forschungstatigkeit auf. Die Niederlande, Italien, Schweden und Deutschland zählen ebenfalls zu dieser Gruppe, da dort weniger als 50 Prozent der Gesamttitel fiir spezifische Forschungstatigkeit aufgewandt werden. Die ubrigen Liinder der EU, insbesondere das Vereinigte Konigreich und Frankreich, wenden vergleichsweise geringe Mittel fiir allgemeine Grundlagenforschung auf und legen den Schwerpunkt eher auf spezifische Forschung (die beiden letztgenannten Länder auch im wehrtechnischen Bereich). Es lassen sich zusammenfassend also sogar innerhalb der Europaischen Union länderspezifische Ausgabenmuster im Bereich der Grundlagenforschung feststellen. Berichten zufolge wendet die Regierung der Vereinigten Staaten, in denen ein erheblicher Anteil fir wehrtechnische Forschung verwendet wird, die geringsten Mittel fiir allgemeine Grundlagenforschung auf, während in Japan, das nur einen sehr geringen F&E-Haushalt im wehrtechnischen Bereich aufweist, das Ausgabenverhalten dem Deutschlands ähnelt.

Im Durchschnitt der Länder der EU 15 werden 40 bis 50 Prozent der staatlichen F&E-Mittel fir nicht fachspezifische Forschung aufgewandt, während sich die Europaische **Kommission** nahezu ausschließlich im Bereich fachspezifischer Forschung engagiert. Hier ist also eine eindeutige Arbeitsteilung zwischen den nationalen Regierungen Europas und der **Kommission** festzustellen, die selbst kaum einen Beitrag zu nicht auf konkrete Problemstellungen ausgerichtete Grundlagenforschung leistet.

Im Prinzip müßten die Beziehungen zwischen nicht zur Industrie gehorenden Forschungseinrichtungen und der Industrie als "Interaktion" im Unterschied zum früher verwendeten **Begriff** des 'Wissenstransfers" bezeichnet werden. Wissen wird nicht nur in einer Richtung transferiert, d.h. von der Forschungseinrichtung in die Industrie, sondern es erfolgt auch eine Wissensweitergabe in umgekehrter Richtung.

Wie aus älteren Untersuchungen hervorgeht, tragt die Grundlagenforschung in entscheidender Weise zum technologischen Fortschritt bei. Es ist jedoch schwierig, die Wege nachzuvollziehen und diese Auswirkungen genau nachzumessen. Genauso schwierig wie die Unterscheidung zwischen Wissenschafi und Technologie ist auch die eindeutige Bestimmung der Wissensstrome zwischen akademischer Welt und Industrie. Da in vielen Fallen ein erheblicher zeitlicher Verzug zwischen wissenschafilichen Entdeckungen und deren Einführung in die **Technik** besteht, ware für deren Erfassung zusätzlich eine ausreichend lange Beobachtungszeit notwendig, was allerdings in den Fragebogenerhebungen häufig ubersehen wird.

In der entsprechenden Literatur wird auf Beobachtungen verwiesen, wonach die wissenschaftlichen Beitrage zu Innovationen m hohem Maße von dem betreffenden Industriebereich und dem jeweiligen technischen Fachgebiet abhhgig sind. Die in Fallstudien gewonnenen Erkenntnisse sind also moglicherweise durch den jeweiligen Industriebereich der Fallstudie "verfälscht". Einige der Abweichungen, die in diesem Zusammenhang festgestellt wurden, dürften verschwinden, sobald all diese komplexen Einflußfaktoren beriicksichtigt werden.

Ein weiterer wichtiger Beitrag zu den Verknüpfungen zwischen Forschung und Industrie besteht in den vorhandenen Spillover-Effekten. Das innerhalb einer Einrichtung gewonnene Wissen breitet sich auf andere Bereiche aus und kann von anderen Einrichtungen genutzt werden. Diese Vorgänge vollziehen sich sowohl innerhalb von Unternehmen und innerhalb von akademischen Einrichtungen einerseits als auch zwischen Forschung und Industrie andererseits. Unternehmen wie auch Einzelpersonen konnen auf externes Fachwissen zugreifen, ohne auf institutionelle Transfermechanismen angewiesen zu sein. Empirische Erkenntnisse lassen eindeutig den Schluß zu, daß F&E sowie weitere Wissensquellen nicht nur diese externen Effekte erzeugen, sondern dariiber hinaus zeigt sich in Untersuchungen, daß diese Verknüpfungen meistens geographisch an die Region gebunden sind, in der das neue wirtschaftliche Fachwissen entstand. Das neue Wissen kann sich zwar auf andere Firmen und wirtschaftliche Akteure ausdehnen, doch ist die geographische Ausbreitung dieser wissensmäßigen Verknüpfungen tendenzmäßig begrenzt, weshalb die spezifischen nationalen Strukturen in diesem Zusammenhang nicht iiberraschen konnen.

Trotz des allgemeinen Konsens, daß sich Wissensverknüpfungen innerhalb der bestehenden Standorte innovationsfördernd auswirken, besteht nur wenig Konsens dariiber, wie dieser Prozeß abläuft, wenn wir uns die Schwierigkeiten vor Augen führen, die sich beim Aufbau von Verbindungen zwischen Forschung und Industrie in den einzelnen Wirtschafisbereichen bzw. Nationen ergeben. Vor diesem Hintergrund ist das Bestreben der Zentralen der multinationalen Unternehmen verständlich, sich gleichzeitig an mehreren Innovationssystemen zu beteiligen, auch wenn der Unterhalt mehrerer F&E-Labors in mehreren Liindern kostspielig ist.

Wissensbasierte Firmen, die mteressanteste Ausprägung im Zusammenhang der Globalisierung, sind im Bereich der Chemie-, Elektro- und Elektronikindustrie zu finden. Diese wissensbasierten Industrien stützen sich m hohem Maße auf die F&E-Aktivitäten von Firmen, die weitgehend von der raschen Entwicklung der zugrundeliegenden Wissenschafien an Universitaten und anderswo profitieren. Die wissensbasierten Firmen entwickeln einen hohen Prozentsatz an Prozeßtechnologie in ihren eigenen Labors. Aus diesem Grund ist der Anteil der Großunternehmen relativ hoch, da Mindestniveaus bzw. schwellen erreicht werden miissen, damit eine lohnende Größe einer leistungsfähigen internen F&E-Abteilung erreicht wird. Andererseits zählt eine bestimmte *Anzahl* von Unternehmensneugründungen im Hochtechnologiesektor zum wissensbasierten Bereich.

Im allgemeinen sind wissenschaftsabhängige Technikbereiche international besetzt, wobei nur geringe Unterschiede zwischen den einzelnen Lhdern bestehen. Die Abhiingigkeit der Technologie von der Wissenschafiist ein ureigenes Merkmal der Technologie. Dennoch besteht der Unterschied zwischen den Liindern darin, daß bestimmte nationale Innovationssysteme in bestimmten wissensbasierten Bereichen aktiver als andere sind und somit - ohne Berücksichtigung der disziplinspezifischen Aufschlüsselung - unter Makrogesichtspunkten so aussehen, als seien sie mehr oder weniger von der Wissenschafi abhangig. Wir miissen also zwischen den intrinsischen Eigenschafien in Wissenschafi und Technik und dem Umfang dieser Aktivitaten unterscheiden, die sich von Land zu Land unterscheiden konnen.

Um wieder auf den Standpunkt der EU zurückzukommen, miissen wir eindeutig feststellen, daß in Europa dieselben Bereiche wie anderswo in der Welt von der Wissenschafi abhshgig sind. Die geringere Leistungsfähigkeit bestimmter (kontinentaler) Lshder der EU in wissenschaftsabhängigen Bereichen riihrt allerdings daher, daß sie in diesem Bereich weniger aktiv als in nicht

wissenschaftsabhängigen Bereichen sind. Wir konnen das Problem also auf reine Profilierungsmaßnahmen und nicht auf eine grundsätzliche Schwache Europas reduzieren.

Die gegenwartige F&E-Politik hat sich von der unzweckmäßigen Vorstellung wegbewegt, daß der Staat die Grundlagenforschung im Bereich technologischer Entwicklungen bis hin zu einzelnen nationalen Innovationen dirigieren konne. Genauso uberholt ist die Vorstellung, daß der Staat sich mit der Rolle eines nachgeschalteten Forderers der Grundlagenforschung begnügen konne und die Kontrolle der Technologie anonymen Marktprozessen uberlassen dürfe. In der F&E-Politik am Anfang des 21. Jahrhunderts ist ein Mittelweg erforderlich: Eine aktive Rolle der Regierung als Mittler zwischen den gesellschaftlichen Akteuren (Unternehmen, Verbände, Interessengruppen, wissenschaftliche Gemeinschaften, Verbraucher, Medien, Arbeitgeber und Arbeitnehmer usw.) ist unbedingt notwendig.

In der europaischen F&E-Politik ist bei dieser Mittlerfunktion auch zu beriicksichtigen, daß diese Funktion von unten her in ihrem Umfang beschränkt ist. Die Aktivitaten der Europaischen Gemeinschaften sind stets im Zusammenhang mit den Maßnahmen der nationalen Politik sowie - zusätzlich m bestimmten Mitgliedstaaten - mit politischen Maßnahmen unterhalb der nationalen Ebene in Bundesstaaten zu sehen, die regionale Forschungsvorhaben fördern.

Soweit eine lieferantenorientierte F&E-Politik m der Europaischen Union dominiert, mussen wir betonen, daß wissensbasierte Innovationen m vielen Fällen (allerdings nicht m allen) wichtig sind. Im Zusammenhang mit globalen Innovationen sind nachgeschaltete verwandte Prozesse, z.B. wirksame nationale führende Markte sowie die Stimulierung und Formulierung der Nachfiage, gleichermaßen wichtig. In diesem Sinne wird empfohlen, daß die F&E-Politik dafür Sorge tragen sollte, daß diejenigen führenden Markte in der Europaischen Union angesiedelt sind, m denen starke globale Akteure agieren. Soweit durch nicht F&E-verwandte Maßnahmen die rasche und stabile Entwicklung dieser Markte erleichtert werden kann, muß die F&E-Politik mit anderen europaischen Politiken kombiniert werden, um maximalen Nutzen zu erzielen.

Die Vermeidung naiver politischer Pläne, wie sie mitunter in den siebziger Jahren verfolgt wurden, bedeutet auch, daß keine übergroßen Planungsgremien eingerichtet werden dürfen und eine mechanische Gestaltung und Kontrolle der wissenschaftlichen und technologischen Einrichtungen unterbleiben muß. Stattdessen mussen die Merkmale einer fortschrittlichen Wissenschafts- und Technologiepolitik auf europäischer Ebene auf der Annahme basieren, daß die Entscheidungsfindung das Ergebnis von Verhandlungen zwischen zahlreichen verschiedenen Akteuren auf unterschiedlichen hierarchischen Ebenen ist. Das Top-down-Konzept ist für die Ära des zu Ende gehenden Jahrhunderts nicht zweckmäßig; die Akteure mussen nach einer gemeinsamen Ausrichtung und Konsens streben. Die Europaische Kommission und die Regierungen der Mitgliedstaaten mussen gemeinsam an der Bereitstellung von m beide Richtungen wirkenden Informationskanälen und Ausspracheforen arbeiten. Erforderlichenfalls muß die Kommission strategische Informationsleistungen in Form von Technologieprognosen, Technologiebeurteilungen und einer strategischen Politikbeurteilung in Wissenschaft und Technologie erbringen. Dabei darf sie sich nicht nur auf Gremien und Stellen der EG verlassen, sondern - aus der Sicht der Mitgliedstaaten - auch auf unparteiische Organisationen oder multinationale Gruppen aus "Think Tanks". Es ist stets hilfreich, wenn strategische Informationen in Form alternativer Szenarien dargestellt werden, wodurch strategische Wahlmoglichkeiten deutlich werden.

Die Forderung europaübergreifender Zusammenarbeit stellt eine dauernde Herausforderung dar. Sie muß auch den Austausch von Mitarbeitern mit Hilfe spezieller Fordexmittel umfassen. Aufgrund der unterschiedlichen Laufbahnstrukturen in Universitaten und Firmen und der sozialen Probleme im Zusammenhang mit der Mobilitätsfrage wird der Transfer von Mitarbeitern - im Vergleich zu anderen Maßnahmen - immer begrenzt bleiien. In diesem Bereich kann von flexibleren Maßnahmen also eine erhebliche Wirkung ausgehen, falls es der Politik gelingt, einen intensiveren Austausch herbeizuführen.

RÉSUMÉ

Depuis les annees 1980, la concurrence mondiale s'est intensifiée, alors que les investissements etrangers directs se developpaient considerablement, que de nouveaux pays s'ouvraient et en devenaient bénéficiaires (ou devenaient influents comme pays de provenance) et que des formes innovantes de cooperation inter-entreprises etaient instaurees. Le developpement des investissements etrangers directs a pu stimuler la croissance economique a l'echelle de la planete au point de contriiuer a entrainer des retombees technologiques, d'internationaliser les echanges technologiques, d'améliorer l'utilisation du savoir-faire, de relever le taux global de rendement de l'investissement et de developper le produit marginal du capital dans le monde entier. La distribution spatiale des flux d'investissements hangers est a son tour influencée par des grappes ("clusters") de centres regionaux ou locaux en matiere de recherche et developpement (RD) et par la disponibilité du capital humain ou d'autres facteurs qui peuvent être combines avec profit avec de solides avantages spécifiques importants pour les sociétés multinationales (SMN). Au demeurant, l'aide publique a la RD et la qualite des systemes d'educationjouent egalement un rôle pour attirer les SMN.

Au cours des annees 1980 et au debut des annees 1990, la concurrence internationale s'est intensifiée dans les pays de l'OCDE, mais egalement dans le monde entier. D'une part, de nouveaux venus issus des NPI d'Asie se sont engages dans la voie des technologies moyennes et des technologies avancees. Dautre part, les Etats-Unis, la France, le Royaume-Uni, ainsi que la Russie ont reduit, après 1990, l'importance qu'elles accordaient a la RD militaire. Par consequent, la fin de la guerre froide a entraine un accroissement de la concurrence dans le marché des produits civils. La part representee par la RD civile dans le PIB s'est developpee dans la plupart des pays du monde et il se peut que les dépenses de RD se diveloppent rapidement dans quelques NPI et dans la République populaire de Chine d'ici a la fin du siecle. En outre, Internet a renforcé l'acces aux nouvelles connaissances technologiques

Le lien entre la mondialisation et l'mvestissement étranger direct est important pour l'UE, tout comme l'interdépendance entre l'mvestissement étranger et les echanges commerciaux dans un monde ou l'on dénombre quantite de nouveaux venus issus d'Asie et d'Europe orientale. Les sociétés multinationales contriiuent au diveloppement economique, mais imposent egalement des mesures d'ajustement aux gowernements des pays de l'UE qui se disputent des investissements mobiles. Toutefois, alors que de nombreuses SMN tentent de trouver les subventions et allégements fiscaux les plus importants, initialement, l'engagement qu'ils prennent d'investir dans certains pays peut contribuer a instaurer de nouveaux criteres en matiere de politique sociale et de politique de l'environnement. La réputation que se sont construite certains produits sur certains marches de pointe, ne sera pas aisement entamee sur d'autres marches qui en principe peuvent être approvisionnes en produits de moindre qualite. Il se pourrait que le rôle environnemental des SMN soit plus ambivalent pour ce qui est de l'utilisation de différents processus de production dans certains pays oh la pression de la concurrence est susceptible d'mciter ces SMN a donner la preference a des pays ou les normes environnementales sont plus souples.

Les aspects theoriques de la politique en matiere de haute technologie meritent une plus grande attention et a cet egard, un programme special de recherche de l'UE pourrait être utile. Si l'on se fonde sur les progres theoriques recents, il est evident qu'il est important d'etudier le lien entre l'accentuation de la différenciation du produit, l'intensité technologique et les economies d'echelle et les repercussions des retombees technologiques. Dans le cas qui nous occupe, le marche unique renforce les economies d'echelle. A cet egard, l'ouverture economique de l'Europe orientale est

egalement importante, etant donne que de nouveaux marches dynamiques emergent et que la RD trouve de nouvelles opportunités en matiere de sous-traitance et de cooperation. L'Europe de l'Est offre un stock interessant de chercheurs qualifies.

Il importera de tenir compte des liens existant entre la mondialisation, la dynamique de l'emploi et les innovations. Il est bien clair que les innovations portant sur des produits et procédés sont cruciales pour l'augmentation de la productivité et la croissance economique. Toutefois, il est également important d'assurer la diffusion rapide des nouvelles technologies et l'utilisation optimale des technologies les plus performantes. Pour ce qui concerne ce dernier aspect, l'Allemagne et d'autres pays continentaux de l'UE ont souffert d'un grave retard par rapport aux États-Unis, une étude recente réalisée par McKINSEY révélant que le rapport entre eux serait de 1 a 3. En outre, l'application de telles technologies se deroule souvent dans des secteurs différents du secteur de l'innovation. En ce qui concerne leur diffusion, par rapport a l'ensemble des technologies en application, c'est le secteur des services qui a nettement dominé au sein du groupe du G7 en 1993. Alors qu'aux Etats-Unis, au Royaume-Uni, au Japon et en Italie, il enregistrait plus de 50%, en France, au Canada et en Allemagne, il ne representait respectivement que 44, 42 et 43%. En particulier, l'Allemagne, pays dote d'un secteur des services en retard de dkveloppement renonce donc a des opportunites de relèvement de la croissance economique et de creation d'emplois. Au début des annees 1990, la part des services dans le PIB representait pres de 10% de moins en Allemagne qu'aux Etats-Unis et en ce qui concerne l'emploi dans les services du secteur privé le differentiel etait du même ordre. Cet ecart apparent dans le secteur des services constitue un deficit structure1 majeur en Allemagne et l'élimination des obstacles entravant l'expansion dans ce secteur represente un defi politique majeur. Il pourrait toutefois être malaise de le surmonter, etant donne que les chômeurs de longue durée, qui sont en forte proportion - il s'agit frequemment d'anciens travailleurs et d'anciens employes d'entreprises industrielles - possederont rarement les aptitudes requises souhaitees pour occuper les nouveaux emplois crees dans les sociétés de services. En outre, les travailleurs du secteur manufacturier, secteur a forte intensite capitalistique et a productivité elevee qui payait des salaires plutôt eleves, trouveront souvent inacceptable de choisir volontairement un nouvel emploi dans le secteur des services, secteur oh l'intensité capitalistique est plus restreinte, oh les salaires sont frequemment inferieurs, mais qui offre une plus grande sécurité d'emploi.

L'Allemagne et de nombreux autres pays continentaux de l'UE souffrent de taux de chômage élevés qui, dans une large mesure ,sont un reflet du sous-développement du secteur des services, des dépenses de RD insuffisantes, du manque de formation et d'instruction et d'une politique de diffusion inappropriee. La rigidite du marche du travail et une dispersion des salaires insuffisante entravent egalement le retour au plein emploi. Selon toute apparence, une partie de I'ecart de productivite qui existe entre les pays continentaux de l'UE et les Etats-Unis est liee au sous-développement des bourses, ainsi qu'a une productivite du capital relativement minime par rapport aux Etats-Unis.

La croissance rapide de l'investissement etranger direct au cours des annees 1980 a accelere les transferts mtemationaux de technologies, etant donne que les echanges de technologie se produisent essentiellement a l'interieur des societes (par exemple, entre societes apparentees et filiales) ou font l'objet d'echanges de licences entre societes multinationales (SMN). Un taux eleve d'innovation en matiere de produits permet a des entreprises de pratiquer des prix plus eleves sur les marches mtemationaux et un taux élevé d'innovation en matiere de processus facilite l'extension des marches et l'exploitation d'economies d'echelle dynamique. Des lors, l'innovation n'est pas seulement une cle

de la competitivite internationale, mais permet egalement aux entreprises de payer des salaires reels élevés dans les pays de I'UE.

La politique europeenne en matiere de RD doit être envisagée dans une perspective aussi bien nationale qu'au niveau de I'UE et de la planete. Une evaluation de base du programme-cadre de RD de I'UE et les groupes d'études ("task forces") proposes suggerent que la politique d'innovation europeenne a marque quelques progres, mais comparees aux américaines, les entreprises de l'UE sont toujours sous-representees dans le domaine dynamique des nouvelles technologies. La politique doit d'une part davantage insister sur le rôle des petites et moyennes entreprises, d'autre part, les defis qui se posent aux organisations mternationales ont une importance cruciale. Avec un nombre d'adherents toujours croissant, l'Office europeen des brevets gagne en importance, cependant qu'il devient toujours plus malaise de conserver la même efficacite. Est Cgalement determinant le rôle de l'OMC, dont l'action est centree sur les droits de propriete intellectuelle lies au commerce et sur certains aspects des investissements etrangers directs. On peut toutefois se demander si l'Organisation mondiale de la propriete intellectuelle ne devrait pas jouer un rôle plus important et prévoir une responsabilite integrale pour les investissements etrangers directs qui constituent pratiquement le compliment a part entière des échanges mtemationaux de technologie. La cooperation internationale pourrait devenir de plus en plus difficile a l'ere de la mondialisation. Toutefois, la division appropriee des tfches entre les gouvernements nationaux, les institutions supranationales et les organisations internationales representera un pas determinant vers l'emergence d'une gestion mondiale.

Le rôle de la bourse des valeurs pourrait egalement se développer a la fin de ce siecle, car a l'ere de la concurrence entre les technologies avancees, l'importance relative des banques sera réduite en ce qui concerne le financement des societes innovantes. L'Union monetaire europeenne ouvre de nowelles possibilites de renforcement du rôle des bourses de valeurs, d'une part, et, d'autre part, en matikre de dheloppement de la financiérisation. Les démarches hesitates entreprises sur le continent pour mstaurer de nouvelles bourses de valeurs pour les entreprises nouvellement créées devraient être encouragees d'un point de vue politique, mais il faut egalement stimuler les operations de capitaux a risque dans les pays adhérant a l'euro amsi que dans d'autres pays de l'UE. Les problemes d'information asymetrique entre l'innovateur et la banque sont typiques des projets d'innovation, de sorte qu'un acces insuffisant aux capitaux (a bon marché) pourrait limiter le caractere innovant des societes de l'UE. Le rôle des capitaux propres devrait être renforcé en Europe a la fin des annees 1990. Les travailleurs étant confrontés a une position de négociation moins favorable dans le cadre du nouveau contexte de la mondialisation economique, on pourrait concevoir, au bénéfice des travailleurs, des incitations fiscales qui les encourageraient a placer leur épargne dans des fonds d'investissement (bénéficiant d'une cotation minimale). Le rôle des marches de capitaux pourrait egalement être renforcé par une reforme des systemes de sécurité sociale, notamment en remplaçant partiellement le système actuel du regime de retraite finance par répartition par des regimes de survie capitalises. Grâce a l'Union monetaire, les strategies politiques favorisant la croissance dans les pays de I'UE pourraient devenir particulièrement importantes, car la valeur exterieure de l'euro pourrait en être renforcée. Il est donc determinant d'éliminer les obstacles a la croissance et d'améliorer les conditions créées pour l'investissement et les chefs d'entreprise.

Pour l'Union europeenne, il sera prioritaire d'exercer une forte attraction globale sur les investisseurs etrangers a l'avenir, lorsque s'intensifiera la recherche de capitaux reels de plus en plus mobiles. Cela tient au fait que non seulement un apport important d'investissements etrangers accroit le taux global de rendement de l'investissement, mais egalement que les effets de la modernisation et les effets de

réseau des investissements contribuent a la compétitivité de l'UE. À leur tour, les investissements etrangers directs a l'extérieur pourraient renforcer la compétitivité de l'UE si l'on observait une complémentarité analogue entre les exportations et les investissements étrangers, comme dans le cas des mvestissements &angers américains. Le fait que les répercussions nettes sur l'emploi des sorties d'mvestissements étrangers soient positives pour le pays de provenance dépend beaucoup du fait que la demande mondiale doive être consideree comme acquise ou incompressible. Si le pays de provenance et le pays bénéficiaire enregistrent tous deux des sorties positives et des rdpercussions sur l'emploi qui renforcent la rentabilité des societes innovantes, on peut attendre comme impact positif un developpement des flux globaux d'investissements etrangers sur la recherche et le développement. La mondialisation peut egalement stimuler la RD *en* aidant les sociétés a realiser des economies d'echelle sur une série plus vaste de marches internationaux. Dans la mesure oh la mondialisation represente un raccourcissement des cycles d'innovation, les societes axees sur les technologies pourraient être incitees, sous la pression, a approvisionner les marches nationaux en produits adaptés a la *diversite* de la clientele, de sorte qu'il convient de modifier la théorie de Vernon sur les echanges commerciaux et les investissements etrangers; le modele cyclique traditionnel de production pour les investissements étrangers suppose que les innovations apparaissent essentiellement dans les pays oh le revenu par habitant est élevé, qui serviront tout d'abord les marches étrangers par leurs exportations et ce n'est qu'ultérieurement, au stade de la standardisation, que la production sera ddplacee a l'etranger *en* vue de bénéficier de coûts avantageux, facteur important pour la standardisation de produits sensibles aux prix.

Les sociétés multinationalesjouent un rôle croissant dans un monde oh des marches de l'information deficients exigent des societes qu'elles realisent des investissements etrangers directs comme moyen de conserver l'hégémonie technologique et de garantir l'acquisition *en* bonne et due forme de revenus provenant des innovations presentes sur les marches mondiaux. Selon DUNNING et d'autres auteurs, les entreprises considereront l'investissement etranger comme une alternative preferable a l'approvisionnement des marches etrangers par le biais d'exportations et de licences si les coiits de transaction internes des entreprises sont relativement bas (par rapport aux transactions conclues dans des conditions d'indépendance) et si un tel investissement constitue le meilleur moyen de garantir qu'il peut y voir appropriation des bénéfices issus des innovations. Les avantages specifiques d'entreprises typiquement fondees sur la maitrise *en* matiere de technologie et d'organisation sont le fondement d'une localisation efficace de la production a l'etranger - c'est-a-dire dans un pays où les entreprises autochtones bénéficient d'avantages naturels *en* matiere de connaissance des preferences et de localisation de la clientèle et d'acces au soutien politique accorde aux activites commerciales. Produire a l'étranger peut être non seulement une façon d'exploiter sa maitrise technologique, mais egalement constituer une strategie de différenciation de la production sur des marches oh les consommateurs ont une preference pour des produits différents, fabriques dans le pays même. La dynamique du marche mterieur de la CE a demontre le dkveloppement des fusions d'entreprises et des acquisitions a l'interieur de l'UE, lesquelles peuvent a la fois être comprises comme un reflet de la necessite d'exploiter les economies d'echelle et de différencier plus nettement les produits fabriques au plan local. 11 arrive fréquemment que les entreprises ne souhaitant pas instaurer a l'etranger des filiales completes et que leur QG offre certaines fonctions (telles que RD, hancement) constituant un reservoir commun pour toutes les filiales. Il sera donc interessant d'analyser la mobilite des centres de RD sur un plan international. Il convient *en* effet d'etablir une distinction entre les industries immobiles et mobiles, comme les concevait Schumpeter, ces dernieres favorisant les secteurs a technologie intensive. Pour certaines industries, des structures de RD peuvent *en* effet être mises sur pied dans de nombreux pays, de sorte que les filiales etrangeres peuvent devenir un moyen de mettre

à profit des technologies mises au point a l'etranger. La presence dans l'UE de filiales americaines ou asiatiques axees sur la technologie pourrait a son tour contribuer au dynamisme technologique de l'Europe occidentale. Sur des marches mondiaux oligopolistiques, la rivalité entre oligopoles pourrait également devenir une incitation majeure a l'investissement etranger.

La tendance générale dans le monde etant de developper les taux de RD civils par rapport au PIB, les entreprises orientees vers la technologie sont fortement incitees a s'engager dans la voie de la multinationalisation. Les gouvernements nationaux sont confi-ontes a une economie mondiale de plus en plus multinationale, caracterisee par une forte mobilite des capitaux, par l'abaissement des bameres commerciales et par l'intensification de la recherche des facteurs de production mobiles; les gouvernements agissant souvent d'une manière plutôt isolee, les gouvernements nationaux éprouvent des difficultés croissantes a mettre effectivement en oeuvre la politique economique - RD comprise.

La concurrence technologique s'est accentuee pour diverses raisons, au nombre desquelles figure l'extension de la part prise par la RD civile aux Etats-Unis, au Royaume-Uni, en France, en Russie et dans d'autres pays. En outre, avec le dkveloppement de nouveaux domaines technologiques et l'emergence des economies asiatique et post-socialistes d'Europe orientale qui creent une nouvelle concurrence pour les pays de l'UE dans les secteurs des industries a forte densite de main-d'oeuvre et a densite technologique moyenne, une nouvelle tendance s'est fait jour, qui va dans le sens d'un renforcement de la concurrence entre les pays de I'OCDE dans les domaines de haute technologie. Etant donne que dans ceux-ci les marches sont plutôt restreints, le redéploiement des ressources américaines en matière de RD encourage les entreprises americaines a s'orienter avec agressivite vers les marches de moyenne technologie, de sorte que les entreprises de l'UE sont confrontées a de nouveaux problemes, lorsqu'elles entendent retirer sur le marche mondial les profits dont parle Schumpeter, profits sur lesquels repose l'autofinancement des projets innovateurs. Le raccourcissement des cycles d'innovation et l'arrivée de nouveaux venus en provenance d'Asie et d'Europe de l'Est, s'insinuant sur les marches traditionnels des entreprises de l'UE confronte l'industrie europeenne a un double problème. Un autre defi interessant reside dans le fait que l'innovation est de plus en plus liee au secteur des services - industries de réseaux comprises - qui figurait egalement parmi les secteurs dominants de la mondialisation dans les annees 1980 ainsi qu'au debut des annees 1990.

Le positionnement de l'industrie de l'UE dans l'economie mondiale sera determinant dans les annees a venir. Le facteur le plus important sera la capacite d'attirer des volumes suffisants d'investissements etrangers directs en provenance de pays a forte intensite technologique et d'intensifier les sorties d'mvestissements etrangers directs de l'UE vers des pays se situant dans un contexte technologique dynamique, en Amerique, en Asie (Australie comprise) ainsi qu'en Europe orientale.

L'amélioration des liens entre la recherche et l'industrie, d'une part, et la mobilisation de l'esprit d'entreprise des universites et des mstituts de recherche specialisee, d'autre part, pourraient contribuer de maniere importante a ce que la RD puisse renforcer son impact, en termes de valorisation commerciale des progres scientifiques.

La mondialisation de l'economie signifie une forte augmentation de la concurrence internationale. La transparence des prix s'améliore pour des raisons technologiques et les frais de transport sont en baisse, de sorte que les pays de I'UE sont confrontés a une concurrence plus forte dans le domaine des produits a forte densite de main-d'oeuvre. Toutefois, il existe egaiement, exterieurement a I'UE,

un approvisionnement en produits commerciaux eminemment technologiques, etant donné que les États-Unis et la Russie ont converti leur RD militaire en RD civile. En outre, des SMN asiatiques et certaines SMN d'Amérique latine sont en train de rattraper l'Europe, grâce au relèvement de leur taux de RD par rapport au PIB et a l'amelioration de leur système d'education. Internet a contribué a accélérer la diffusion globale du savoir-faire, mais offre egalement de nouvelles opportunités pour les pays de l'UE: il permet la creation d'entreprises innovatrices virtuelles et du commerce électronique. Il sera plus important encore pour les entreprises de tirer parti des opportunites d'internationalisation a prix reduit et de pouvoir compter sur des reseaux Intranet puissants permettant d'assurer la coordination entre entreprises.

Il importe que l'UE reconsidere le rôle de la politique de RD a l'avenir et procede a une meilleure evaluation des strategies politiques au plan national. Le developpement de reseaux de recherche transeuropeens et le cofinancement d'etudes internationales d'etalonnage permettant une evaluation de la politique pourraient representer autant d'impulsions importantes qui pourraient Gtre donnees au niveau de l'UE. Des consignes politiques prudentes, une amelioration de la transparence des mesures et un soutien special aux sociétés orientees vers les technologies qui se trowent en phase de démarrage pourraient egalement revêtir une importance particulière a l'avenir. Devront egalement être examines les problemes liés a la protection des brevets et aux politiques d'education, amsi que les possibilites de mobilisation du potentiel innovateur des universites dans la société de l'information.

Douze conclusions politiques majeures pewent être tirées de ces considerations:

- la mondialisation se traduit par une intensification de l'interdépendance internationale, etant donné que le renforcement des liens noues par le biais du commerce, des investissements etrangers - dans un sens large, afflux d'mvestissements de portefeuille et investissements étrangers directs - et par Internet se développera dans les pays de l'OCDE et dans le monde entier. La mondialisation se poursuivra après le tournant du siècle, de sorte que surgiront d'importants problèmes politiques à long terme, associes a cette mobilite nouvelle. Celle-ci s'est considerablement développée pour les capitaux reels et le travail qualifié; a l'avenir, Internet ouvrira un nouveau site permettant de rendre le travail semi-qualifié plus mobile dans le monde entier. L'intégration des marches financiers est susceptible de se derouler plus rapidement que celle du cadre reel de l'économie. L'instabilité des marches financiers nationaux et mternationaux pourrait devenir un obstacle a la croissance soutenue de l'economie mondiale. Une telle instabilité, le chômage eleve observe dans de nombreux pays industrialises et la pauvreté qui prevaut dans les PVD sont les principales sources de preoccupation d'une politique a long terme.

- Pour les pays de I'UE, la mondialisation signifie une intensification de la concurrence internationale en matiere de technologie et partant, un développement du besoin de specialisation. Une accélération de Finnovation a l'échelle de la planete implique une croissance plus elevee et, éventuellement, des problèmes environnementaux majeurs. Il est donc necessaire de mettre en place des programmes de RD supplementaires cofinancés par les gouvernements et centres sur l'ecologie, ainsi que des mesures destinees a internaliser les effets négatifs externes de la croissance. Etant donné qu'a l'ere d'Internet, le savoir-faire et les connaissances deviennent plus accessibles partout dans le monde, la politique commerciale exterieure de I'UE pourrait d'une part soutenir les initiatives de developpement de reseaux Internet dans les pays en voie de developpement, mais devrait egalement souligner que les pays de I'UE laisseront leurs

marches ouverts aux "outsiders" qui offrent de plus en plus de produits à fort contenu technologique. De telles promesses de la part de l'UE seront difficiles a respecter si le plein emploi en Europe occidentale n'est pas restauré et si l'UE ne lance aucune initiative fructueuse lui assurant la maîtrise de la haute technologie. La mondialisation signifie une nouvelle division internationale du travail et du savoir-faire, alors que les pays de l'UE devront certainement intensifier leurs efforts en matiere de RD et ameliorer les processus de diffusion.

- Ce sont les gouvernements nationaux, les syndicats et les organisations patronales qui en premier lieu sont responsables de l'évolution de I'emploi et des taux de chômage élevés, chacun a leur niveau. Les taux de chômage eleves entraînent une resistance des travailleurs au progres technologique, qui represente un problème pour tous les pays de l'UE qui sont desireux d'améliorer la competitivite internationale par le biais de la modernisation et de l'innovation technologiques. Une dispersion salariale insuffisante dans de uombreux pays continentaux de l'UE peut être observee, alors que les salaires bruts relativement Cleves de la main-d'oeuvre non qualifiée y constituent un probleme majeur. En reduisant les taux d'imposition des travailleurs a faibles revenus, les syndicats seraient disposes a accepter un allongement de la periode durant laquelle les travailleurs non qualifies beneficieraient d'augmentations salariales non adaptees. Une dispersion accrue doit entrainer un developpement de l'emploi et - a moyen terme - un relèvement de la croissance moyenne des salaires. Ce facteur stimulerait, a son tour, la demande globale et encouragerait d'autres investissements, ainsi que le dheloppement de la production.

- Les dépenses liées a la formation et a la scolarisation sont insuffisantes dans de nombreux pays de l'UE, compte tenu de la nécessité d'affronter la concurrence croissante des biens d'importation a forte intensite de savoir-faire des pays d'Europe orientale et d'Asie. Vu les salaires eleves pratiques dans la plupart des pays de l'UE, une forte productivite de la main-d'oeuvre est necessaire pour éviter d'autres augmentations du taux de chômage. Le recyclage continu et des programmes de formation speciaux dispenses par les entreprises - reposant en partie sur Intemet - sont autant d'options qu'il convient d'envisager sérieusement.

- La productivite du capital dans les pays de l'UE est inférieure a celle des Etats-Unis, ce qui souligne l'inefficacite des marches europeens de capitaux. L'euro creera des marches plus intégrés, mais il reste douteux que l'Europe puisse largement en bénéficier si la legislation fiscale nationale n'est pas harmonisee dans une certaine mesure et si la volonté politique de reformer les regimes de sécurité sociale du continent n'est pas renforcee. L'abandon au moins partiel des systèmes de retraite par répartition dans la plupart des pays continentaux de l'UE, au profit d'un nouveau regime de pension capitalise, assorti de mesures énergiques incitant les travailleurs a souscrire aux fonds d'investissement, donnerait une forte impulsion au dkveloppement de la productivite du capital et en fin de compte, de l'emploi.

- Il conviendrait d'augmenter les dépenses de RD en Europe occidentale et de renforcer l'efficacite des programmes y relatifs.

- Il n'est pas toujours possible d'eviter les dépenses qui font double emploi dans les principaux secteurs de la RD si l'on veut tirer parti de la concurrence dans ce domaine. Dans les marches interieurs, les banques d'affaires internationales s'occupant des fusions et acquisitions d'entreprises exerceront une pression accrue sur les gouvernements afin qu'ils envisagent des

programmes de RD bilateraux ou multilateraux et poursuivent une politique de renforcement de la specialisation dans ce domaine.

- Il semble que le developpement de la diffusion des innovations soit tres important pour la croissance et la competitivite internationales. De nouvelles options sur Internet doivent être etudiees en vue d'améliorer la dissemination des informations relatives aux innovations.

- Il pourrait être procede a une reforme du systeme universitaire, en particulier dans les pays où les universites financées par les powoirs publics occupent une position dominante. De nouvelles universites privées insistant sur l'informatique avancee, Internet et les technologies de telecommunications pourraient être creees de maniere a encourager la recherche universitaire a s'orienter davantage sur les besoins du monde des affaires et de la societe.

- Il conviendrait que les universites soient jugees non seulement en fonction du nombre d'étudiants et des mérites scientifiques des professeurs, mais egalement par rapport au nombre de firmes créées par d'anciens eleves. Il conviendrait d'encourager les universites a tenir un registre authentique dans ce domaine.

- Vu le nombre limite de creations de nouvelles societes a vocation technologique dans l'UE, on pourrait envisager la mise en place de programmes speciaux destines a stimuler la creation de nouvelles entreprises dans le domaine des technologies nouvelles. En fait, les fonds publics seraient rarement necessaires, si les marches des capitaux a risque et les bourses de valeurs powaient se développer dans la plupart des pays de l'UE. La politique du marche des capitaux est importante comme moyen indirect d'encourager la RD dans la Communaute.

- La recherche de l'UE n'est pas suffisamment spécialisée et les innovations introduites par les entreprises europeennes ne relèvent pas souvent des categories les plus dynamiques. Un certain degre de coordination informelle entre les politiques de RD pourrait être utile a l'avenir et il conviendrait d'encourager la création de reseaux de RD a l'echelle de l'UE. Toutefois, la creation d'un tel reseau ne devrait pas être envisagee - saufexception specifique - s'il n'existe pas de reseau concurrentiel alternatif en Europe occidentale. Les entreprises européennes pourraient être encouragees a faire appel au potentiel de RD existant en Europe de l'Est et en Russie, où une main-d'oewre qualifiee bon marché est disponible. Au total, il est clair que pour affronter la mondialisation des relations economiques, les pays de l'UE doivent ameliorer leurs efforts en matiere d'education, de formation et de RD, en vue de conserver un statut de "leader" technologique mondial. La proportion peu elevee de capitaux propres des entreprises de nombreux pays de l'UE soulève des doutes en ce qui concerne la capacite de l'UE a exploiter avec fruit les nouveaux domaines de l'innovation, où la mise a disposition de capitaux a risque est importante pour la survie et l'expansion des nouveaux venus. Un plus grand nombre d'etudes internationales d'etalonnage seront necessaires a l'avenir et le "benchmarking" sur une base régulière peut être recommande dans tous les principaux domaines de la politique. Si les societes solidement etablies d'Europe sont bien organisees (probleme des avantages acquis), les nouveaux venus et les societes nouvelles sont moins organises et moins aides par le systeme bancaire et par le système politique. Enfin, il convient de noter que les taux eleves de chômage ne decouragent pas seulement l'investissement et l'innovation parce qu'un chômage record impose des perspectives limitées a la croissance des nouveaux revenus et partant, aux opportunites de plus fortes croissances. Les taux de chômage eleves renforcent egalement

l'opposition des travailleurs au progres technologique. Le retablissement du plein emploi dans les pays de l'UE stimulerait donc la croissance economique et la compétitivité internationale directe et indirecte.

La justification theorique de la politique de haute technologie procede **d'un** dysfonctionnement inherent au marche. La haute technologie implique la production et la commercialisation de connaissances economiques nouvelles. **En soi,** les nouvelles connaissances sont différentes des facteurs plus traditionnels de la production du travail, du capital et des ressources naturelles, qui sont connus et possèdent une valeur economique relativement certaine. A l'oppose, la production de nouvelles connaissances souffre de trois sources de dysfonctionnement majeures du marche: l'indivisibilite, l'incertitude et les facteurs externes.

Les aspects "dysfonctionnement" du marche, concernes par l'activite economique fondee sur les connaissances, justifient d'une manière fondamentale une intervention gouvernementale, *en* particulier pour aider ce qui **sans** cela serait une sous-production de cette activite. Toutefois, l'une des considerations pratiques primordiales inspiree par les institutions qui mettent en place la politique technologique est la question de savoir comment éviter ce que la litterature specialisee connaît sous le nom "d'emprise reglementaire" (regulatory capture). **De** telles institutions sont principalement creees pour eviter cette emprise, c'est-a-dire eviter que les decideurs politiques qui sont mandates pour concevoir et mettre *en* oeuvre la politique technologique ne tombent sous l'emprise de groupes privilégiant des **intérêts** particuliers. Les procedures administratives destinees a réduire l'influence des activites politiques recherchant le profit relèvent de la responsabilite a l'egard du public, de l'independance et de la transparence.

Les approches traditionnelles et neoclassiques a l'egard de la theorie de la croissance etaient axees sur les liens entre les mtrants du travail et du capital, d'une part, et sur les extrants, d'autre part, dans un contexte de production modele, la croissance economique s'expliquant alors soit par l'augmentation de la quantite des intrants ou par la productivite de ceux-ci. Toute croissance supplémentaire ou **non** escomptee etait attribuee aux mutations technologiques exogènes qui, dans une large mesure, etaient considerees comme une "manne céleste".

Le concept de la croissance endogène englobe une palette de travaux empiriques d'ordre theorique qui sont apparus au **cours** de la demiere decennie. La nouvelle approche **a** l'egard de la theorie de la croissance souligne que **la** croissance economique est un résultat endogène **d'un** systeme economique. Les implications pour la politique gouvernementale d'un developpement de la haute technologie qui s'opere *en* vertu de la theorie de la croissance endogène, diffèrent d'une maniere tout a fait saisissante des conséquences décrites dans la theorie neoclassique traditionnelle de la croissance. **Dans** le cadre de cette demike, le rôle du gouvernement est limité et reduit au minimum. Les profits de l'investissement dans le domaine des connaissances nouvelles reviennent aux entreprises et aux individus qui realisent ces mvestissements, de sorte qu'il **n'y** a aucune raison pour les gouvernements d'intervenir sur les marches des hautes technologies.

A l'oppose, *en* vertu de la nouvelle theorie de la croissance, une raison contraignante s'impose au gouvernement pour engager une politique vigoureuse et active permettant de creer les technologies nouvelles. Cette contrainte, c'est l'existence de facteurs externes a la connaissance sous forme de retombees **dans** le domaine des connaissances. **En** soutenant la creation de connaissances nouvelles, de liens produisant des retombees et la commercialisation de ces connaissances, la politique

gowernementale peut comger les dysfonctionnements du marché inhérents à l'activité économique fondee sur la connaissance.

Le défi economique le plus important auquel l'Europe soit confrontée est la restructuration de son activite economique, a partir d'industries fondees sur les facteurs traditionnels de production, pour se tourner vers des industries fondées sur les connaissances. La conception traditionnelle en ce qui concerne le processus de la mutation structurelle, c'est que les grandes entreprises constituent la force d'entraînement d'un tel changement. De grandes organisations ont la maitrise de vastes ressources en matiere de RD. Toutefois, un ensemble de preuves irrésistibles portant sur une vaste série de pays incite a penser que les petites et nouvelles entreprisesjouent un rôle crucial dans le déclenchement de la mutation structurelle. La raison pour laquelle les petites et nouvelles entreprises constituent une force d'entraînement, c'est qu'un entrepreneur lance sa société pour realiser une idee qui autrement ne pourrait pas être développée par les societes en place. Les nouvelles entreprises sont des vecteurs du changement, elles se demarquent du statu quo et se tournent vers de nouvelles activités qui sont controversees ou sur lesquelles pesent des mcertitudes.

L'une des raisons pour lesquelles l'avantage competitifde l'Europe a glissé, délaissant les industries traditionnelles pour se tourner vers les industries fondees sur les connaissances, c'est l'emergence d'entreprises en Europe de l'Est et dans les NPI. D'une part, les sociétés d'Europe centrale et orientale ainsi que les NPI ont acces a une main-d'oeuvre beaucoup moins onereuse. D'autre part, les niveaux en matière de savoir-faire et de capital humain y sont tres élevés, du moins dans certains d'entre eux. Le defi posé a l'Europe par la nowelle concurrence, c'est la question de savoir sil faut resister a cette nowelle concurrence dans le domaine des industries traditionnelles a contenu technologique modéré, en installant des entraves et en se protegeant, ou s'il convient de reconnaitre que les evenements de 1989 ont enclenche un glissement a long terme de la position concurrentielle avantageuse d'une Europe (occidentale) où les coûts sont élevés vers des activités économiques basees sur les connaissances.

La plus grande difficulté pour parvenir a des politiques de RD efficaces en Europe, reside dans la reduction des entraves empichant la mobilite et la commercialisation des nouvelles connaissances. L'Europe n'a pas su tirer profit de l'investissement réalisé dans le secteur des nouvelles connaissances, tant en termes de RD que de capital humain. Une partie de ce defi reside dans un déplacement de l'accent politique qui ne doit plus être place sur la production et les résultats a atteindre, mais sur l'apport des connaissances. Dans sa deuxieme partie, ce défi concerne des institutions complémentaires, telles que les marches financiers et les marches du travail, qui influencent la capacite des entreprises et des individus a commercialiser leurs nowelles connaissances.

Ces dernières annees, l'une des caracteristiques importantes des marches de l'emploi dans les pays anglo-saxons a au moms été l'élargissement significatif des ecarts en matiere de qualification. Le long ghssement en faveur du travail qualifié, qui s'est opere au detriment du travail non qualifie, semblerait s'être accelere au cours des deux decennies ecoulees. L'offre en matiere de qualifications s'est developpee moins rapidement et les salaires de la main-d'oeuvre non qualifiee ont enregistré une diminution relative (et aw Etats-Unis, en valeur absolue). Aux Etats-Unis et au Royaume-Uni, le fait que le glissement relatif de la demande en faveur d'emplois hautement qualifies soit la tendance dominante n'est guere conteste, alors que cela est plus ambigu en Europe continentale, etant donné qu'a intervalles, on note un dheloppement du chômage de la main-d'oeuvre qualifiée. Au lieu de

poursuivre la controverse, il convient de se pencher sur les raisons qui president au glissement relatif de la demande.

Ces facteurs sont au nombre de deux: le dkveloppement des echanges internationaux et une mutation technologique privilégiant les compétences (c'est-a-dire economisant la main-d'oeuvre non qualifiée), chacun d'eux relevant de la "mondialisation". Tant aux Etats-Unis qu'au Royaume-Uni, si l'on decompose les changements globaux qui s'opèrent dans les emplois, disons non manuels, on s'aperçoit que les mouvements "intra-industriels" l'emporteraient sur les glissements "interindustriels". Si le commerce international était le coupable, on pourrait s'attendre au contraire, etant donné l'incidence inegale des echanges internationaux sur les secteurs de l'economie. Des analyses commerciales distinctes, exploitant les données relatives au contenu des facteurs dans les industries d'importation/exportation, ainsi que des etudes d'effets sur les prix (preferentiels) ont révélé que la contriiution du commerce a ces glissements de la demande et partant, a cette inégalité dans les profits - ("immiseration effect o ftrade") - a en effet été assez modeste. Bref, apres FREEMAN (1995, 30), on peut declarer que les salaires de la main-d'oeuvre non qualifiee dans les economies développées ne sont pas fixés a Pékin. Quoi qu'il en soit, l'histoire de la mutation technologique a connu un certain malaise, et ce parce que l'aide dont elle a bénéficié a ete indirecte, c'est-à-dire que l'on s'est montre conventionnel en considerant ce changement technologique comme résiduel.

Recemment toutefois, un certain nombre de tentatives empiriques de sonder la boite noire des technologies ont ete enregistrees. L'utilisation de substituts aux technologies privilégie plus directement cette explication. Mais la preuve n'est pas évidente et il se pourrait qu'a l'avenir d'autres explications telles que la dereglementation, partagent ce rdle plus equitablement avec la mutation technologique. Il est clair que l'inégalité reside dans un certain nombre d'autres facteurs non commerciaux et la mutation technologique peut être lancee par l'accroissement de la concurrence (dimension endogène).

Pour mesurer les rkponses a apporter au march6 du travail, il semble improbable que les indices de flexibilité normaux aident beaucoup notre compréhension des problemes poses par la mondialisation en général et par le changement technologique en particulier. En l'occurrence, il convient d'etudier l'adaptation au niveau de l'entreprise. Les etudes qui ont exploite de telles donnees ont revele l'extrême hétérogénéité des entreprises tant en ce qui conceme la reaffectation du travail que le processus de relèvement du niveau des connaissances. La recherche de modeles plus systématiques pour les donnees relatives a l'emploi devrait bien sûr faciliter notre comprehension de la mutation technologique et du rôle du commerce et nous permettre d'apporter des réponses adaptees au marche du travail.

En général, l'histoire nous apprend que le marché répond plutôt bien aux modifications de la demande. Autre résultat pratique: c'est la forte complementarite existant entre la scolarisation et la formation qui devrait continuer de guider la politique a long terme. Mais comme pour ceux qui sont marginalisés par les mutations technologiques, il ne suffit pas de compter sur les marches et la notion de complementarite universelle a trouve une confirmation negative. Des travailleurs qui sont desavantages de la sorte ont besom d'aide. Au stade actuel des connaissances que nous avons de ce qui fonctionne pour ces personnes, la garantie des ressources et des mesures supplementaires sont indiquées.

La mondialisation de la RD est depuis longtemps un probleme majeur pour les chercheurs universitaires. Les idees nouvelles echangees a l'occasion de conférences internationales et la collaboration transfrontière dans le cadre de projets aussi prestigieux que la physique des hautes énergies, la fusion nucleaire ou la recherche spatiale sont devenus réalité depuis plusieurs décennies. C'est egalement vrai pour les domaines du genie genetique et de l'oceanographie, tout en étant probablement moins évident, étant donné qu'aucune structure commune d'importance n'est necessaire. La RD mondiale pour le monde des affaires est maintenant davantage consideree comme un probleme d'importance majeure qu'il y a quelque vingt ou trente années. Pour les décideurs presents dans les gowernements, la mondialisation semble davantage constituer un probleme qu'une opportunité, etant donné que les frontières territoriales et les systemes legaux respectifs ne peuvent pas être aisement transcendés (a l'exception de l'Union europeenne).

A la suite des changements structurels survenus dans le domaine des technologies, les SMN peuvent combiner leur decision prioritaire avec les decisions relatives aux localisations et poursuivre quelques volets de la RD dans un pays et d'autres dans un autre. Ces localisations, peut-&re dans des Etats ou regions appartenant a des pays, deviennent plus ou moins attractives si les centres ou reseaux competents existant entre les entreprises et institutions publiques et si le jeu de conditions-cadres favorables offrent des avantages concurrentiels par rapport a d'autres. Par conditions-cadres favorables, nous entendons tant la secheresse des faits (legislation du pays ou de l'État, disponibilite de la main-d'oeuvre qualifiee, etc.) que les facteurs de mieux-être (tels que de bonnes conditions de logement, le developpement d'un systeme de transport longue distance, mais egalement pour utilisation quotidienne, des possibilites touristiques et autres loisirs, un enseignement plurilingue et beaucoup d'autres).

Il est évident qu'il existe des SMN qui sont dotées de structures chargées d'assurer la distribution de leur RD. La RD tournée vers la mondialisation quitte le niveau modeste auquel elle se situait pour se développer dans la plupart des pays. Les sorties nettes de RD sont une source de preoccupations pour certains d'entre eux, mais la question de savoir s'il est preferable de faire travailler les societes "nationales" a l'étranger et de participer a des systemes nationaux orientes vers l'etranger ou d'inviter des societes etrangeres sur son propre territoire reste largement ouverte. Les retombees technologiques et les flux de connaissances s'accumulent certainement dans les deux cas et le débat relatif aux flux nets de RD ainsi qu'a leurs avantages est dans une large mesure un probleme d'emploi sur le territoire national ainsi qu'un probleme de rentrees fiscales en provenance de la RD, de la production et des services au plan local.

La plupart des economies des pays industrialises sont en passe de devenir des economies axees sur les services. Ce qui apparait le plus clairement, c'est la mutation structurelle qui s'opere dans l'emploi: même les economies qui souffrent d'un chômage spectaculaire dans le secteur manufacturier peuvent simultanement presenter un developpement de l'emploi uniforme dans le secteur des services. Mais cette restructuration ne signifie pas que l'industrie manufacturière cessera bientôt d'exister. La regle empirique nous apprend que la plupart des societes nouvelles de services font appel a des biens d'équipement pour assurer ces services. Le defi qui se pose alors a l'industrie d'equipement, c'est de savoir si elle produit ou non les machines "adéquates" pour la societe des services de l'avenir, ce qui augmentera sa competitivite dans le secteur de la fabrication.

Dans un avenir proche, c'est tout juste si l'on peut s'attendre a ce qu'une expansion rapide des secteurs a forte intensité de RD sera suffisante pour resoudre les problemes du chômage des pays industriels

fortement développés. Toutefois, les secteurs a forte intensite technologique pewent egalement tirer parti du glissement qui s'opere vers l'industrie des services. Et en particulier, les fournisseurs de services a forte intensité de savoir-faire gagnent rapidement du terrain et offrent des emplois a de nombreuses personnes, et ce, des maintenant. Leur succes est de plus en plus subordonné a l'innovation, ainsi qu'a l'utilisation de nouvelles technologies. Ce facteur engendre a son tour de nouveaux marches pour les producteurs de technologie, en particulier pour les technologies de l'information et de la communication, les infrastructures pour les secteurs des transports et des communications et la technologie medicale. Les avancées technologiques sont de plus en plus adaptees aux besoins du secteur des services.

La mondialisation de l'industrie, a son tour, a fortement stimule la demande de services (transports, finances, distriiution, recherche et ingénierie) et accéléré la tendance vers la tertiarisation. La "societe des services" est egalement génératrice de nouvelles demandes en matiere de politique technologique. En gheral, elle devrait entrainer un glissement continu, passant du développement de la production de nowelles technologies a leur promotion et a leur utilisation, ainsi qu'a leur diffusion. Les liens avec l'approvisionnement technologique devraient rester intacts.

La tendance vers une "economie des services" entraîne egalement des répercussions sur les exigences en matiere de performances techniques. Les services axes sur les affaires ont continuellement besoin des nouvelles impulsions donnees par le secteur des innovations du monde industriel en vue de developper une base continue. Il convient de mettre en place des services avances si l'on s'engage dans la RD, la commercialisation, le hancement, la production, etc.. Ce secteur renforce les impulsions de croissance générées par l'industrie et fortifie le fondement industriel des produits issus de ces services. D'autre part, les contriiutions de l'innovation s'inscrivant dans le cadre d'un changement apportant une valeur ajoutee glissent d'un systeme de production de materiels vers un systeme de production de logiciels, ainsi que vers les services. Il existe dans le secteur des services des domaines coûteux qui ne sont pas tributaires des sites de production technologiques, mais reclament des solutions technologiques élaborées pour être en mesure de remplir leur rôle initial. A cet egard, il est egalement essentiel d'accorder plus d'attention aux applications potentielles amsi qu'a la combinaison optimale des technologies dans le secteur des services en expansion.

Si ce n'est pas la description des fonctions, mais la qualification des travailleurs qui sert de critere d'étalonnage pour le diveloppement du capital humain, dans ce cas, pour les pays de l'OCDE les plus importants, on en arrive a revaluation suivante: au cours de la premiere moitié des années 1990, il se confirme une tendance deja identifiee auparavant selon laquelle la proportion des travailleurs titulaires d'un diplôme superieur (universite, ecoles polytechniques ou apparentees) et du personnel académique (diplijmes universitaires seulement) se développe dans le secteur manufacturier et dans l'industrie des services. Cela signifie que l'on tend a employer des personnes possedant des qualifications beaucoup plus elevees, en donnees relatives, dans un secteur des services en expansion, ainsi que dans le secteur manufacturier, qui enregistre des pertes d'emplois.

Si, pour resumer, nous considerons les economies dans leur integralite, c'est-a-dire que si nous portons un jugement tant sur le secteur manufacturier que non manufacturier, on peut sans nul doute diagnostiquer que l'importance du capital humain est déterminante pour la croissance economique. Grossierement, pres de la moitie des activites du secteur manufacturier ainsi que du secteur des services sont des activites a forte intensite de capital humain ou de connaissances; ces deux chiffres ont augmente au cours des dernieres annees. Parmi ceux-ci, le secteur des services occupe une

position de plus en plus dominante d'annee en année et, par consequent, la mutation sectorielle vers une Cconomie à forte intensite de connaissances est stimulee par la mutation sectorielle vers une Cconomie des services, a laquelle il faut ajouter les augmentations enregistrees dans chacun de ces secteurs. Celles-ci semblent être les deux faces d'une même monnaie.

S'il est exact que la croissance est plus forte dans les domaines imbriqués, dans les domaines transdisciplinaires de la technologie, par rapport a l'essentiel des domaines technologiques traditionnels, il apparaît que les défis futurs en matiere d'education et de recyclage ainsi qu'en matiere de formation professionnelle ne pourront Gtre seulement releves dans les écoles, facultés, disciplines et cercles traditionnels. En matiere de compétences, les exigences du futur vont dans le sens d'une connaissance interdisciplinaire et de l'apprentissage tout au long de la vie. Ce qui met a l'ordre du jour la question de savoir si nos etablissements d'education traditionnels sont suffisamment bien adaptes pour former la prochaine generation de travailleurs.

Le concept de "science" couvre la creation, la decowerte, l'examen, la classification, la reorganisation et la diffusion des connaissances dans les domaines relevant de la physique, de la biologie ou des sciences sociales. Par "technologie", on entend l'application scientifique du savoir-faire. En tant que telle, elle appartient a un vaste groupe d'activites du même ordre, qui englobe la mise au point et l'utilisation d'objets fabriqués, d'objets artisanaux et d'éléments impliquant une connaissance, ainsi que diverses formes d'organisation sociale. La technologie ne signifie pas seulement l'application des résultats scientifiques, mais tout traitement intentionnel, toute méthode, toute methode de travail et aptitude dans l'exploitation de la connaissance scientifique, ainsi que les produits qui en résultent.

L'importance du processus de la "recherche" dans la concretisation des innovations est incontestee aujourd'hui. Selon les regles qui ont jusqu'ici prévalu en ce qui conceme les statistiques relatives a la recherche, il y a lieu detablir une distinction entre la recherche fondamentale, la recherche appliquee et le developpement experimental (OCDE, 1993). Ces trois différents concepts sont souvent combines dans l'expression générique "recherche et dkveloppement (RD)".

Une serie de pays europeens de taille plus modeste s'orientent vers des universites générales et vers d'autres recherches non orientees et consacrent comparativement peu de moyens financiers a la recherche. Les Pays-Bas, l'Italie, la Suede et l'Allemagne appartiennent egalement a ce groupe, qui consacre moins de 50% a la recherche orientee. Les autres pays de l'UE, et notamment le Royaume-Uni et la France, consacrent relativement peu de credits a la recherche générale de base et insistent davantage sur la recherche orientee (et pour ces deux demiers pays, cette consideration s'applique egalement a l'armement). 11 nous faut donc en deduire, en ce qui conceme la recherche de base, que les modes de dépenses propres a chaque pays persistent egalement dans le cadre de l'Union europeenne. La rumeur veut qu'avec la part importante qu'ils consacrent a la recherche dans le domaine de la defense, le gouvemement des Etats-Unis consacre moins de credits a la recherche générale de base, alors que le modele japonais, qui consacre un budget limité a la RD en matiere de défense, ressemble au modele allemand.

Dans la moyenne des pays de l'UE des Quinze, de 40 a 50% des credits affectes par les gouvernements a la RD sont consacres a la recherche non orientee, cependant que la Commission europeenne consacre presque exclusivement ses fonds a la recherche orientee. Nous observons en l'occurrence une nette distribution des tfches entre les gouvernements europeens nationaux et la Commission, qui contribue a peine à la recherche de base non orientee.

Fondamentalement, la relation entre les mstituts de recherche non industrielle et l'industrie devrait être décrite c o m e une "interaction", par rapport a l'ancien concept du "transfert". Les connaissancesne se transmettent pas seulement en sens unique, depuis les instituts de recherche jusqu'à l'industrie, car il existe un flux de savoir-faire qui s'exerce en sens opposé.

Comme l'ont démontré des etudes plus anciennes, la science fondamentale contribue d'une maniere decisive aux progres technologiques. Toutefois, il est difficile d'en retracer les procedures et d'en mesurer l'impact precis. Tout c o m e il est malaisé de définir une science par rapport a la technologie, il est difficile de préciser les flux de connaissances s'operant entre les universités et l'industrie. C o m e dans de nombreux cas, il existe un retard important entre le moment où apparait une découverte scientifique et son introduction dans le domaine de la technologie; existe en outre la necessite de prevoir une période d'observation suffisamment longue, exigence qui est souvent negligee dans les enquêtes effectuees sur base de questionnaires.

La littérature correspondante fait état d'observations selon lesquelles l'intrant scientifique mcorpore dans l'innovation dépend fortement du secteur mdustriel concerné et du domaine technique considere. Des lors, ce que l'on peut trouver dans les etudes de cas peut être "terni" par le secteur mdustriel oh l'étude de cas est realisee. Certains des écarts dont il est fait état en la matiere sont susceptibles de disparaitre si l'on tient compte de l'influence de tous ces facteurs complexes.

L'existence de retombees apporte une autre contribution importante aux liens existant entre la recherche et l'industrie. Les connaissances crees dans le cadre d'une institution produisent des retombes qui sont utilisées par d'autres institutions. Ce phénomène se produit d'entreprises a instituts academiques, mais egalement entre le monde de la recherche et le secteur industriel. Les entreprises et les individus ont acces a des connaissances qui leur sont étrangères sans qu'il existe des mécanismes institutionnels de transfert. Les indices empiriques donnent clairement a penser que la RD et les autres sources de connaissances n'engendrent pas seulement ces ficteurs externes, mais des etudes suggerent Cgalement que de tels liens tendent a être geographiquement limites a une région où les nouvelles connaissances economiques ont été creees. C'est-a-dire que les nouvelles connaissances peuvent se répandre vers d'autres entreprises et agents economiques, mais l'extension geographique de telles interactions est limitée et partant, Fapparition de structures nationales specifiques n'a rien de surprenant.

En dépit du consensus général selon lequel en matière de connaissances, les interactions se produisant en certains endroits donnes stimulent l'activité innovante, l'on n'est guere d'accord sur le déroulement exact de ce phénomène, si nous pensons aux difficultés que comporte l'etablissement de liens entre la recherche et l'industrie, par secteur et par nation. Le désir des quartiers généraux des SMN de participer simultanement a plusieurs systemes nationaux d'innovation est donc parfaitement comprehensible, même si le maintien de plusieurs laboratoires de RD dans divers pays est onereux.

Les societes dont l'activité est fondee sur la science, le type de societe le plus interessant dans le cadre de la mondialisation se situent dans le secteur du suivi de l'ingenierie chimique, electrique et électronique. Les industries qui se fondent sur la science, reposent largement sur les activites de RD des entreprises, qui profitent largement de l'évolution rapide des sciences fondamentales developpees dans les universites et ailleurs. Ces entreprises fondees sur la science mettent au point un pourcentage eleve de procédés technologiques dans leurs propres laboratoires. Parmi celles-ci, la proportion de grandes sociétés est relativement importante, etant donne qu'il existe un niveau ou un seuil minimum,

a partir duquel une entreprise peut pratiquer une RD efficace intra-muros. D'autre part, un certain nombre de sociétés qui se sont engagees dans la voie de la haute technologie relevent du secteur qui fonde son activité sur la science.

D'une maniere generale, les domaines tributaires de la science sont des domaines internationaux et les différences entre les pays ne sont guere profondes. La subordination de la technologie par rapport a la science est une de ces caracteristiques intrinsèques. Toutefois, la différence entre les pays reside dans le fait que quelques systèmes nationaux de recherche de Pinnovation sont plus dynamiques dans certains secteurs scientifiques que dans d'autres et que, par consequent, sans procéder a une ventilation spécifique de cette discipline, ils se situent dans une perspective macro-economique, comme s'ils etaient plus ou moins tributaires de la science. Il nous faut donc faire un distinguo entre le patrimoine intrinsèque en matiere de science et de technologie et I'etendue des activites qui peuvent différer entre les pays.

Pour en revenir a la situation dans l'UE, il nous faut clairement dire qu'en Europe, les domaines qui sont triiutaires de la science sont les mêmes que partout dans le monde. Toutefois, les performances plus faibles enregistrees par certains pays (continentaux) de l'UE dans les secteurs tributaires de la science tiennent au fait qu'ils sont moms actifs dans ce domaine que dans les secteurs non dépendants de la science. Par consequent, nous pouvons ramener la question a un probleme de profil d'activite et ce n'est donc pas une question d'inefficacite fondamentale.

La politique de RD contemporame a délaissé l'idée peu cohérente que l'État, au-delà des développements technologiques, pouvait infléchir la recherche fondamentale pour la ramener a une serie d'innovations nationales introduites par les individus. Est egalement surannée I'idee que l'État pourrait se satisfaire de jouer le rôle de promoteur d'appoint de la recherche fondamentale et de laisser la technologie sous le contrôle de processus de marché anonymes. La politique de RD du debut du XXIe siecle exige un moyen terme: un rôle actif de la part du gouvernement, comme intermediaire entre les acteurs sociaux (societes, associations, groupes d'intérêt, communautes scientifiques, consommateurs, medias, employeurs et travailleurs, etc.).

En ce qui concerne la politique de RD européenne, ce rôle intermediaire doit egalement tenir compte du fait que son champ est limité a la base. Les activites des Communautés europeennes devraient toujours être envisagees dans le cadre des efforts des politiques nationales et, dans certains autres pays membres, des politiques se situant sous le niveau national, notamment dans les Etats de type federal, qui developpent la recherche sur une base regionale.

Dans la mesure où, en matiere de RD, une politique de stimulation de l'offre a prévalu dans l'Union europeenne, il convient de souligner que Finnovation scientifique est importante dans de nombreux cas, mais non dans tous. Lorsqu'il s'agit d'innovations ayant une resonance mondiale, les processus en aval qui y sont lies, tels que des monopoles nationaux effectifs, la stimulation et l'articulation de la demandejouent egalement un rôle important. Dans ce sens, il est recommande que la politique de RD s'efforce de garantir que ces monopoles s'inscrivent dans l'Union europeenne, la oh des acteurs mondiaux puissants sont actifs. Dans la mesure où le developpement rapide et stable de ces marches peut être facilite par d'autres mesures que des mesures de RD, la politique dans ce domaine devrait être combinee avec d'autres politiques europeennes pour en tirer un profit maximal.

Le rejet de la politique de planification naïve qui a parfois été poursuivie dans les années 1970 signifie également qu'il ne faut pas mettre sur pied des organes de planification très vastes et qu'il faut s'abstenir de creer mécaniquement et de contrôler les institutions engagées dans la science et la technologie. En lieu et place de cela, les caracteristiques d'une politique scientifique et technologique avancee, au plan européen, devraient être fondees sur l'hypothese selon laquelle les prises de decision procèdent des négociations engagees par une diversite d'acteurs, agissant a divers niveaux de hierarchie. L'approche "du sommet a la base" n'est pas utile en ce tournant de siècle: les acteurs doivent s'efforcer de s'aligner et de dégager un consensus. Pour faciliter les choses, la Commission europeenne et les gouvernements des Etats membres devraient jouer de concert le rôle de vecteurs en assurant l'information dans les deux sens et en organisant des tribunes pour en débattre. Au besoin, la Commission devrait être un pourvoyeur d'intrants en matiere d'information strategique, en recourant a la prevision, a revaluation technologiques ainsi qu'à l'evaluation des politiques strategiques en matiere scientifique et technologique. Ce faisant, elle ne devrait pas compter sur les instances ou agences de la CE mais, en se situant dans la perspective des Etats membres, sur des organisations desinteressees ou des groupements multinationaux disposant de laboratoires d'idees. Il est toujours utile d'organiser l'information strategique sous forme de scénarios alternatifs, permettant aux choix strategiques de devenir apparents.

Le developpement de la cooperation intereuropeenne transfrontalière est considere en permanence comme un defi. Il devrait egalement mclure l'échange de personnes par le biais de subventions spéciales. En raison des différentes structures de carrière existant dans les universites et les entreprises et des problemes sociaux inherents a la mobilite, le transfert du personnel sera toujours limité, par rapport aux autres mesures. Ce domaine pourrait être riche en potentialites si la politique pouvait entrainer une extension des echanges.

1. Globalization of the Economy and Increasing International Competition

The globalization of the economy means that international trade and investment are rising in a world economy characterised by falling transportation and communication costs as well as a larger number of countries which open to world markets. The economic opening up of the PR China in the 1980s and the former socialist eastem Europe, including the Soviet Union, has created a set of new players, which are gradually also becoming active members in international organizations. The larger number of open countries and rapid growth of foreign direct investment are leading to more intensive competition in worl markets. In the face of declining profit margins in markets for standardized goods, firms in OECD countries and NICs are turning towards more product differentiation and intensified process innovations. R&D expenditures are thus increasing worldwide. At the same time the end of the Cold War has led to a slight reduction in public R&D in the largest countries - mainly at the expense of military R&D.

As this intensified price competition stimulates the international race for innovations, the policy framework for R&D is becoming ever more important. Similarily, the organization of invention, innovation and diffusion as well as the financing of risky innovations are gaining in importance. One major issue at the level of the EU is whether national governments and supranational bodies are devoting sufficient ressources to innovation. Since only a few Community activities are directly related to R&D, R&D policies in western Europe currently fall in the realm of national policymaking.

In the case of the business community it is clear that the single market and disappearance of politico-economic borders within the EU has reinforced pressures to exploit scale economies and differentiate products. The internal market as well as the future monetary union create a high degree of market transparency which should stimulate firms to modernize equipment and output baskets as well as to exploit new opportunities to upgrade products and technologies. Modem communication technologies facilitate the integration of knowledge, know-how and new research results within an international team approach. Thus research is becoming more international, and international cooperation is gaining in importance - not least for small and medium-sized companies. In the case of western Europe the general tendency of mcreasing internationalization is reinforced by the opening up process of eastern Europe and Russia.

International trade in technology is still limited, as is well known in the literature. Since patent protection in the world economy is rather incomplete both fiom a legal and a practical perspective, innovative firms are rarely interested in selling licenses but rather try to establish a majority-owned (or fully owned) subsidiary. Multinational companies (MNCs) increasingly turn to license swaps, where both firms involved are equally vulnerable to opportunistic behavior. Effective patent protection depends on the length of the innovation cycle. In many industries innovation cycles are becoming shorter, so that the pace of the innovation race itself is protection for innovative Schumpeterian firms. Innovative firms have a strong interest to recover the largely fixed R&D costs by selling large amounts of the new product. Given the long term increase in the ratio of R&D to GDP in all major OECD countries and in most NICs, it is clear that the pressure on innovative firms is rising to become succesSll exporters in more and more countries. In the era of global competition it is important to recover high R&D expenditures as well as exploit scale economies - often in combination with product differentiation.

Intensified global competition means pressure to accelerate structural change and impulses for R&D specialization. It is unclear to which extent western Europe's economies will successfully face these challenges. Reduced labor mobility in Europe and high unemployment rates have raised adjustment costs and reinforced resistance against flexible change and optimal specialization. The low capital productivity in Germany and several other EU countries in comparison to the US not only raises doubts about the functioning of labor markets in Europe, it also puts in question the efficiency of capital market. Stock markets on the Continent are notoriously underdeveloped compared to the US, while disclosure standards are rather poor - above all in the case of limited liability companies in Germany. These factors distort signals to investors in capital markets. Government ownership and public procurement is also likely to distort capital allocation in many EU countries. At the same time it is clear that the single market plus monetary union will create a very high transparency in all markets.

The intensified global technology race raises the question about the direction of the internationalization process and the role to be played by multinational companies on the one hand, and national and supranational governments on the other hand. As other countries are catching-up vis-a-vis western Europe there is a need to intensify R&D policies in the EU and to refocus many innovation projects in industry and the service sector. There are also important theoretical questions with regard to high technology policy, both at the national and the EU level. Moreover, it is necessary to compare R&D policies adopted in Europe, the US and Japan, and to study new opportunities for international cooperation as well as to highlight future policy options for EU countries. Meaningful policies will not only have a technological impact but should also contribute to solving the EU unemployment problem to some extent and to reinforce the international competitiveness of EU firms.

1.1. Rising International Trade

Import penetration and export coverage in the manufacturing industry of OECD countries have been growing continuously during the 1970s and 1980s, with growth accelerating in the 1990s (Tab. A1). The export share in industry has increased in the US and other OECD countries, whose exports partly represent exports by US foreign subsidiaries. It is indeed remarkable that the share of the US in world exports is gradually declining while that of US multinational firms has remained relatively constant. Trade increasingly represents trade in upstream inputs (Tab. A2) and international exchange of differentiated products - reflecting a rise in intra-industry trade (Tab. A3). The rise in trade is, therfore, less conflict prone than in the past, during the era of dominant inter-industry trade where the expansion of some sectors was accompanied by the elimination of sectors in which other countries' firms had a comparative advantage. The high share of imported intermediate inputs in some countries implies that the trade in finished products is highly dependent on an open trading system which facilitates the exploitation of specialization gains and economies of scale.

As regards trade, globalization shows clusters of regional trade flows, where the EU dominates in western and eastern Europe, the US in the Americas, and Japan - together with the US and China - dominates in Asia. Until the financial market crisis in 1997, the Asian NICs were characterized by robust growth. But the need to correct overvalued exchange rates and excessive asset prices will impair prospects for high growth in the medium term. As was clearly evident in the Asian crisis, insufficient competition within the banking system and the absence of efficient prudential supervision

can cause serious regional instabilities and uncertainties which particularly impair long term investment and innovation.

1.2. The Increasing Role of Foreign Direct Investment

Capital Flows

International portfolio capital flows increased strongly in the 1970s and 1980s (Tab. A4), leaving countries vulnerable to sudden reversals in capital flows and to external interest rate shocks. Foreign investment also rose in the 1980s, with foreign direct investment outflows largely dominated by the US, the UK, Germany, France, the Netherlands, Switzerland, Canada, Italy and Belgium. As regards portfolio investment outflows as well as inflows it possible to discern a series of regional shifts and, sometimes, sudden changes in response to anticipated devaluations or major policy problems. Foreign direct investment inflows have concentrated on OECD countries and China, and, only recently, on eastern Europe and Russia.

While the growth rate in trade among OECD countries exceeded that in foreign direct investment flows in the 1970s (18.9% p.a. compared to 15.9% p.a.), the 1980s showed a different pattern. The growth rate in foreign investment reached 16.3. p.a., which was clearly above the 6.2% in OECD trade growth. The growth rate in foreign direct investment is likely to exceed that in trade in the 1990s, since eastern Europe's transforming economies increasingly attract foreign direct investment. While it is true that east-west trade in Europe is growing at high rates, one cannot overlook that within eastern Europe trade diversion or only modest trade creation is occurring, so that overall trade growth rates for eastern Europe could indeed fall short of those in foreign investment flows. *Given* the high growth in global FDI flows, roughly amounting to $300 bill. p.a. in the late 1990s, one may expect a fist increase in the stock of FDI, which reached some $2700 bill. in the mid-1990s (UNCTAD, 1996).

Foreign investment by multinational companies represented in the late 1980s an investment output ratio of about 1% (Tab. A4), which is more than 1/10 of all investment in machinery and equipment in OECD countries. Compared to the 1970s this meant a doubling in the MNC's share of gross fixed capital formation (OECD, 1996) Moreover, multinational companies are among the top users of advanced software, which represents non-physical investment from an economic perspective. As regards productivity growth expenditures on software - together with purchases of computer equipment - are quite important for economic growth.

MNCs will benefit from falling international telecommunication costs which are expected as a result of early liberalization in the UK and the Scandinavian countries as well as due to the general post-1998 liberalization in EU member countries (WELFENS/GRAACK, 1996; GRAACK, 1997). The international dissemination of technological know-how will be facilitated and accelerate innovation cycles. Rising foreign direct investment in combination with cheaper advanced telecommunication networks will intensify the global technology race and intensify locational competition among EU countries. Few observers consider the rapid rise in global FDI as only a minor problem for leading EU countries (HÄRTEL et al., 1996).

Foreign direct investment inflows only occur if attractive locational conditions (in economic terms) and political stability exist in host countries. Under such circumstances, FDI inflows can make an

important contribution to the restructuring of the economy, structural change and employment growth (WELFENS/JASINSKI, 1994). As regions of high medium term growth, Eastern Europe and Asia can, be expected to attract high FDI at the turn of the century, while the US and the EU will continue to be the main source and host countries of foreign investment. Japan still is mainly a source for foreign investment. But the need to overcome slow growth might require Japan to reconsider its policy stance vis-a-vis foreign investors, who sometimes complain about a hardly receptive host country environment. Indeed, in the era of globalization of the economy - with a higher technological specialization of countries - it can be to the disadvantage of a country if it cannot attract sufficient foreign investment inflows from a diversified source basis.

From a source country perspective it is important that firms have ownership specific advantages, which are mainly rooted in advanced technology, and that the firms' internal international exchange of services is superior to arms-length transactions via the market which is associated with higher transaction costs. The case of telecoms operators provides an example of a sector in which high technological dynamics are observed and where ownership specific advantages are naturally important. Moreover, the recent wave of privatizations in western Europe has removed the political restrictions on EU telecoms operators' ability to invest abroad. Furthermore, one may take into account the rapid emergence of international alliances in telecoms operation, which is leading to a high degree of international oligopolistic interdependence and in turn stimulates waves of foreign direct investment outflows (KLEIN/WELFENS, 1992; WELFENS/WOLF, 1997). New forms of international cooperation which do not involve full foreign ownership are particularly interesting in this context. Subcontracting, international alliances and joint R&D projects are among the important developments.

The enormous importance of MNCs for economic development is due to the firms' large size and high technology intensities - except in some sectors (e.g. food industry, furniture, agriculture). Furthermore, international trade in the case of leading OECD countries conists largely of intra-industry trade - roughly up to 1/3. In the period 1983-92, 43 % of EU-US trade was intra-company trade (OECD, 1996, p. 30). For all these reasons MNCs are crucial for economic growth. Moreover, MNCs have extended networks of supplier firms which depend on the survival and expansion of MNCs. This is not to deny the important role of small and medium-size enterprises which dominate employment in all EU countries. As regards R&D policies the international presence of MNCs allows such companies to critically compare alternative policy approaches and to shift investment and innovation projects to those countries which are receptive to the requirements of technology-intensive firms. Comparing alternative locations will become even more important after the introduction of the Euro since this will create unprecedended transparency with respect to costs and prices in Europe. The marginal investment decisions of MNCs will certainly be influenced by economic policies in alternative location countries. This could lead to some problems for the smaller innovative firms in Europe insofar as the rising pressure of large companies might bring about a decline in the share of public R&D funds allocated to small and medium-sized firms.

1.3. Global Telecoms Networks and New Communication Technologies

Rising trade in goods and services as well as intensified foreign direct investment imply that the global innovation race is intensifying in the economic field. Product innovations typically are relatively expensive and introduced in high income countries first where only a minority of affluent households

often will be the pioneer users. Such households often are trendsetters for innovative products which gradually will be adopted by broader strata of society. However, as the production process becomes more standardized and logistical demand patterns bring about a wider use of the product innovation in leading OECD countries, prices start falling. The novel product is exported to countries with medium per capital income, and often production is also relocated towards such countries in later stages of the innovation cycle when the home market increasingly will be served by imports fiom abroad. This pattern of the product cycle trade is likely to intensify as modem telecommunication technologies and improved education and training in NICs facilitate the worldwide relocation of production.

With privatization and deregulation oftelecommunications in the EU - the starting date for the latter being 1998 for voice telephony and network opeation - and the further liberalization of telecommunications m the US and Japan m 1997 there are favorable prospects for the telecoms sector to quickly become a global industry with high technological dynamics. System integration in combination with internationalization on the one hand, incorporating latest computer technology on the other hand are the main challenges here. Multinational companies get fiom large international telecom operators or consortia "one-stop shopping" and increasingly use the telecom network to learn about market and technology developments worldwide (WELFENS/GRAACK, 1996; WELFENS/YARROW, 1997; GRAACK, 1997).

The main global alliances are Global One (headquarters in Brussels) which consists of Deutsche Telekom, France Telecom, and Sprint of the U.S.; Concert, which is composed of BT, MCI of the U.S. and Telefonica (plus the dominant Portuguese operator); and WorldPartners, whose stakeholders are AT&T (40%), the Japanese KDD (24%), Singapore Telecom (16%), and Unisource NV (20%). Unisource NV m turn represents Swiss Telecom, the Dutch KPN and the Swedish Telia. It seems that alliances are not very stable. Cable & Wireless Communications (formed in 1996 by the merger of MCI and three cable TV companies) and NTT constitute two major companies that are still non aligned, and there are new firms ready to challenge established alliances, such as Equant and WorldCom fiom the U.S. WorldCom launched a succesful bid to acquire MCI which had already been envisaged for full takeover by BT having a 20% stake in the US company. The development of Concert thus is uncertain but there is little doubt that besides niche players in the telecommunication market large multinational companies with a global strategy will dominate international markets.

Competition in telephony is developing worldwide via alliances and foreign investment. Foreign investors take advantage of liberalization and privatization. Restrictions in technology trade have been lifted after the end of the Cold War and higher investment in telecommunications is undertaken in eastern Europe as well as m NICs and LDCs. This will lead to improved international communication opportunities for firms fiom low income countries, which will also have easier access to foreign know-how and knowledge - mainly via internet and new virtual partners. Privatization introduces pressure fiom capital markets and hence stimulates competition. Market entry by newcomers has a similar effect (Fig. 1). In a more internationalized and competitive environment telecom operators have a strong incentive to increase R&D and become more active in patenting.

The telecoms network is a crucial part of the overall infrastructure and a powerful basis for linking firms and households in a way that allows fast communication and data transmission. Telework and telelearning are interesting options for increasing flexibility and productivity in the information

society. Indeed, empirical evidence shows that telecommunications currently account for a considerable part of economic growth in Germany (JUNGMITTAG/WELFENS, 1996).

While traditional telephone networks establish a dedicated connection between the two parties of a telephone conversation, the internet uses flexible routing for digitalized packages of communication data (voice gateways and service providers which use leased-line capacities are required for internet telephony.). The U.S. newcomer Global Link will offer internet-based telephony already in 1997, Swedens Telia will follow after 2000, and many dominant operators are likely to follow suit as the quality of transmission improves and internet telephony becomes cheaper.

International alliances mainly offer their service to multinational companies that require one-stop billing and a seamless network. It is even conceivable that global virtual networks will emerge where the operator does not own a network but combines leased-line capacities worldwide in order to provide services for major customers. The global telecoms market reached about $700 billion in 1996 and could reach almost $1,000 billion by the turn of the century. Since about 90% of global revenues still come fiom national telephony, one may anticipate that even global alliances will have to establish a firm foothold m national markets and their corresponding customer bases. Eastern Europe's markets will become fully open for foreign investors only after 2002.

With domestic markets becoming open to foreign investors, the typical west European national operator reacts to the coming inroads of foreign network operators by entering foreign markets itself: The mutual invasion of markets m western Europe will reinforce competition across European countries; it is likely to bring down the prices charged by traditional network operators as they become more efficient and innovative technologies are introduced ever more rapidly under the pressure of competition and foreign investors. If the intensity of competition in EU countries were to rise while that in eastern Europe were to stagnate, there would be poor prospects for economic convergence in the whole of Europe.

1.4. Russia and China as New Players

Russia

With systemic transformation and economic opening up in the former USSR, Russia is a new player in the global market of civilian R&D. The former Soviet Union had before 1991 about 4500 R&D institutes, of which some *550* belonged to the Academy of Sciences and focused mainly on basic R&D and military innovation projects. The other R&D institutes were primarily branch institutes under the supervison of the respective ministry and conducted applied research. About 1100 of the branch institutes were privatized in the course of systemic transformation but often find it difficult to Survive on their own m the new market environment characterized by very slow economic growth. The Russian federal government has designated 60 top state research centres which can expect solid government support, and it has earmarked 41 priority objectives for R&D, including high-energy physics, fusion power, high-temperature superconductivity, genetics, bioengineering, space exploration, environmental friendly power generation and industrial processes, and technologies, machines and ''industries for the future''. Government financed R&D fell from 1.9% of GDP to roughly 0.6% in 1995 and increased slightly in 1996. It is expected to reach the US figure of about 0.8 by the end of the century. While there is no doubt that Russia has a pool of excellent scientists, few institutional adjustments have occurred which would allow high-quality research to be translated

into process innovations and profitable novel products for domestic and international markets. In Russia foreign firms employ researchers and programmers as subcontractors, but Russia still has to become a normal partner for foreign investors. This can be achieved only if Russia is characterized by macroeconomic stability, institutional adjustment, political stability and the rule of law - which is a formidable list of requirements. It is in the EU's interest to support the transformation process in Russia.

China

The PR China has decided to strongly increase R&D in the future and has, therefore, adopted a series of modernization measures (IWD, 1997, No.3). Government declared that it intends to catch up with leading western countries by the year 2010, namely in fields such as telecommunications and information technology, biotechnology, space flight and research on energy and new materials. From a ratio of R&D expenditures to GDP of 0.5% in 1995 the ratio is to reach 1.5% in 2000. This is still half a percentage point lower than the EU average was in the mid-1990s. In 1993 China employed about 2.4 million people as scientists and researchers. Among these were 1.5 million engineers and scientists. On a full-time basis the number of people working in research and development amounted to 650 000, about 1/3 above the figure for Gexmany.

The PR China has launched a national program for high technology research and development. Some 13000 researchers will be involved in this program which represents some $ 1.8 bill. With the help of the 'Torch Programme" government intends to accelerate the diffusion process and has therefore decided to support about 12000 high technology firms which have about 800 000 employees. R&D expenditures increased by 50% m real terms in the period 1988-93 and reached some $ 17 bill. in 1993. Between 1986 and 1993 the share of high-technology products in China's exports increased sixfold and reached about $ 5 bill. China recorded 12 000 patents by domestic residents in 1993 which was double the figure of 1990. With ongoing structural change - people leaving the agricultural sector m order to move to industry or the service sector - there exist favorable prospects for a long term acceleration in Chinese rate of innovation. There are, however, three problems: (i) the federal budget faces serious problems with respect to funding; (ii) provincial authorities often follow a rather independent innovation policy so that it is difficult to achieve a coherent overall approach; (iii) the PR China suffers fiom an aging problem among its researchers and scientists and therefore has to broaden and rejuvenate its R&D personnel. China certainly will try to exploit its new location, Hong Kong, to convince expatriate Chinese researchers to return home - a difficult task m the presence of a natural brain drain on the one hand, and, on the other hand continuous political uncertainties and near-absence of the rule of law and respect for human rights in China.

While it will take time for R&D m Russia and China to develop a successful outward orientation there is little doubt that both countries could become serious contenders in medium technology and high technology in the long run. It is up to EU firms to use the new opportunities for cooperation and subcontracting. National governments as well as the EU Commission could stimulate the international exchange of researchers. It is clear that support for China's and Russia's research system could have a solid commercial pay-off m the long term since technology partners often also become commercial partners.

1.5. Increasing High Technology Competition and Rising Role of Trade and FDI

With improved international dissemination and increasing civilian R&D-GDP ratios worldwide technologically leading high-income countries will face pressure to move up the technology ladder, i.e. concentrate more on leading-edge and high technologies and accept that poorer countries specialize more in low and medium technologies. Multinational companies in EU countries thus will relocate specially labor intensive or weakly technology intensive production to eastern Europe, Asia, Latin America or Africa. At the same time firms fiom EU countries will try to control and reduce R&D costs by undertaking foreign investment in technologically leading partner countries - mainly the US, Switzerland, Israel, Norway, Australia and Japan (in the long run also in Russia).

For technologically leading countries increasing high technology competition will mean that investment in human capital building and software needs to increase at the expense of investment in machinery and equipment. At the same time innovative firms from high technology countries will face specific risks in the sense that higher R&D (plus software) investment means relatively increasing sunk costs. With shortening innovation cycles and intensifying import competition there are higher investment risks than before. Firms in EU countries will react at the aggregate level with reduced levels of investment - broadly defined - relative to GDP unless other elements of uncertainty relevant for investment are reduced. With the European monetary union the exchange rate risk for firms with strong market orientation towards Europe will indeed decline. Using future markets in a better way and with prudent demand management policies - basically with a long term focus (not short-term Keynesian strategy) - demand uncertainty might also be reduced at the sectoral level which should stimulate investment.

To the extent that increasing national and international technology dynamics imply the creation of novel technology fields or reduced sunk costs - as in the Service sector - one may anticipate improved opportunities for new firms and newcomers from other sectors. Such newcomers are the more likely to emerge, the more high-quality innovations can be launched by integrating different innovation fields which traditionally were separated. Such newcomers also face better prospects if government standards, consumer preferences and relative price developments strongly favor expansion of so far underrepresented sectors. For example in the automotive industry computer and electronics have gained strongly in importance - measured in terms of the share in overall value-added - so that newcomers from these sectors might one day dominate at least some niches in the automobile market. If electrical engines could gain market shares, firms in the traditional automative sector might indeed become dominated by powerful firms in the electrical engineering sector, and other firms in the automotive industry would have to accept new firms of equal cooperation with innovative electronics firms which in turn would try to retain a larger share of Schumpeterian rents from intermediate products.

International R&D collaboration among OECD countries could become more important in the future as high technology competition will not only to raise the share of high technology exports but push countries to increasingly rely on imported high tech equipment and the use of international research networks. With sustaining globalization the international geography of R&D spillovers is also crucial. AUDRETSCH/FELDMAN (1994) argued that industries with knowledge spillovers, "that is where industry R&D, university research and skilled labor are the most important, tend to have a greater propensity for innovative activity to cluster than those in industries where knowledge externalities are less important" so that spatially-mediated knowledge spillovers are important. According to this

proximity hypothesis successll innovation in certain fields not only requires that firms are attracted to a given location but also that universities (and competition among universities) and research centers together with a pool of skilled labor are in place.

Globalization clearly is not only related to higher FDI but also to rising international trade. COE/HELPMAN (1993) provided evidence in favor of a trade-mediated hypothesis. Their econometric analysis for 22 OECD countries during 1971-90 showed that a country's total factor productivity is influenced by import-weighted sums of the trade partners' cumulative R&D spending levels as well as by its own "R&D capital stock". These spillovers are rather involuntarily and their importance on a global scale should increase with more and more countries opening up to the world economy: Regional economic catching-up of poorer countries thus should be accelerating, and the rising and high growth rates of Latin American countries and Asian NICs indeed seems to support this hypothesis.

There is also evidence on voluntary R&D spillovers in a multilateral setting (LICHTENBERG, 1995), namely that the EC's Eureka program has created significant positive spillovers. The analysis is consistent with the hypothesis of localization of R&D collaboration at the country level. The country analysis estimates are consistent with some patterns of crossnational patenting - this already was noted by SCHO'IT (1994) who argued that new technology increasingly is created by collaboration among inventors. The share of US patents that were "coinventions" - with patents issued jointly to several inventors - increased from 40.7% m 1975 to 52.5% in 1991. The analysis of LICHTENBERG showed also that the optimal firm size necessary for commercialization exceeds that necessary for applied research and development. Taking into account globalization this could imply that the optimum firm size for commercialization has increased. Hence, one should expect a wave of national and international mergers and acquisitions.

With international trade and international M&As are becoming more important for optimal innovation and diffusion, so that the role of international organizations responsible for smooth trade and international investment relations is increasing in importance. Moreover, *given* the rising global integration of financial markets and national economies, there is a rising negative externality risk associated with imprudent national economic policies (e.g. exchange rate policies, banking supervision). Multilateral surveillance thus should be strengthened and at least the range of economic indicators published by international organizations - data to be provided in due time by member countries - should be widened.

One might also have to consider options to improve the functioning of international organizations. Their decisions should be transparent - ie. be mainly guided by rules and clear policy principles - and efficient (based on a cost-benefit analysis), consistent and speedy. The latter is necessary especially for *crisis* management. Since international organizations should be active only where one is facing the problem of providing an international public good - which could apply to several countries or, as an extreme, to all countries (e.g. global warming problem), it might be useful to have regional and global organizations. Applying the principle of subsidiarity would require that regional international organizations tackle problems first, except where global externality problems are an issue. It also is clear that the governance of international organizations is often a problem, *given* the diversity of member countries and the manifold conflicting interests. International leadership is therefore useful. The US assumes this role in many international organizations, although in 1997 the reluctance of Congress to grant fast-track authority for trade negotiations to president Clinton indicates that even

the US faces some problems in leadership. The EU could also assume leadership in some fields, but as long as many EU countries face high unemployment rates, especially high long term unemployment rates, the looming internal political conflicts erode the EU's potential for international leadership. To the extent that successll high technology and growth policies of EU countries contribute to full employment in western Europe the EU could become a more active and credible partner in international leadership. Such leadership is at a premium in the world economy, since Japan and Russia have serious problems and hence Asia and eastern Europe could face negative external economic or political spillovers. EU investment m the improved international R&D cooperation might thus result in a double dividend: It could raise growth m the EU and help to stabilize the international system.

1.5.1. Multinational Companies: Regional Concentration and Issues of Innovation

The 1980s were characterized mainly by rising foreign direct investment within OECD countries (STEHN 1992; JUNGMITTAG 1997). The supply in US and many EU markets is based on local production. As regards US firms there is a tendency to serve world markets increasingly via exports of foreign subsidiaries and to rely less on exports of the parent company: The ratio of subsiaries' exports to overall company exports increased from 37.5% in 1966 to 56.4% in 1991 (MCGUIRE 1995, p. 128). While US and Japanese MNCs pursued an international diversification strategy in the choice of the location of subsidiaries, British, French and German firms reinforced geographical concentration, namely on Europe (Tab. A5). What holds for FDI outflows also holds here for FDI inflows. It remains to be seen whether EU intraregional FDI concentration is a temporary or a more long term phenomenon.

As regards individual industries one may note that international relocation of production and other company activities is rather easy except for a few exceptions in immobile "Schumpeter industries" (KLODT et al. 1994). As Schumpeter industries one may dubb those with a high technology intensity. They are mobile in technological terms if R&D and production can be uncoupled in space. By contrast, immobile Schumpeter industries require the continuous cooperation of R&D and production - such as in the aerospace industry - which implies very limited options for dislocating production activities to low income (and low wage) countries. This holds as long as one can assume that top research capacities are only available in high income countries. The obvious exception is Russia but foreign direct investment in this *country* markedly increased only in 1997. Foreign investors complain about legal uncertainty, weak patent protection and the absence of Russia in the European Patent Agency.

The share of foreign enterprises in manufacturing production and employment has increased in the 1980s (Tab. A6) where Canada and Ireland reached top figures of about 50 and 40%, respectively, in 1988. France, the UK and Italy recorded figures of around 20%, Germany a much lower figure of around 10% in the late 1980s; worse, the share of foreign enterprises in terms of production and employment declined in the 1980s. This is remarkable during a period in which worldwide FDI strongly increased. One may notice, however, that FDI growth worldwide was particularly strong in services and m the provision of infrastructure where governments in Europe, Asia and Latin America adopted strategies of liberalization and partial or full privatization in the 1980s.

Research also became more internationalized m the 1980s (Fig. A7). Compared to the UK, Germany and France could still strongly raise the share in patents of domestic companies, where the invention

took place abroad. This could imply losing well-paid jobs in Europe, probably in favor of the US whose efficient and diversified university system is quite attractive to EU firms seeking R&D inputs from abroad. This option is all the more interesting because the US offers a link to a growing dynamic home market. Oligopolistic interdependency could stimulate many EU companies to follow sooner or later the example of industry leaders which established expanding R&D activities in the US early on. The high share of foreign companies contributing to patents in the host countries Germany and France - probably also Italy - could still strongly increase the international division of technology development. This would require that major EU countries become more attractive for technology oriented MNCs fiom abroad.

Given the bank dominated financial markets on the continent (Tab. A7, A8) one may doubt whether there are large unexploited opportunities for foreign investors to acquire firms. The British system which is based on stock markets and opportunities for hostile takeovers is more receptive to foreign investors and also more flexible in adjusting the industrial and services landscape in response to changing international conditions. This could be a major advantage for the UK (and the US) in the era of globalization - with intensified pressure for structural change - and should encourage other EU countties to study the virtues of expanding the role of stock markets. For technology-oriented firms access to stock markets is vital and the expected global high technology race favors countries where firms can build up a sound equity capital base (WELFENS, 1997).

1.5.2. Competition, Skill Requirements and Labor Markets in the US

This section addresses the growth in skill differentials at a time when there has been a growth in the share of the skilled workforce, or, equivalently, the phenomenon of (somewhat) increased unskilled worker unemployment at a time of falling unskilled worker relative wages. This particular concatenation of events is not confined to the U.S. (as we shall see, the U.K. experience is rather similar) but clearly does not obtain for major continental European countries (e.g. Germany).

The increase m the premium for skill workers at a time when the share of the workforce with higher qualifications has increased is not really controversial, but it is prima facie consistent with two different demand-side forces: industrial change on the one hand and technological change on the other. And this is where the controversy resides. Industrial/sectoral change would include such factors as heightened international trade and the growth of the service economy, while biased technological change reflects pervasive skill upgrading across all sectors, resulting from an increase m skill complementarities and/or an increase in technological change.

Much U.S. research work has been devoted to establishing which influence - sectoral (or between-industry) demand shifts on the one hand, or within-industry movements on the other - is the more important source of the increased demand for skilled labor. (See the surveys by LEVY and MURNANE, 1992; BURTLESS, 1994; RICHARDSON, 1995.) The standard approach has been to decompose the aggregate change in the structure of employment, as follows:

$$\Delta E = \sum_{i=1}^{N} \Delta S_i \overline{E_i} + \sum_{i=1}^{N} \Delta E_i \overline{S_i} \qquad (1)$$

where ΔE is the aggregate change in employment share, $E_i = X_i/L_i$ is the share of group X in industry i employment; $S_i = L_i/L$ is the share of industry i in total employment; and where the bar

operator signifies a mean over time. The first term on the right hand side gives that part of the change in aggregate employment that is attributable to to between-industry shifts in employment among branches with different skill intensities, while the second term identifies the contribution of within-industry shifts.

Table B1 provides estimates of the two component magnitudes using data for both U.S. and U.K. manufacturing. The U.S. study by BERMAN et al. (1994) covers no less than 450 four-digit industries, while MACHIN's (1996) British study is for a smaller sample of 100 three-digit industries. In both cases, the "dependendent variable" is the change in the employment and wage shares of nonproduction labor.'

On the basis of the table, it appears for the U.S. that there has been a long-term shift away from production labor. Thus, using the employment share measure, the shift toward nonproduction labor was at the rate of 0.069 percentage points per year in the earliest period, increasing to 0.299 points per year in the intermediate interval and to no less than 0.552 points per year in the most recent period. As can be seen, similar results obtain when using the wage share.

As for the decompositions proper, both studies indicate that the within-industry movements dominate the between-industry changes. This is particularly obvious in the British case: the percentage contribution of the within-industry component to the total change is is 82.0 percent for the employment share and 82.9 percent for the wage bill share. For the U.S., the corresponding values for 1979-87 are 70.1 and 60.5 percent, respectively. Moreover in the U.S. case there are clear signs that the within-industry component accounts for the bulk of the acceleration in the share of nonproduction worker employment between the 1970s and the 1980s.

On this evidence at least, the suggestion is one of pervasive skills upgrading rather than sectoral shifts that might be associated with international trade or deindustrialization. Further historical perspective is added in a recent study by JUHN and MURPHY (1994), who construct demand indexes for a wider range of skill groups. The indexes measure the percentage change in the demand for a particular skill group (the five quintiles of the wage distribution) as a weighted average of percentage changes in employment shares of different industries and occupations, where the weights conform to the group's initial employment distribution across these industry and occupational categories. (Note that the indexes are adjusted for relative wage changes, without which there would be understatement of demand shifts in groups with rising relative wages.)

It is shown that the relative demand for workers in the highest quintile of the wage distribution grew faster that the demand for the bottom quintile in the 1940s than in either the 1970s or the 1980s. In short, there is nothing new about demand shifts in favor of skilled workers. What is new, however, is the changed relation of the between- and within-industry components. In particular, during the 1980s the within-industry component accounted for the entire (11) percentage point differential in demand growth between the highest and lowest quintile workers. In the 1940s, by contrast, the Within-industry component accounted for just 6 of the 15 percentage point change in relative demand for skill. That is to say, the within-industry component has accelerated in the 1980s. JUHN and MURPHY (1994,358) conclude that "factors such as changes in product demand and international trade had only minor influence during the 1980s." Instead, the facts are consistent with labor-saving (i.e. biased) technological change.

Tab. B2 presents some beginning- and end-period summary statistics from the above study. The table also reveals that there has been some hollowing out of the income distribution; that is, a decline in the demand for those in the middle quintile. This is another stylized fact of the U.S. income distriiution. But, more importantly, the authors infer fiom these facts that there has been "a growth in the demand for the type of skills that are more inelastically supplied in the economy" (JUHN and MURPHY, 1994,357).

JUHN and MURPHY also briefy examine changes in the relative supply of skill over their sample period, concluding that such changes cannot account for differences in the growth of wage inequality; for example, the growth in the relative supply of skill was slowest of all in the 1940s. But a more compelling analysis of the supply side is offered by BLACKBURN et al. (1990), who seek to explain the deteriorating position of high school dropouts and high school graduates using a conventional demand and supply fiamework. On the demand-side, a shift-share analysis of the change in average wages received by less skilled workers is used (supplemented by a logarithmic earnings regression model with year dummies). This reveals that between 70 and 80 percent of the the increase in the earnings gap between high school dropoutdgraduates and college graduates over 1979-87 occurred within industries, again underscoring the relative unimportance of changes in the allocation of labor across industries.

The authors next attempt to ascertain the contribution of supply-side factors as well as institutional factors (specifically, minimum wages and declining unionization) to these within-industry shifts. The supply side analysis focuses on shifts in the relative supply of workers with different educational qualifications. BLACKBURN et al. first examine the increase in the differential between college trained and high school dropouts/graduates between 1979 and 1987, assuming there were no shifts m relative demand. Despite the growth in the proportion of college graduates in the workforce, the ratio of college educated among those aged 25 and 34 actually declined after 1979. The suggestion is then that part of the increase in the observed differential(s) after 1979 could be due to this falling supply of young college graduates. And it is found that the decline could explain up to 30 percent of the growing differential of college educated younger workers. In other words, this amount of the differential potentially attributable to shifts in relative demand is in fact due to a supply *shift*.

Next, assuming that the rate of increase m relative demand was the same m the 1980s as in the 1970s (when the differential was fairly stable despite a sizeable growth in the college educated population), the authors estimate how the slowed growth m the relative supply of college educated workers in the 1980s contributed to the change in differentials between the periods 1979-87 and 1973-79. It is reported that the deceleration m the the growth of college educated manpower can explain much but by no means all of the increase m the growth of the wage gap. In other words, the suggestion is that shifts in relative demand in favor of the college educated accelerated in the 1980s.

Lastly, BLACKBURN et al. report that although the effect of (declining) minimum wages had minimal effects on differentials, the 13 percentage point fall in union density may have contributed up to one fifth of the drop in relative wages received by low skill workers during the decade of the 1990s.

The interest of this study is twofold. First, it is able to demonstrate that an accelerated shift in demand favoring more skilled workers and a reduced growth in their relative supply combined to increase wage inequality in the 1980s. Second, in the process it quantifies within a unified fiamework the

contributions of a number of factors making for declining wages among the unskilled. That analysis while clearly supportive of biased technological change does not accord it exclusive domain.

We now return to the interpretation of the dominance of within-industry over between-industry shifts in explaining changes in the structure of U.S. employment and in wage inequality. As we have noted, the conventional view is that biased technological change largely underpins these developments. This view is on balance shared by the labor and trade literatures.[2] But the biased technological change argument has not gone unchallenged. Much of he criticism has focused on the point that the evidence is actually less supportive of the biased technological change *story* than it is destructive of the alternatives. In other words, there is an absence of direct evidence favoring the technology hypothesis. This is sometimes referred to as the "labeling problem," namely, that "biased technological change" is a label for our ignorance. This problem is attenuated though by no means eliminated (not least because the skill requirements embodied in specific technological advances are unobserved) in several new studies that seek to proxy technology. These studies are reviewed in section 2.5.

The technology explanation is that autonomous changes in production methods have caused changes in relative demands and hence factor prices. A second line of criticism has focused on this assumed exogeneity. Might not technological change be caused by factors such as deregulation? If so, one has to be wary of attributing changes in wages and employment to technology. Ultimately, the argument may be widened to include trade itself, although there are few signs to suggest that trade does in fact stimulate productivity gains (Scherer, 1992). (A related issue is that major changes in technology may have followed rather than led changes in employment.) A third criticism is that the data analyzed typically pertain to manufacturing. Is it safe to deduce economy-wide effects fiom results that largely relate to manufacturing alone?

We will return to criticism of the biased technological change argument below (section 2.5). In the interim, we have first to consider differences in labor market responses between the U.S. and (continental) Europe. The conventional representation is that wages are inflexible in Europe and conversely in the U.S. Thus, technological change (or increased trade) that shifts demand away fiom unskilled labor translates into quantity adjustments in the former and price adjustments in the latter. An initial observation in this regard is that unskilled worker unemployment has also risen in the U.S. Thus, for example, TOPEL (1993) finds that nearly all the increase in unemployment between the peaks of 1967/68 and 1987/89 has fallen upon unskilled individuals. The number of weeks unemployed among those in the lowest decile of the wage distribution rose by 3.7 weeks as compared with 0.2 week for those in the top four deciles. At the same time, the change in log wages for those in the lowest decile was -0.30 as compared with 0.04 for the top four deciles. These are the facts of market clearing in the U.S.

Next, turning to the European situation, do wage inflexibilities lie at the heart of the matter? Answers to this question hinge on two issues. First, is the relative *shift* in demand explanation appropriate to the European case? And, second, assuming that it is, what is the scale of the required flexibility. It should come as no surprise to learn that we do not know as much as we would like about either issue. In any event, on the former question, NICKELL and BELL (1995, 1996) argue that the demand shift away fiom unskilled labor is capable of explaining only a fraction of the overall rise in European unemployment from the 1970s to the late 1980s - 19 percent of the average rise in Germany, the Netherlands, and the U.K. Adverse neutral shocks are claimed to have assumed much greater importance than relative shifts in demand.[3]

On the second question, estimates of the substitution elasticity between between skilled and unskilled labor in Germany, reported by STEINER and WAGNER (1996), suggest that reductions in relative earnings on the U.S. scale would have countered the trend decline in unskilled worker employment (partly indexing biased technological change), if not actually restoring past employment levels. By the same token, the fall in the employment share of unskilled workers due to an inflexible wage structure per se is modest.

Finally, we turn to manpower projections for the U.S. Official forecasts up to the year 2005 show not only above-average growth in occupations that require a bachelor's degree or other postsecondary education or training but also above-average employment growth for many occupations requiring less formal education (SILVESTRI, 1993). For example, the number of operators, fabricators, and laborers is expected to increase by 1.6 million, or 10 percent. This is to be sharply contrasted with German projections that point to a 50 percent decline in unskilled worker employment by 2010 (TESSARING, 1994). The U.S. estimates of changes in occupational employment have been broken down into their industry shifts component on the one hand and those changes resulting fiom the changing occupational structure of industries on the other. For major occupational groups, most of the change is attributed to projected changes in industry employment. This is especially true for the service occupations. Only in two (out of 9) broad occupations - administrative support workers (including clerical) and professional specialty occupations - are significant shares of employment changes attributable to expected changes in the occupational structure (SILVESTRI, 1993, Table 7).[4] There is the suggestion of some dissonance between official manpower forecasts and the notion of accelerating technological change story, although it should be noted that technological change underpins official estimates of both industry employment shifts and occupational structure changes.

1.5.3. Environmental Problems, Innovation and Optimal Global Growth

A problem associated with globalization and rising foreign direct investment is that govemments in OECD countxies increasingly hesitate to raise the prices of natural resources in a way that is necessary for inducing an efficient factor allocation. If emission-intensive production is relocated fiom OECD countries to soft countries among NICs and LDCs which then raise their exports to the OECD massively, the environmental aspect of higher foreign investment is that higher capital mobility undermines efforts to internalize negative external effects of production. From a theoretical point of view there exists a need to estimate the negative external effects of all production and consumption in order to determine appropriate Pigou taxes. In the field of international resource taxation some minimum international coordination will be necessary if any effective Pigou taxation is to be imposed. One might, of course, also discuss alternative instruments, such as trade in emission certificates.

The increasing global output growth and the continuing growth in international trade contribute to national and global environmental problems. Emissions and discharges represent negative external effects so that one should employ models of endogenous growth with negative external effecs (GRADUS/SCHMULDERS, 1993; BOVENBERG/SCHMULDERS, 1993). These models do not take into account the additional aspect of R&D and its impact on growth and sustainability - a problem which is covered m an innovative paper by BRETSCHGER (1997a, b,c). His main focus is on the link between a growing stock of knowledge which partly substitutes for natural inputs, namely in one or n-sector models of growth. Various aspects of this substution process are analyzed in models of expanding goods varieties.

A one sector model is quite misleading because it cannot express the fact that an economy adjusts not only in terms of the factor mix in output but also in the sector mix where sectors use the inputs with different intensities. Hence BRETSCHGER (1997c) introduces a research sector in the model to generate knowledge capital and endogenous growth. The three sector model is quite useful, although simple in its setup: with R&D, traditional goods are produced under constant returns to scale, and high technology consumer goods are assembled from differentiated intermediate inputs. Interestingly, it can be shown that a decrease in the supply of natural inputs can even increase the steady state rate of growth. Incentives for pro-ecological substitution processes on the input side have to rely on the price mechanism in a market economy.

In EU countries industries and consumers often are opposed to rising prices of natural resources, and sometimes industry representatives point to the globalization challenge as an excuse for not pursuing ressource-saving technologies more decisively. Stricter environmental standards are criticized on the grounds that it would raise production costs, and that, as long as competitors do not impose stricter standards as well, it would put EU industries at a disadvantage. As a matter of fact higher prices for some natural resources are indeed appropriate in many cases and may induce innovations both in the technologically leading North and stimulate international relocation of production in favor of the South. It is clear that inflexibilities in labor and capital markets in the North - i.e. high structural adjustment costs - reinforce industry's resistance against stricter environmental policies. This holds even for the case where such policies would strongly emphasize support for environmental-friendly R&D. In this case few firms would benefit fiom "green R&D projects" while most multinational firms would need to adjust production, output mix and the firm internal international division of labor.

1.6. MNCs' Role for Environmental Policy and Social Policies

The role played by multinational companies in environmental progress is rather ambiguous in the medium term, but probably positive in the long run. Mobile real capital clearly implies that profit-oriented firms will try to relocate pollution intensive production to countries with soft environmental standards. If the goods produced under soft standards are then exported to the parent country we have a case of ecological dumping in a wider sense. In a strict sense this would only amount to ecological dumping if the host country allows foreign firms - e.g. in export processing zones - to have higher discharges than domestic producers producing for the home market. Given different national and individual preferences for a clean environment one should politically tolerate the mobility of real capital as long as minimum environmental standards are not violated and as long as international cooperation among govemments is not undermined. The positive impact of MNCs depends on the intensity of international technology transfers, which certainly is relatively modest in the case of foreign ownership restriction in the host country. The technological and ecological modernization of foreign direct investment could be reinforced by gradually removing barriers to foreign majority ownership. Majority ownership is the minimum requirement that technology intensive firms expect if modern technologies are to be transferred internationally.

Quite important for global technological development is the technology policy in major source countries of foreign direct investment. If govemments in source countries - leaders in technological development - impose strict environmental standards and use market-based instruments in environmental policy MNCs have strong incentives for pro-ecological technological progress. Given that within the international network of firms mainly proven technologies are applied, the divergence

between the standards/technologies applied by the parent company and those applied abroad will be limited. Hone assumes that there is a **maximum** range, the continuous upgrading of **environmental** standards **in** OECD countries is crucial.

Given the high growth rates in eastern Europe and many NICs global environmental problems are increasingly compounded by the economic success of countries catching up with OECD countries. While it is certainly important that EU countries do not impose arbitrarily trade restrictions **on** goods produced under *"dirty* environmental conditions", consumers nevertheless have a right to obtain adequate information. Countries could be assigned an environmental quality label - possibly differing between sectors or products - **so** that consumers can take into account implicit environmental standards when they decide to purchse goods. Information about foreign environmental conditions are a collective good fiom the perspective of all importers and consumers. Therefore govemments or international environmental agencies have a role to play m the creation of a certification procedure. **This** does not rule out that environmental rating of countries is organized by private firms or specialized NGOs.

What holds for environmental rating of countries could also apply to social standards. Countries should be encouraged to mtroduce social standard labels which indicate the degree to which **minimum** levels **in** social ***security*** have been achieved. Assuming that consumers fiom rich countries are willing to pay more for a good fiom a country with a favorable rating the poorer countries will have some incentive to introduce some social protection. Consumers are, of course, fiee to ignore ecological rating or social rating results.

MNCs contribute to the development of social security systems through the technology transfer effects and efficiency gains brought about by foreign direct investment: with higher economic output and higher tax revenues there are improved opportunities for govemments to develop some **minimum** social protection. At the same time it is clear that MNCs will view social security protection as a locational disadvantage to the extent that **it raises** labor and production costs, respectively. This could encourage high income countries with excessive social security systems to trim these safety nets.

It **is** clear that a basic level of ***social*** protection is productivity-enhancing since it allows young people to attend schools - **otherwise they** might have **to start** working at a **very** early age m order to pay for medical care for their ill parents - and since unemployed workers can take a longer time to search for a new job after being laid **off**. A longer search time (within reasonable **limits)** should facilitate the matching of labor demand and labor supply in a world with heterogenous labor.

Some critics have argued that the growing importance of MNCs will lead to much reduced corporate tax rates which m **turn** could force governments to reduce the level **of** social security protection. The **risk** of a downward spiral can be contained by international **minimum** standards which should be low enough to allow differentiated upgrading across countries and over time. **A** serious problem in the field **of** social security systems could be that the rise in the number **of** countries since **1990** leads to efficiency problems m international policy coordination and **m** supranational/multilateral organizations which are getting bigger and bigger. While there is some risk of a downward spiral one should not overlook that MNCs - i e. locational competition - also have economically positive effects by helping to avoid excessive ***social*** security systems. ***Given*** the poor organization of the taxpayers in most **EU** countries an excessive social security system - gradually developed under the pressure **of** political competition - can indeed be a serious problem in **OECD** countries with **high** per capita income.

There are various arguments which lead to the conclusion that globalization will create impulses in favor of the reform of European social security systems (WELFENS/HILLEBRAND, **1998).** International organizations could play an important role in setting international minimum standards.

1.7. Theory of Globalization: Trade and Growth Theory in a Technological Perspective with FDI

The fact that in the **1990s** a record number of countries were a member of the leading international organizations is *mainly* explained by political developments and the demise of the socialist system in eastern Europe. However, it also has to do with the visible failure of development policies in Latin America that focused on import substitution. The successll outward-oriented policies of Asian **NICs** certainly have encouraged the worldwide shift towards external economic liberalization. The direction of technological progress in the field of computer and telecommunication has also facilitated globalization in the sense that the creation of large multinational companies with a global presence - production on all continents - is not necessarily associated with an increasing degree of centralization in the economy. While the parent company will always assume some headquarter functions, several dozen subsidiaries abroad can be managed in a rather decentralized **fashion** provided that adequate communication technologies are employed.

Given the many imperfections of the market for information the gradual increase in the R&D-GDP ratios in **OECD** countries and **NICs** has encouraged an increasing number of firms fiom ever more countries to become multinationl companies. At the same time regional integration - e.g. in Western Europe - has created larger markets, which in some sectors has implied a larger minimum optimum plant size. **This is** stimulating international mergers & acquisitions. In the EU aggressive US investment bankers are also actively contributing to this development in the **1990s.**

A theory of globalization **still** has to be developed in full, but one may at least point out basic theoretical building blocks that can help explain globalization. Moreover, it is necessary to check to which extent the standard body **of** economic theory has to be revised. While there seem to be many necessary changes the adjustments in conclusions need not be equally encompassing.

From a methodolgical point of view the gravity equation is important in explaining rising international trade, but - suitably modified - it could be equally important for the analysis of foreign direct investment. New growth theory **also** is important for the analysis as it emphasized the importance of spillover effects and scale economies in technology intensive sectors and in sectors which are human capital intensive. Since foreign direct investment often occurs in clusters in certain regions, the new growth theory helps explain foreign investment developments in the **1980s** and early 1990s, which saw a rather uneven regional allocation of **inflows.**

Putting the main emphasis of globalization **on** foreign investment raises the question how traditional economic trade analysis changes in a world of trade *and* foreign direct investment. Following the **Dunning** approach to FDI the main basis for successll outward foreign investment is provided by ownership specific advantages, which typically are in the form of technological (or organizational) advantages. **A** conclusion to be drawn here is that in the case **of** economic sectors with FDI the level **of** technology differs between the home country and abroad. The standard Heckscher-Ohlin model,

therefore, is **no** longer valid as it is based upon identical (macroeconomic) production functions at home and abroad.

The standard neoclassical theory offers elegant models for a world without differences in technology levels - and without economies of scale and innovation. Even without international factor mobility there will be, according to this theory, equalization of relative factor prices across countries and ***finally,*** a convergence of absolute factor prices. This analysis can be slightly modified by taking into account the heterogenous labor **skills** as well as education abroad and at home. However, in reality the world is not neoclassical **in** this traditional sense. The global economy is characterized by product differentiation and scale economies as well as network effects **on** the demand side (the marginal utility of user C positively depends **on** users **A** and B also having access to the respective good, e.g. a telephone network). Taking this into account will lead to a more diverse set of models.

Some of the above challengeswere picked up by NELSON/WINTER (1982), who stressed the need for analyzing bounded rationality m a world with innovation and suggested an evolutionary paradigm. More recently new trade theory - emphasizing differentiated products, innovation and scale economies as well as transport costs - added new aspects (BRANDER/ SPENCER, 1984; VENABLES, 1985; HELPMAN/KRUGMAN, 1985), while still neglecting the technological dynamics of overlapping research fields (GRUPP, 1997). With economies of scale and innovation, ie. differentiated products, the neoclassical fiee trade doctrine has to be modified. It is still true that m a two country, two *commodity* model fiee trade will benefit both countries but the gains fiom fiee trade can be rather unevenly spread depending upon which product country I and II specialize in. The choice of product innovations and of technologies can influence the respective gains **fiom** trade.

Multinational companies have *hardly* been integrated mto traditional macroeconomic analysis. Foreign ownership creates a need to distinguish between gross national income and gross domestic product. GNP m a pure source country is ***gross*** domestic product plus profits accruing to foreign subsidiaries. WELFENS (1996) has emphasized that economic convergence m the sense **of** narrowing per capita GNP across countries cannot be expected if the internatinal distribution **of** industrial property rights is rather uneven. Assume, for simplicity, that the production functions abroad and at home are identical and of the Cobb **Douglas** type (with the output elasticity of capital equal to D, of labor equal to 1-ß). Furthermore, assume that the GDP m the two countries with equal populations is the same (Y at home = Y* abroad), but **all** capital at home and abroad is owned by the home/source country so that national income **of this** country amounts to Y+ßY. National income abroad is then **Y-ßY**. In the illustrative case of ß=1/3, this leads to a GNP per capita ratio of **2** for the home relative to the foreign countxy. In reality a more complex production function will have to be considered and foreign ownership of capital typically is a two-way phenomenon. Furthermore, traded goods are not homogeneous and trade balances will not always equilibrate. Without going into complex details the main message of globalization in the context of foreign owership and innovations is the following:

- Profits at home and abroad are needed to increase the firm's equity capital which in **turn** is required to finance risky innovations and investments. Countries which impose high income taxes and corporate taxes are likely to face locational shifts of major companies, which will opt for a higher share of production and R&D abroad.

- **Profits** will be higher the more Schumpeterian economic rents can be appropriated by innovative firms. Such rents crucially depend **on** product innovations, process innovations and first-mover

advantages in scale intensive industries. To the extent that government procurement falls on scale intensive goods large countries could have an advantage over countries with smaller home markets.

- First mover advantages in world markets are important especially in scale intensive sectors. This points for firms fiom all countries, especially the smaller ones, to the importance offiee access to foreign markets.

- The ability of a country to accomodate foreign multinational companies is crucial for economic growth and full access to the international trade network, part of which is intra-company trade. A hospitable legal fiamework for foreign firms is not sufficient to attract high FDI inflows, complementary factors also have to be available in relative abundance. Positive long term growth prospects plus political stability should be in place.

- The ability of a country to be a major source country of FDI is important ifthe country is to have access to global technological progress. With more subsidiaries located in technologically leading countries the parent companies' opportunities to tap the foreign pool of advanced technologies mcrease. This creates a particular problem for national R&D policy because with a rising presence offoreign multinational companies the 'leakage effects" rise; i.e. as more and more foreign firms either directly benefit fiom R&D programs or imitate the technologies of rivals in the host country considerable international external benefits will accrue. This could lead to suboptimal public R&D expenditures as governments do not take into account the positive external benefits of induced innovations. International cooperation could only partly solve the problem.

Scale economies can explain the regional concentration (location in space) of production. Product differentiation allows firms to appropriate economic rents in oligopolistic markets. Regions which specialize m product varieties with a high income elasticity of demand will particularly benefit if static or dynamic scale economies are also present. While transportation costs typically lead to a homogeneous location pattern of production, scale economies imply concentration effects. Following KRUGMAN (1991) scale economies are particularly important for industrial goods so that the expansion of industry - rising share of industry in output - will reinforce concentration patterns. Innovation, product vaxieties and trade were theoretically analyzed by GROSSMAN and HELPMAN (1991). ROMER (1990) emphasized the role of accumulation and technology spillovers in his approach to endogenous economic growth.

With firms from the US and EU countries shifting industrial production to low income/low wage countries, one may expect that concentration effects in the dominant service societies of North America and Western Europe become less pronounced at the turn of the century, while concentration effects - ie. the problem of agglomeration - become more important in eastern Europe, Asian NICs as well as m Latin American NICs. This could imply that environmental problems become regionally more concentrated in the world economy, especially since the newly industrializing countries experience high growth rates and rapidly increasing traffic. Indeed the world economy has a problem to the extent that transportation costs do not fully reflect economic costs, where road transport probably has high negative external effects which are not properly internalized. A Pigou tax could be a useful instrument for stimulating pro-ecological innovation in the automotive and truck industry. To the extent that greenhouse problems are accentuated by rising international transport and trade, one might consider a multinational R&D program on "green transportation technologies". The

willingness of NICs to contribute to such programs will increase only gradually, namely as a consequence of rising per capita incomes and changing individual preferences. International real income convergence thus could facilitate international political cooperation to the extent that less divergent preferences in UN countries ease the bargaining process in the field of environmental policy. This positive North-South perspective could be undermined by more intense policy conflicts within Europe where the goal of full employment and high growth is not easily compatible with ecological improvement.

Those countries and regions in the world economy which are main exporters of such products and major source countries of foreign investment will record particularly high per capita GNPs. It is, however, doubtful that massive net foreign direct investment outflows have no negative consequences on employment in the source countries and hence could not cause higher unemployment and intensified social conflicts between workers and wealthy owners of domestic and foreign capital. A strategic policy focus thus should be to make sure that the country is not only an attractive host country for foreign investors but also an active source country.

Since successll foreign investment abroad can *only* be expected if the parent company has ownership specific advantages - special management know-how and technological leadership in some fields - fostering innovation is crucial. Moreover, a strict domestic competition policy is required in order to generate sufficient domestic pressure in the tradables and nontradables sector to develop highly competitive firms.

1.8. MNCs' Impact upon National Economies and the EU

The main impacts of multinational companies on economic development is positive since already basic economic models of foreign direct investment show a global economic gam fiom a fiee flow *of* capital. With rising capital mobility locational competition certainly is intensified. Therefore high capital mobility should encourage governments to pick up political best practice solutions fiom competing locations with high economic success. By helping to accelerate learning in the political *system,* MNCs are a catalyst for change. Those countries where governments learn rather slowly will suffer fiom capital outflows and - m the case of flexible exchange rates - a currency devaluation. This will raise the pressure for political reforms. However, the crucial question is whether political competition among parties is truly functional and efficient. Only with functional competition one may expect that FDI implies systemic competition in a meaningful way, namely by contributin to the diffusion of political solutions from abroad.

One major problem of mobile real capital is that the tax basis in countries with a high tax rate will be strongly eroded; indeed with rising intra-company trade there are all kind of options to use transfer prices to reduce taxes in some countries and to allocate tax payments in a rather arbitrary way to the country with the company headquarter or to countries with subsidiaries facing more favorable tax conditions. In Europe there is some need to rationalize and harmonize national tax systems. Harmonization should not mean primarily that tax rates become equal but that definitions of the tax basis and fundamental rules m tax policy are equal, and, of course, that arbitrary political decision are avoided. It is an open question to which extent EU countries really should have a minimum corporate tax rate. While some minimum tax rate might be considered in order to make sure that sufficient tax revenues for financing basic infrastructure is available, one should also consider the positive role of

tax competition within a clearly set fiamework of credible rules. Government will be forced to consider for each project whether the "tax price" is matched by adequate provision of benefits for society.

Rising intra-EU foreign direct investment can be expected as a consequence of the single market and monetary union. While the single market encourages the exploitation of economies of scale - therefore of local concentration of production in favorable locations allowing to serve the whole EU market - monetary union will create a fully integrated capital market with increased competition among banks and many financial innovations. Under such conditions international (intra-EU) mergers and acquisitions will become more easy. Since fay reasons remain after 1999 why mobile real capital should not flow to locations within the EU in which the marginal product of capital is highest, the convergence of marginal products across Euro countries and the (near) equalization of real interest rates across regions is to be expected. Different tax regimes within the EU will, of course, remain a factor that could cause differences between rates of return across Euro countries.

Higher intra-EU foreign direct investment will contribute to accelerated technology transfer within the Community. This in turn should stimulate real convergence of per capita productivity and per capita GDP in the Community. If this effect is strong enough to offset regional concentration effects emphasized in the new growth theory, there could be opportunities to reduce EU structural funds and to allocate a higher share of the EU budget to the promotion of R&D projects.

1.9. Foreign Direct Investment in the Triad and Eastern Europe

FDI inflows contribute to higher investment, economic growth, and technology levels plus higher exports m the long term, in turn stimulating rising foreign direct investment outflows. High foreign investment inflows will only develop if there is political stability, well-developed infrastructure, and a profitable, expanding market. In Spain, the share of foreign investment in total domestic capital formation increased fiom average annual shares of 5.2% in the period 1981-85 to 9.9% in 1986-1990, while the outflows relative to domestic investment reached 1.8% in the period 1986-1990. The U.S. had inflows of 6.1% and outflows of 2.9%; Canada 5.9% in inflows and 5.1% in outflows in the same period (see Tab. A11, A12). Gexmany and Japan, which have both been suffering fiom an economic crisis m the 1990s recorded *only* around 1% in foreign investment inflows but much higher outflows (In Japan the problem of foreign investment is aggravatated by language problems for foreign investors and extreme problems in hiring skilled personnel, which typically prefers to work for Japanese companies). The Republic of Korea has become an important source country for foreign investment, but is still not really open to foreign investment inflows. Effectively, however, the widespread use of subcontracting to Korean firms (mainly with orders fiom U.S. and Japanese firms) is a silent form of foreign investment. In the period 1990-94 foreign investment outflows and inflows m Taiwan amounted to 7.5% and 3%, respectively relative to domestic investment, while Singapore's respective figures were 10 and 28%, (IWD, 1997). The top ten source countries of foreign investment m the period 1990-95 were the US ($309.7 billion), Japan (167.8), France (150.8), the UK (143.5), Germany (130.8), the Netherlands (78.1), Hongkong (77.7), Switzerland (46.4), Sweden (40.8), and Italy (36.4).

In the Visegrad countries, foreign investment inflows in the early 1990s contributed to up to 10% of gross domestic investment, while the figure for Russia was about 1%. Clearly, foreign investment can

be only expected on a broader scale if privatization in combination with competition has led to the emergence of an efficient supplier network and of interesting options for mergers and acquisitions. Other prerequisites include political stability, sound prospects for growth, and high profits. Lack of foreign investment has to be seen as a crucial bottleneck to higher economic growth in Russia.

The top ten recipients m foreign investment m the first half of the 1990s were the U.S. (238.6 billion), the U.K. (118.0), China (117.8), France (108.2), Spain (65.5), Belgium/Luxembourg (56.0), the Netherlands (47.1), Canada (37.3), Australia (37.1), and Sweden (32.1). China's high foreign investment inflows in the 1990s are largely from Chinese expatriates and also reflect the booming prospects of the whole Asian region. Russia's options are different and require more domestic reforms, including prudent regulatory reform as a prerequisite for attracting high and sustained foreign investment inflows.

Foreign investment in post-socialist countries rapidly increased in 1994/95, when Hungary and the Czech Republic sold part of their national telecoms operator to foreign investors. Assuming that foreign investment contributes to an acceleration in the modernization of the telecoms sector, one may expect a positive foreign-investment multiplier effect: a modernized telecoms network generally improves the prospects for attracting foreign investors to whom reliable telecoms links to world markets are crucial. The CEFTA group - Poland, the Slovak Republic, the Czech Republic, Hungary, and Slovenia - reached a stock of foreign investment of $32.6 in mid-1996; while Russia, according to the UN Commission for Europe, - had a stock of 6.6 billion, roughly the same as the Czech Republic and about half of the Hungarian stock value of $ 13,9 billion (DIW, 1997). Russia certainly could increase its share m global FDI flows, which sharply increased after 1985. Foreign investment relative to gross domestic capital formation reached up to 15% in some EU countires in the late 1990s (SVR, 1996, Tab. A11, A12). Telecommunications is a good starting point, since successful joint ventures and foreign investor operations could prove the usefulness of foreign capital in a straightforward way for firms and households. Because a modernized network would facilitate the expansion of the business sector, the rise of exports and the spread of internet use for firms, government authorities, and private households, the benefits of a rapid telecom network development are obvious.

2. Theoretical and Practical Aspects of High Technology Policy

The theoretical justification for high technology policy stems fiom the observation by Kenneth Arrow (1962) that economic activity based on new knowledge suffers fiom an inherent market failure. High technology, by definition, involves the production and commercialization of new economic knowledge. New knowledge is inherently differently fiom the more traditional factors of production – land, labor and capital. These traditional factor inputs are more or less known and their value added is more or less certain. This is not the case with new economic knowledge.

More than most other economic goods, the production of knowledge generally suffers fiom all three sources identified by Arrow (1962) as constituting market failure – indivisibilities and monopoly, uncertamty, and externalities and public goods. The first source of market failure emanates fiom the propensity for new knowledge to be a discrete rather than a continuous commodity. As a result, both economies of scale and scope are often associated with the production of knowledge. The second

source of market failure involves the extraordinarily high degree of uncertainty inherent in new economic knowledge. While virtually every economic good is subject to uncertainty, almost none is exposed to the degree of risk involved with introducing new products and technologies. There are two additional elements of uncertainty inherent in innovative activity that are not present in other goods. The first is in the realm of production. How a new good can be produced is typically shrouded m uncertainty. The second level of uncertainty involves demand. To whom the product can be sold and which types of marketing should be utilized is a conjecture at best. Even if the technological knowledge can result in a new product, it is not at all clear that the product can be profitably sold. Technological knowledge can enable a new good to be produced, but there is no guarantee that sufficient demand exists, or that the new technological knowledge can be transformed into economic knowledge.

The third source of market failure stems fiom the public good characteristics and externalities inherent in much knowledge-generating activity. The production of knowledge does not preclude other economic agents fiom applying that knowledge for economic gain. It is difficult to delineate and enforce property rights to newly created knowledge. The externalities associated with the production of new knowledge make it difficult for firms undertaking such activities to appropriate all of the economic returns accruing fiom their investment.

The market failure aspects involved in knowledge-based economic activity provides theoretical justification for government intervention, particularly to support what would otherwise be an under-production of that activity. However, a more practical consideration of technology policy institutions is how to avoid what has become known in the literature as ***regulatory capture.*** The main goals of creating such institutions are the avoidance of regulatory capture, that is having those policy makers with a mandate to devise and implement technology policy be captured by particular interest groups. A problem that is not particular to technology policy is that the centralized power and interest groups that are actually promoted through coalition structures can influence the political process and restrict or at least impede the entry of new firms. That is, the institutions shaping and implementing technology policies are particularly vulnerable to the special interests represented by a highly concentrated group of large producers. Administrative procedures to diminish the influence of political rent-seeking activities generally fall under the heading of providing ***accountability, independence,*** and ***transparency.*** The principle of accountability suggests that a greater degree of political scrutiny is required to help compensate for the inevitable imbalance between the concentration of producer interests on the one hand, and the relatively dispersed interests of the general public on the other hand. According to the principle of independence, weakening the link between the control of administrative agencies by elected officials will also tend to reduce the likelihood and extent of regulatory capture. The principle of transparency generally suggests that institutions implementing technology policies should be charged with revealing to the public the maximum amount of information and reasoning upon which technology policies are based.

2.1. Endogenous Growth Theory and Theory of High Technology Policies

The traditional or neoclassical approach to growth theory focused on the linkages between the inputs of labour and capital and output in a production model fiamework (Solow, 1956 and 1957). Economic growth was then explained either by increases in the quantity of the inputs or by the productivity of the inputs. But the neoclassical models could not fully explain variations in growth

rates over time for any particular country (time series) and across different countries at any one point in time (cross sectional). The residual, or "unaccounted growth" was attributed to exogenous technological change. This technological change was largely considered to be "manna from heaven".

The concept of *endogenous growth* embraces a diverse body of theoretical and empirical work that emerged in the last decade. This alternative approaches to growth theory differs fiom neoclassical growth theory in the emphasis that economic growth is an endogenous outcome of an economic system, and not merely the result of forces that impinge from the outside. As Romer (1994, p. 3) points out, the endogenous growth theory, "does not settle for measuring a growth accounting residual that grows at different rates in different countries. It tries instead to uncover the private and public sector choices that cause the rate of growth of the residual to vary across countries." The major contribution of the so-called "new growth theory" has been to endogenize technological change in the process of long-run rate of economic growth. Technological change consists of a number of dimensions, such as research and development (R&D), stock of scientists and engineers, the extent of human capital, labour skills, and learning capacity of firms and individuals. Rather than being purely exogenous, these dimensions of technological change become endogenous in the new growth theory, in that greater rates of growth afford higher levels of R&D investment, superior training of the worlcforce, better education, etc. (Grossman and Helpman, 1991). And the higher levels of these dimensions of technological change lead, in turn, to higher growth rates. Thus, Romer (1986 and 1990) pointed out that there are increasing returns to technological change and endogenous growth.

Audretsch and Feldman (1996) and Audretsch and Stephan (1996) argue that the mechanism by which these increasing returns to new knowledge take place is through the spillover of knowledge. Knowledge spillovers can be defined as knowledge that is generated in one organization but commercialized in another organization.

According to Baumol (1993, pp. 259-260), "...so far as capital investment, education, and the like are concerned, one can best proceed by treating them as endogenous variables in a sequential process – m other words, these variables affect productivity growth, but productivity growth, in turn, itself influences the values of these variables, after some lag. To some degree, the same story can be told about the exercise of entrepreneurship, investment m innovation, and the magnitude of activity directed to the transfer of technology." Thus, Baumol (1993, p. 260) concludes that, "productivity growth, and the resulting enhancement in GDP per capital, are, in turn, among the main stimulants serving to enhance the values of those same variables... investment is heavily influenced by output per capita, being systematically higher m countries whose GDP per capita is higher. Similar remarks apply to a country's expenditure on education, its investment in R&D, and a number of other variables usually cited as stimulants of productivity growth".

The implications for government policy m the development of high technology under the endogenous growth theory are strikingly different than those under the traditional neoclassical growth theory. The role of government in the traditional neoclassical growth theory is limited and minimal. The returns fiom investment m new knowledge are appropriated by those firms and individuals undertaking those investments. Thus, there is no theoretical reason for governments to intervene in high-technology markets.

By contrast, in the new growth models there is a compelling reason for governments to undertake a vigorous and active policy in shaping high technology. This is due to the existence of knowledge

externalities m the form of knowledge spillovers. As a result of the externality, the social value of new economic knowledge exceeds the private value, which represents the type of market failure first identified by Kenneth Arrow (1962). By supporting the creation of new knowledge, activities which generate the spillovers of that knowledge, and the commercialization of knowledge, govemment policy can correct the market failure inherent in knowledge-based economic activity.

2.2. Trends in International Innovations and the Presence of MNCs

Globalisation of research and development (R&D) since long is a major topic for academic researchers. The exchange of new ideas during mtemational conferences and the collaboration across boarders in such prestigious projects as in high energy physics, nuclear fusion or space research is reality since several decades. The same is true in areas such as genetic engineering or oceanography but probably there less obvious as no joint large-scale facilities are required. Global R&D for the business community is now considered a major important topic than some twenty or thirty years ago. For decision makers m governments globalisation seem to be more a problem than an opportunity as the temtorial boundaries and the respective legal systems cannot easily be surpassed (with the exception of the European Union).

A particularly strong trend towards the globalisation of R&D began in the 1980s and now; m the mid 1990s, no end of this process is coming m sight (GERYBAZE, REGER, 1997). Multinational companies (MNCs) play a key role both in the generation and in the diffusion of new technology. Certainly, deregulation in the eighties has facilitated this process which is obvious for such markets as telecommunications (GRUPP, MAITAL, 1996), and one should never forget that companies like IBM always had large production and R&D facilities m Europe, what was also true for trusts like ITT before the company disappeared. Yet, the new observation m recent years is that the R&D and international location strategies of translational cooperation have changed substantially.

At the same time international trends m innovation in terms of technical preferences are changing. If one accepts patent statistics as a proxy for innovative output, one can arrive at the conclusion that since the end of the eighties some areas are the winners of structural change in innovation and some are the loosers. Among the winning areas we mention turbines, telecommunications, optical instruments along with railway technology, medical instrumentation, agro chemistry, and pharmaceuticals (the latter two areas being heavily influenced by the new biotechnology). On the shrinking side we find nuclear energy, armament technology, semi-conductors, and computing (these developments peeked at the end of the eighties) along with textile machines, food processing, photography, and consumer electronics (BMBF, 1997). Environmental concerns have been overplayed by concerns of employment, and, although most environmental problems remain unresolved, the development of environment-friendly or resource saving technology is now in the down-swing.

MNCs, following these structural changes in technology, can combine their priority decision with a location decision and pursue some parts of R&D in one country, other parts in another. Those locations, maybe states or regions within countries, get more or less attractive if competence centres or networks between existing firms and public institutions, and favourable fiame conditions in combination offer competitive advantages against others. By favourable fiame conditions we mean both hard facts (country or state legislation, availability of skilled labour force etc.) as well as soft

factors (such as nice housing opportunities, developed traffic systems for the long distance but also for daily use, touristic and other leisure opportunities, school teaching in several languages, and many more).

This is not to hide that there are several deficits in the economic analysis of globalisation of R&D. Most studies provide us with macro economic or sectoral results of the internationalisation of R&D and do not disclose business related strategies with implications for managers. It is also not to deny that many more such investigations on US firms are available than on European or Asian companies. Many more studies deal with transnational enterprises but are silent on their R&D.

One can observe different strategies of MNCs. Recently, GERYBADZE and REGER (1997) published a survey on some twenty MNCs explicitly focusing their R&D. They found two clusters of companies "going international" in different ways. The first group of high-tech corporations has a strong global orientation, invests a relatively large amount in R&D and shows a strong presence abroad. This group performs 50 per cent or more of corporate R&D in other countries than the one where the headquarter is located. To this group belong companies like ABB, IBM, Philips, EISAJ, and chemical-pharmaceutical companies like Ciba-Geigy, Hoechst, Roche and Sandoz.

The second cluster consists of a group of enterprises mainly active in the area of medium-to-high tech. They have divisions classified as high-tech but their overall R&D intensity is lower than for the first group at least on average. This group does not transfer more than half of the R&D function to countries foreign to the headquarter location. A typical value would be 20 to 30 per cent of R&D which is internationalised, indeed. This group of countries includes companies like Siemens, Sulzer, BASF, Sony, Sharp, Bosch and others in the sample studied.

Thus, the presence of MNCs with distributed R&D facilities is a matter of fact. Globalised R&D is increasing fiom a low level in most countries. The net outflow of R&D is a concern for some countries but whether it is better to make "national" companies work abroad and participate in foreign national systems or to invite foreign companies to the own territory remains largely open. Technology spill-overs and knowledge flows certainly accrue in both cases and the debate of the net R&D flows and their benefits is largely a question of employment within the national temtory and also tax revenues fiom local R&D, production and services.

2.3. International Trends in Service Industries

Most industrialised countries are m the process of becoming a service economy. Most obvious is the structural change in employment: Even those economies suffering from dramatic unemployment in manufacturing can have at the same time monotonously increasing jobs in the service sector. But this restructuring does not mean that manufacturing industry will soon seize to exist. As a rule of thumb one may assume that most of the new service firms use capital goods to provide their services. To give some examples we just mention credit card machines, computers, coin change machines, cafeteria appliances, cleaning machines, service robots and so forth. Inventions for the special market of "service machinery" show above average growth-rates (GEHRKE et al., 1994). The structural change towards a service society will always result in demand for capital goods from the manufacturing sector (GRUPP et al., 1996, p. 55). The challenge for machinery industry is, then,

whether or not it provides the "right" machinery for the service society of the future, which will enhance its competitiveness in the manufacturing sector.

In the near future, it can hardly be expected that a rapid expansion of R&D-intensive sectors will be enough to solve the unemployment problems of highly developed industrialised nations. But, still, the technology-intensive sectors may also benefit fiom the shift towards service industries. Know-how-intensive service providers m particular are rapidly gaining ground and already now provide jobs for many. Their success is increasingly dependent upon innovation and the use of new technologies. This in turn generates new markets for technology producers, particularly for information and communication technologies, infrastructure facilities for the transport and communication sectors and medical technology. Technological advances are geared increasingly to the service sectors needs.

Parallel to this, the service sector is expanding its own research and innovation activity. In the USA, for instance, service enterprises already generate one third of their technical know-how through their own R&D efforts. In the United Kingdom, this figure is one forth. As a rule, company-oriented services expand fastest is areas where there is a demand for their products among innovating industries. Conversely, how-how-intensive service enterprises are still able to contribute to maintaining and enhancing the respective countries' attractiveness as a site for industry even when the service sector has undergone dramatic internationalisation, such as in the past several years (BMBF, 1997).

The globalisation of industry has, in turn, sharply stimulated the demand for services (transportation, finance, distriiution, research and engineering) and accelerated the trend towards tertiarisation. The "service society" generates also new demands on technology policy. In general, this should result in a continued shift away fiom promoting the production of new technologies and towards promoting their use and dissemination. Ties to the technology supply should remain intact.

Let us consider one country in detail. In Germany's manufacturing sector nearly all jobs created after 1985 have since been lost in a net balance, whereas the service sector is characterised by a steady growth of employment. After 1991, and certainly after 1992, the growth rates became modest, but still there is no loss. If one examines the functional specifications of all business positions, then one finds that up until 1985 more than 37 per cent of the employees worked in production, maintenance, or repair ofmachines whereas this share in 1993 reduced to 32 per cent. Job function specifications in office work, planning, research, managing, educating and information in the same period of time expanded fiom 37.2 per cent to 42.4 per cent in the entire German economy.

What is reported here for Germany, can be observed in more or less the same way in the other large OECD countries. Tab. C1 shows the increase or decrease of employment between 1981/83 and 1991/93 for the United States, Japan, West Germany, France and the United Kingdom. With the only exception of Japan and R&D-intensive branches in manufacturing in Germany, all other branches in the countries considered suffered from a net loss in industrial employment. On the other hand, there is not one case of decreasing employment in the service industries be it services of distribution, services for firms, government services or services for private persons.

According to the table the increase in service industries was largest in the United States (nearly 30 per cent). One objection consists in the argument, that this increasing employment is problematic as it is low income jobs with low skill requirements. It is true, indeed, that 20 per cent of the increase

in service jobs are in the area of retail and transportation and about 40 per cent is in services for households which includes the large restaurant and pub sector, yet, a similarly large share of service employment takes place between service providers and firms as users. In this case we speak of banks, insurances and so forth and this is a service sub-sector with relatively high skill requirements. It is exactly the United States where this share of service employment is largest so that the overall observation, that increasing service jobs are connected to low wages, maybe true, but it is less true for the United States than for other countries.

Let us now consider skill requirements and technology dynamics and elaborate the last argument further.

2.4. Skill Requirements and Technology Dynamics

The trends towards a "service economy" also has consequences for the demands on technical performance: Business-directed services continually need impulses fiom innovative areas in the industrial sector m order to develop an ongoing basis. Advanced services are needed if research and development, marketing, financing, production, and the like are pursued. This sector reinforces the growth impulses coming fiom industry and strengthens the industrial base within its service products. On the other hand, innovative contributions within the value added change are shifting from-hardware production to software and services. There are expensive areas in the service sector that are not dependent upon technology production locations but require advanced technological solutions to fulfil their primary role. In this regard, it is also essential, that greater attention be paid to potential applications for, and the optimal combination of technology in the expanding service sector.

If not the functional specification but the qualification of the employees serves at a benchmarking criterion for the human-capital intensification, then for major OECD countries one arrives at the following assessment. In the first half of the nineties one has to confirm a trend claimed already earlier that the share of employees with a higher education degree (university, polytechnical or related schools) and the share of academic staff (university degrees only) is increasing in the manufacturing sector and in the service industries. This means that there is tendency to employ relatively more highly qualified persons both in the service sector, which is expanding, and in the manufacturing sector with a loss of jobs.

More interesting is another tendency. The structural change towards a service society is also accompanied by an increasing share of highly qualified employees there. In most years and in most countries the share of highly qualified employees m the service sector (except government employees) is about one per cent point above that in industry. For the immediate future one may assume that an intensification of human capital is ongoing in all sectors of the industry and any structural change towards more employment in the Service sector gives an additional relative growth of higher qualified jobs (GRUPP et al., 1996, p. 56).

If we now, in summing up, consider the economies as a whole, that is, if we judge on both the manufacturing and the non-manufacturing sector, then the significance of human capital for economic growth can be diagnosed without doubt. Roughly speaking about half of the manufacturing and the service sectors are human-capital or knowledge-intensive; both figures increase in recent years. Therein the service sector is more and more dominating fiom year to year and thus, the sectoral

change towards a knowledge intensive economy is spurred by the sectoral change towards a service economy in addition to the increases within each of the sectors. These seem to be two sides of the same coin.

If it is right, that there is more growth in overlapping, transdisciplinary fields of technology as compared with the core of the traditional technological areas, then it becomes apparent that the future challenges for education and re-education and also vocational training cannot be mastered within the classical schools, faculties, disciplines and circles alone. Future skill requirements go in the direction of interdisciplinary knowledge and life-long learning. This brings the question onto the agenda, whether our traditional institutions for education are sufficiently fit to train the next generation of employees.

As an example for the significance of multidisciplinary requirements and technology dynamics, we point to the example of German industry which - according to a questionnaire survey - has proven the multiplicity of technologies required. Even traditional industries are increasingly using several technologies at a time and thus staff originating from diverse schools and with diverse grades. There is no observation that tells us that in other countries this situation is much different. Thus, the close connection of technology dynamics and skill requirements can no more be denied.

Being educated themselves earlier, not only the young people, but also their teachers have to be retrained in particular in countries where for various reasons the educational staff is over-aged and cannot be replenished quickly enough because of low fluctuations.

2.5. Technology Dynamics, Skills, and Unemployment

One of the main objections to the inferential material in section 1.5.1 was that biased technological change was in the nature of a residual, exactly that in regression analyses, giving rise to a labeling problem In the present section, we peer inside the technological change black box, examining U.S. and U.K. studies that include technology proxies. In addition, we review an interesting German study that addresses the relative importance of trade and technology factors in explaining relative unskilled worker employment. We also briefly consider skill upgrading at the level of the firm. Such changes and policy implications are further discussed in section 2.7.

Our starting point will again be the two studies cited in Tab. B1. We begin with the U.S. study. Having earlier decomposed the increase in the nonproduction worker share of the wage bill and total employment into their between-and within-industry components, BERMAN ET AL. (1994) regress within-industry shifts in the wage bill share (results for employment shares are not reported) on changes in output and changes in either capital or equipment and plant intensities. Dummies for the 1970s and 1980s are also included, given the finding that the change in the wage bill share is increasing through time. (A simple cost function is used to derive a share of nonproduction wages in total wages, from which evidence on the elasticity of substitution between production and nonproduction labor can (theoretically) be derived as well as the presence of capital-skill complementarity. This share equation is then first differenced to yield the basic estimating equation.)

The authors' estimates point to capital-skill complementarity and equipment skill complementarity, although capital accumulation does not contribute materially to the explanation of skill upgrading.

Altogether, the independent variables explain around 12 percent of the variance in changes in the wage share of nonproduction workers. Adding in technology variables - specifically, the fraction of investments devoted to computers, and R&D intensity (the ratio of R&D expenditures to sales) - substantially improves the fit. The two proxies for technological change account for almost three-quarters of the observed shift away fiom production labor.

Similar results are reported by MACHIN (1996) for 16 two-digit U.K. manufacturing industries, using almost identical procedures but this time also presenting regressions for within-industry changes m the employment share of nonproduction workers. MACHIN provides separate regressions for his two technological change indicators: annual R&D intensities, and the number of innovations introduced/used. He finds that a one percentage point increase in R&D relative to sales increases the nonproduction worker wage bill share by 0.07 percentage points, and the employment share by .05 percentage points, although his results for innovations are *only* weakly statistically significant. Machin also provides disaggregative regressions using Worlcplace Industrial Relations Survey (WIRS) establishment data that allow him to evaluate the impact of increased computer usage. He finds among other things that increased computer usage is asssociated with increased employment shares of nonproduction workers and reduced employment shares at the lower end of the occupational employment range.

Another well-known piece of evidence consistent with the biased technological change argument is KRUEGER'S (1993) analysis of computer usage and occuptional earnings. He finds that working with computers (versus not working with them) is associated with a cet. par. increase in wages of between 15 and 20 percent. Moreover, his estimates imply that the expansion in computer use during the 1980s can explain up to 50.5 percent of the observed increase m the return to education. (See also ALLEN, 1993.) Unlike the two preceding studies KRUEGER's analysis is not restricted to manufacturing industry.

A very recent study by STEINER and WAGNER (1997) is of particular interest because of its attempt to address the relative contribution of trade and technology factors m the decline m unskilled worker employment m German manufacturing, 1975-90. The authors' fixed effects, partial equilibrium model relates the relative demand for unskilled workers to relative wages, a trend variable, and a vector of (other) demand variables (e.g. the capital-output ratio) affecting the relative demand for the unskilled.[5] The coefficient estimate for the trend variable is supposed to capture factors common to all industries; in particular, skill-biased technological change and the overall decline in the supply of unskilled labor. The coefficient estimate for the relative wage variable captures the substitution elasticity between unskilled and skilled labor. For the authors' preferred specification the substitution elasticity is around -0.32, much lower than reported m other extant German estimates, while the secular decline m unskilled worker relative employment is m the order of 3 percent a year.

To gauge the effects of trade and technological change, the authors split their 31-industry sample according to quartiles of import penetration and productivity growth, respectively. For the former, the trend decline is modestly higher in industries with relatively high import shares (3.7 vs. 3.0 percent). For the latter, the trend decline is considerably higher in industries with high productivity growth rates (4 vs. 2.2-2.9 percent), suggesting a larger role for skill-biased technological change than for international trade - although the authors themselves consider the two forces to be interrelated. Interestingly, as was noted earlier, the substitution of unskilled by skilled workers due

to the high relative earnings of the unskilled in Germany appears to have been small relative to the trend decline in the relative employment of unskilled workers.

In section 1.5.1 we noted that, despite its appeal in the U.S., the technology story has not gone unchallenged. This is also true at the empirical level, even if there has been little disagreement about the long-run course of events. That is, the complementarity between capital and skill is well established (e.g. GRILICHES, 1969) and the role of capital accumulation and technology in shifting demand in favor of higher order skills accepted. The main bone of empirical contention is whether technology's impact accelerated in the 1980s and 1990s.

In particular, MISHEL and BERNSTEIN (1996) have argued that the technological change story must proceed beyond its typical focus upon broad employment and education differentials to examine the entire skill and wage distributions (i.e. the demand for workers at various education and wage levels, where the latter are also assumed to proxy skill). The basic motivation here is the need to disaggregate.

MISHEL and BERNSTEIN's decomposition of within-industry wage inequality proceeds as follows. Their dependent variables reflect two measures of wage inequality, namely, between group inequality (or "education quantities," defined as the share of workers in a given education category) and overall wage inequality (or "wage quantities," defined as an industry's utilization of low, middle, or high-wage workers). Six education categories and five wage quantities are distinguished, and separate regressions run for each. The independent variables comprise a technology vector and a control for industry employment growth. Three technology indicators are deployed: the gross real equipment stock and the gross computer stock per full time equivalent, and the share of scientists and engineers in each industry. (All variables are measured as first differences.)

Because the effects of technological change can take the form of changes in skill bias as well as changes in the pace of technological change, the empirical model allows a distinction to be drawn between changes in complementarities and changes in the overall impact of technology through time. This is achieved by also interacting the technology covariates with time. (Three time intervals are recognized: the 1970s, which provide the reference period, and the 1980s, and the 1990s.) Changing complementarities are thus directly revealed by the (two) interaction terms. The overall impact of technology is is obtained by multipling the complementarities specific to each period by the average within-industry change in the relevant technology indicator over that period. Comparing these per period effects then establishes whether or not the impact of technology has accelerated through time. The reduced-form model is estimated over just 34 manufacturing and nonmanufacturing private sector industries over the three time periods (i.e. n=102), and estimates are provided for two specifications, namely, with and without the computerization covariate.

The authors' estimates are not favorable to the accelerated technological change argument, even if it is generally the case that greater levels of technology are associated with proportionately fewer high school equivalent workers and fewer middle and lower paid workers (namely, the bottom three-quarters of the wage structure). Specifically, as far as the educational quantity (i.e. education upgrading) regressions are concerned, the large majority of interaction terms between the relevant technology indicator and the time period are statistically insignificant. That is, there are no real signs of the complementarities shifting through time. Disregarding statistical significance, the estimates do not suggest a more profound effect for technology than for other factors, such as industry shifts.

These results pertain to males. For females, on the other hand, there are some signs of acceleration in the technology effect but these are quantitatively very modest.

For wage quantities much the same negative conclusions hold, but in this case the result follows from technological change being less biased in the 1980s than in the 1970s for men in the bottom half of the distribution; correspondingly for the more skilled groups (the top 25 percent) technological change was less favorable. The pattern for women is again different, but once more there is no support for an accelerated technology effect adversely impacting the bottom half or three-quarters of the distribution and favorably impacting the top half.

The very directness of this study vis-a-vis its precursors may mean that the biased technological change explanation may have to share somewhat more equal billing with other explanations of wage and employment developments in the 1980s and 1990s (e.g. institutional changes.), even if the long-term impact of technology on skill upgrading is not controversial. In other words, attributions of biased technological change on the basis of the predominance of within-industry movements may still be subject to a labelling problem. That being said, worrying features of the study concern its level of industry aggregation, lingering ambiguity over the reduced forms, and conflict with KRUEGER's (1993) results since MISHEL and BERNSTEIN's computerization variable fails to indicate stronger complementarities through time where these might be expected.

It might usefull be pointed out at this stage that, KRUEGER'S study has been critiqued by DINARDO and PISCHKE (1997), who report that use of his methodology with German data produces the result that working with pencils yields a wage premium no less than working with computers! Using the German Qualification and Career Survey, which contains information on a variety of tools used on the job, one of the authors' specifications suggests a return to computers of 18.6 percent in 1991 and to pencils of 13.5 percent. Since everyone can use pencils, the inference might be that the return to computers is a selection effect - increased computer use picks up some unobserved skill whose return has also increased through time - albeit one that is not easily identified with standard statistical procedures. But, in the final analysis, DINARDO and PISCHKE are more critical of the use of the computer variable as a direct indicator of technological change than they are of the notion that accelerating technological change underpins observed changes in wages.

There are of course many factors behind changing pay inequality observed in Anglo-Saxon countries. For his part, MACHIN (1996), whom as we have seen reports fairly strong evidence of skill bias at the upper reaches of the occupational spectrum, is concerned to point out that these occurred at a time of radical transformation of the U.K. labor market (i.e. the Thatcher reforms). In particular, he alludes to the "shift in the balance of power" between management and labor during the 1980s. MACHIN recommends that such Eactors need to be modeled to obtain a fuller understanding of the determinants of changes in the employment structure.[6] He might also have emphasized the need to examine skill upgrading at the level of the *firm,* not least because of the breadth of the technological change concept.

In fact, MACHIN does present some findings pertaining to skill upgrading, 1984-90, using establishment data fiom the British Workplace Industrial Relations Survey(s). He reports that at the higher end of the nonproduction worker occupational distribution (middle/senior managers and senior technical/professional workers) most of the observed changes in employment shares are within industry while they are predominantly between industry at the tail (clerical workers). Furthermore,

his regression analysis of changes m employment shares on the introduction of microcomputers in the workplace points to a positive association at the top end of the wage structure and a negative relation at the bottom, unskilled manual worker level He interprets this evidence as indicating that computers provide an important means of upgrading the workforce.

Here again we have evidence of a direct indicator of technological change explaining some part of the observed change in the structure of employment, even if the process may be considerably more noisy than is indicated in this study.[7]

2.6. New Firms and and Small Firms: Role for Innovation and Structural Change

The traditional view about the role of new and small firms is that they do not have a lot to do with the process of change, let alone structural change. This is because the most prevalent theory in economics focusing on change, the model of the knowledge production function (Griliches, 1979), links knowledge-generating inputs to innovative output. The most important source of new knowledge is generally considered to be R&D. But most of the R&D expenditures in Europe, as throughout the OECD countries tend to be made in large firms (Cohen and Klepper, 1992). New firms, which are particularly small, and have around an average 8 employees in manufacturing in various OECD countries (Audretsch, 1995; Mata, 1994; Wagner, 1994) and an even fewer number of employees m the services (Caree and Thurik, 1996), simply do not seem to possess the resources to provide much in the way of change, or innovative activity. While new firms can and do have employees with very high degrees of human capital, the number of such employees is typically trivial compared to large corporations, such as Phillips, Thompson, or Siemens. The convention wisdom suggests, then, that due to possessing only a negligible amount of the crucial knowledge-producing inputs, principally R&D and human capital, the capacity for innovation and change in new firms is quite limited.

Towards the end of the 1980s, studies started being undertaken to identify the relative innovative activity contributed by small and large firms. These studies spanned most European countries, including the United Kingdom (Rothwell, 1989), Italy (Santarelli and Sterlacchini, 1990; and Audretsch and Vivarelli, 1996), Germany (Harhoff and Licht, 1996), and the Netherlands (Kleinknecht, 1989), as well as the United States (Acs and Audretsch, 1988 and 1990) and Canada (Baldwin, 1995). The results were surprising and did not at all confirm the conventional wisdom that innovative activity is largely the domain of the largest enterprises. Rather, the evidence from a wide spectrum of European and OECD countries clearly documented that small firms as well as large enterprises play an important role in generating innovative activity.

One attempt to reconcile the new evidence that small firms as well as large enterprises generate innovative activity was to suggest that perhaps the innovative activity of small firms was less consequential than that contributed by large enterprises. This interpretation argued that, due to a lack of knowledge-generating resources, small firms and especially new startups simply did not posses the resources required to generate innovations, especially the kind that contribute to structural change (Harrison, 1995). While the significance of innovative activity is difiicult to measure, what little evidence there is suggested that the innovative activity of small firms is no less than that of their larger counterparts (Acs and Audretsch, 1990; Audretsch, 1995).

The conventional wisdom that expected innovation and structural change to come fiom largely large enterprises erred because the implicit model underlying that review miscast the process of innovation and ultimately structural change. In this conventional view the firms are exogenous. They then invest m knowledge-generating activity, such as R&D and human capital, m order to obtain the output of innovative activity. Thus, the firms are exogenous and the knowledge leading to innovative activity is endogenous. In this conventional model the disadvantage confronting small enterprises, and especially new enterprises, which tend to be the smallest firms of all is clear. They simply lack the resources required to generate change. From the vantage point of the conventional model of the knowledge production function, one wonders why any rationale person would ever start a new firm, especially in an environment where innovative activity plays an important role.

The flaw in this conventional view provided by the model of the knowledge production function is the implicit unit of analysis at the level of the firm, which leads to what appears to be the logical assumption that the firms are *given* or exogenous. But when the lens is shifted to the unit of analysis of people, or the individual, a very different result emerges. While firms are no doubt receptacles creating and storing howledge (Dosi, 1988; Teece et al., 1994; and Nelson and Winter, 1982), at least some knowledge is embodied m people, either as individuals or collectively.

A rather large literature has emerged focusing on what has become known as the appropriability problem (Baldwin and Scott, 1987). The focus of this literature has again been focused on the unit of analysis of the firm. The underlying issue revolves around how firms which invest m the creation of new knowledge can best appropriate the economic returns fiom that knowledge (Arrow, 1962). What has been almost completely overlooked in the literature is that individuals are also confronted with an analogous appropriability problem. When the lens is shifted away fiom the firm to the individual as the relevant unit of analysis, the issue of appropriability remains, but the relevant question becomes, *How* ***can people with a given endowment of ideas and capabilities best appropriate the returns from that knowledge?***

If a person can pursue his ideas within an existing firm for roughly what he thinks they are worth, he will have no reason to start a new firm. But if he cannot pursue those ideas, or at least be rewarded for them, he has an incentive to start a new firm, either alone or in a team, in order to appropriate what he considers to be the value of his knowledge. Under what conditions is someone likely to remain in an incumbent firm or alternatively become involved in a new start-up? If the ideas and competence of a person, or his knowledge, is compatible with that of the incumbent firm, or what has become known as the firm's core competence and technological trajectory (Dosi, 1988; and Dosi et al., 1995), the person is more likely to be able to remain in an incumbent firm in order to appropriate the value of his knowledge. This is because there is more likely to be a convergence between the individual and the decision-making hierarchy m the evaluation of the ideas. Colleagues in the decision-making hierarchy are more likely to assign a roughly similar value to the ideas and be willing to implement them. Such (potential) innovations can be considered to be incremental in that they are compatible with the core competence and technological trajectory of the firm. The implementation of such incremental innovations do not require significant change in the firm or its personnel.

By contrast, a radical innovation can be defined as beyond the boundaries of the core competence and technological trajectory of the firm. Implementation of a radical innovation would require significant changes in the firm and its personnel. If the knowledge embodied in an individual involves a potentially radical innovation, there is more likely to be a disparity in the evaluation of that potential

innovation between the individual and his colleagues in the decision-making hierarchy. The incumbent firm is less likely to agree to pursue changes that involve activities outside of its core competence and technological trajectory. This means that for the individual to appropriate the value of his knowledge he must start a new firm.

An implication of shifting the lens of the appropriability problem fiom the firm to the individual is that, in an effort to appropriate the value of their knowledge, people are more likely to start new firms when a radical innovation is involved but less likely to start a new firm when the innovative activity is incremental. This suggests that structural change, which involves change and innovative activity that is fundamentally different and beyond the technological trajectories and core competencies of the incumbent firms, is more likely to come fiom new firms than fiom incumbent firms.

Shifting the lens of the appropriability question to the individual suggests that the traditional model of the knowledge production function is less likely to hold in the case of innovative activity inducing structuring change, or radical innovation, but more likely to hold in the case of incremental innovation, which does not typically induce structural change. In the case of incremental innovation, the knowledge generated in a firm through its R&D and human capital investments tends to be pursued and appropriated within the boundaries of that firm. Thus, the firm can rightly be viewed as being exogenous and the generation of knowledge and innovative activity endogenous.

However, in the case of innovative activity inducing structural change, or what could be termed as radical innovation, the traditional model of the knowledge production function is less likely to be valid. In this case, the effort by individuals and teams of people to appropriate the value of their knowledge through innovative activity leads to the creation of a new firm. This actually leads to a reversal of the traditional view of the knowledge production function, where the knowledge can be considered to be exogenous and a new firm is endogenously created.

There is considerable anecdotal evidence and case studies documenting the importance of new firms in structural change, along with the resistance and inability of large incumbent enterprises to undertake structural change inducing innovative activity (Audretsch, 1995). IBM resisted the development of the personal computer and later the microprocessor for years. The personal computer ended up being developed and introduced in a new *startup,* Apple Computer, and the microprocessor was developed and introduced by Intel. Siemens decided not to pursue the ideas of an employee to develop a work station, which led to his decision to leave Siemens and start a new firm in California, Sun. The biotechnology industry has its origins fiom scientists who were unable to commercialize their knowledge in large incumbent pharmaceutical companies and university laboratories and resorted instead to starting their own companies (Audretsch and Stephan, 1996). Based on their studies on the emergence of the biotechnology industry, Audretsch and Stephan (forthcoming) conclude that structural change in the form of new industries appears to come fiom knowledge created with perhaps one purpose in mind, but which is valuable in a very different context.

2.7. Labor Reallocation in Dynamic Markets

A conventional measure of quantitative flexibility in labor markets is the Index of Structural Change.[8] This index has often been used to address the ability of the labor market to adjust to shocks. Thus, for example, ALLEN and FREEMAN (1995) have assembled data on industry ISCs,

inter al., to suggest that there has been no increase in flexibility in the U.S. labor market in recent years, fiom which they infer that quantitative flexibility is unlikely to explain the different performance of the U.S. and European economies in recent years. [9]

Part of the ISC data they provide for U.S. one-digit occupations, 1956-93, is reproduced in Fig. B1. This points if anything to a decline in occupational shifts in the U.S. over the last two decades as compared with the 1950s, '60s, and '70s. Abstracting fiom the issue of the usefuness of the SIC construct, one interpretation of this result is of course that there has been no acceleration in technological change. Another possibility, also noted by the authors, is that the decline in relative wages for the less skilled in the U.S. has necessarily reduced the scale of employment shifts, perhaps because of a reduction in institutional rigidities (e.g. the decline in unionization). Yet another is that supply has reacted too slowly to shocks, thus requiring increased wage flexibility.

In comparing SICs for European countries with those for the U.S., ALLEN and FREEMAN emphasize the lack of major disparity in respective flexibilities, as measured by ISCs. They ultimately conclude fiom the different unemployment and real wage records of the U.S. and Europe that the U.S. has paid for its good employment performance via a weak wage performance. Flexibility, on this view, transcends overt restrictions on freedom of contract.

While accepting the latter point, it remains moot how far one can proceed in analyzing labor market reallocation on the basis of occupational ISCs, not least because the evidence also points to considerable shifts within occupations. A better approach to labor reallocation is to examine what happens at the level of the firm. First, and more generally, examination of the process of labor reallocation at the plant level within U.S. manufacturing rather tends to confirm what we have learned fiom more aggregative analysis but with one important qualification. Thus, it has been found that job reallocation (the sum of job creation and job destruction) in the U.S. is not widely different from that in many other nations. Vulgo: job churning is a normal state of affairs. *Also,* across all sectors there is excess job reallocation, that is, the sum of job creation and destruction often considerably exceeds that quantity required to meet net employment changes. Decomposition of this index of simultaneous job creation and destruction into its between-industry and within-industry constituents shows that the latter dominate the former, the interpretation now being that the process of job reallocation is driven by plant-level heterogeneity. (This is the important qualification.) Relatedly, there is little overall indication that greater exposure to international trade - as measured by import penetration or export share - impacts gross job flows or net job growth. additionally, job creation is higher in industries with greater total factor productivity growth. Because job destruction is not higher in these sectors, the implication is that industries with higher productivity experience greater within-industry reallocation as well as net employment growth. (For an amplification of these points, see DAVIS and HALTIWANGER, 1992; DAVIS ET AL., 1996.)

Second, and more specifically, analyses of skill upgrading within plants also reveal evidence of considerable plant heterogeneity. Although BELLMANN ET AL. (1996) are able to discern patterns in German establishment data - for example, a decline in the demand for workers without professional/vocational training that is monotonic in firm size, and major differences in the skill composition of the workforce in growing versus declining and closing firms in favor of the former - other analyses point to greater heterogeneity. Thus, in a personnel rather than employment based survey of 1,000 manufacturing firms in the German province of Lower Saxony, ADDISON and WAGNER (1997) report considerable heterogeneity in levels of and changes in skill composition

within firm size classes, age cohorts, and industries. They find no support for the notion of "creative destruction," nor do they find that the skill composition of exiting firms is in any observational sense inferior to that of survivors. They do find that the employment share of those with a university or polytechnic degree is positively associated with output and trade competitiveness but this result does not extend to skilled workers more generally.

The bottom line of establishment studies is therefore one of plant heterogeneity. As DAVIS ET AL. (1996, 158) note: "employment growth outcomes exhibit enormous heterogeneity among plants and firms that operate in the same classifiable sectors." The problem of heterogeneity is twofold. In the first place, it reminds us that technology encompasses many kinds of change that extend well beyond machines or computer programming or technical processes (e.g. management ability). Second, it manifestly complicates the design of labor policy.

Turning in conclusion therefore to policy, the main implications were rehearsed in WELFENS ET AL. (1997) and are *only* briefly noted here. These were that policy initiatives should seek to build on the notion of "universal complementarity" (MINCER, 1993) - namely, the strong empirical association between formal schooling and postschool training investments and returns - while safeguarding the position of the disadvantaged worker. The precise *mix* of policies for the latter is admittedly opaque in the absence of programs that have applied fully (as opposed to quasi) experimental procedures (BLOOM ET AL., 1997; ORR ET AL., 1996), and must anyway proceed on an incremental basis. As for the generality of the non-disadvantaged, the question of "what works best for whom" is we would argue best left to the market given the historical record (see, for example, GOLDIN and KATZ, 1995) and pending much more refined empirical analysis of alleged training shortfalls in private-sector training (on the theory of which, see BOOTH and SNOWER, 1996).

2.8. Firms from Eastern Europe and the NICs as Newcomers in Europe

The emergence of firms fiom Eastern Europe and the NICs is having a profound impact on Europe. The most immediate impact is m terms of new competition. On the one hand, firms fiom Eastern and Central Europe, as well as the NICs have access to considerably less expensive labor. The 1992 daily earning of labor have been estimated to be $78.34 in the European union, but only $6.14 in Poland, $6.45 in the Czech Republic, $9.25 in Hungary, and $8.98 in Romania (data adopted fiom Jensen, 1993). The wage gap is even greater m *Asia*. The 1992 *daily* average wage was $1.53 in China, $2.46 in India, $3.12 m Pakistan, $1.25 in Sri Lanka, and $1.49 m Vietnam. Firms fiom these countries also have access to enormous populations willing to work at these low wages.

On the other hand, the *skill* and human capital levels m at least some of these countries are quite high. Certainly countries such as Hungary and Poland have a long tradition of worker discipline. Taken together, firms from Eastern Europe and the NICs are able to combine low costs with quite high skill levels. This has upset the patterns of comparative advantage that the post-war Western Europe was built upon.

Giersch, Paque and Schmieding (1993) point out that the German Wirtschaftswunder, or economic growth miracle, was fueled to a considerable extent by relatively low labor unit costs and an undervalued currency. Technology developed in the United States could simply be adopted in

Germany, as was also the case elsewhere in Europe, with the end result of lower unit costs of production and international competitiveness in Europe. But as the European countries caught up to the United States, and the unit cost of labor began to even surpass that of the United States in countries such as Germany, the comparative advantage of high-cost Western Europe is shifting away from traditional moderate-technology industries and towards newer high-technology industries. Firms from Eastern Europe and the NICs are increasingly able to produce in moderate-technology industries at a substantially lower cost.

The three largest countries in Central and Eastern Europe, what was at that time Czechoslovakia, Hungary and Poland, signed treaties with the European Community in 1990. At the heart of those treaties was a declaration of cooperation concerning trade, commercial and economic relationships. These agreements anticipated the set of Association Agreements involving those countries, and the European Union, which were signed in December 1991, and became ratified by the fifteen national parliaments. In the preamble of what became known as the ***Europe Agreements,*** a commitment was made to the "development of trade and investment, instruments which are indispensable for economic restructuring and technological modernization" (CEPR, 1992). The Europe Agreements are not without problems, particularly with respect to conflicts and implementation. According to Winters (CEPR, 1992, p. l), 'The agreements are disappointing in the degree of support and encouragement they guarantee to Czechoslovakia, Hungary and Poland)...Indeed they sometimes appear to be designed as much to minimize the adjustment that the revolutions of 1989 cause in the EC than to maximize the benefits that accrue to Czechoslovakia, Hungary and Poland."

The timing of the association process was divided into two stages, each lasting five years. A key condition upon passage into the second stage is the "progress to a market economy'' (CEPR, 1992, p. 14). The first condition for making progress to a market economy is the free movement of goods. This involves the abolition of customs duties on "most industrial goods originating in the three countries" as well as all quantitative restrictions" (Mayhew, 1992, p. 14). In addition, an "anti-dumping" clause was included for protection of domestic industries against serious injury. Finally, under the European Agreements the Association Countries are held responsible for adhering to the competition laws of the European Union, as mandated under the 'Treaty of Rome". Similarly, all international trade agreements under the GATT must be adhered to (Mayhew, 1992, p. 16).

As Winters (1992, p. 20) points out, despite the promised trade liberalization inherent in the European Agreements, iron and steel producers m the European Unon were threatening antidumping actions against competitors m the Czech and Slovak Republics, Poland and Hungary: "As previously positioned, Czechoslovakian, Hungarian and Polish producers suffer a potential double-jeopardy – if Eastern and Central Europe must converge towards that practiced in the European Union. Similarly, practices involving customs law, company law, banking law, company accounts and taxes, intellectual property, protection of workers at the workplace, financial services, rules on competition, protection of health and life of humans, animals and plants, consumer protection, indirect taxation, technical rules and standards, transport and the environment all need to conform to the analogous practices currently found in the European Union.

In view of the large number of institutional adjustments that must be rapidly implemented in Eastern and Central Europe, Winters (1992, pp. 25-26) called for, "It is clear that (Czech and Slovak Republics, Poland and Hungary) need the legal framework – the soft infrastructure – to establish a market economy, and that they need it quickly; off-the shelf institutions seem to make sense in these

circumstances and in many casess the EC model is as good as any other. Moreover, given their aspirations to join the EC it seems better to adopt the necessary institutions *ab initio*. The difficulties, however, are two fold. First, (Eastern European countries) have no discretion about the final goal – harmonization – and no influence on the ways in which the EC might move the goal posts either through new legislation or the interpretation of existing legislation. Second, the timetable for approximation looks unduly quick ... In particular, it appears to be intended that approximation precede the (Eastern European)-EC fiee trade, which is not due for ten years. This reverses the normal order of integration and leaves a distinct impression that the EC is wiling to trade freely only on its own terms. By requiring (Eastern Europe) to adopt the same legal restrictions on economic activity as it has itself, the EC undermines many of the advantages of mutual trade. If (Eastern Europe) feels happy, with, say, lower worker protection, it makes sense for the EC to buy fiom them those goods for which this offers significant cost reductions. It is far fiom clear that the EC conventions, developed for countries such as France and Germany, are ideally suited to the needs of the poorer transitional economies, and yet the Europe Agreements appear to offer the latter no alternative, even temporary."

The challenge to Europe posed by the new competition from Eastern Europe and the NICS is whether to resist that new competition m traditional moderate technology industries in the form of barriers and protection, or whether simply to acknowledge that the events of 1989 have shifted the comparative advantage of the high-cost Western Europe to knowledge-based economic activity.

2.9. Globalization and Rising Importance of Diffusion

Product and process innovations clearly are crucial for productivity increases and economic growth. However, important is also the rapid diffusion of new technologies and an optimum use of best-practice technologies. With respect to the latter Germany suffered fiom a critical backwardness vis-a-vis the US, namely about 1/3 according to a recent study by McKINSEY (1996). Moreover, application of such technologies often are m sectors different fiom the innovative sector. Technology diffusion as a percentage of total embodied technology clearly was dominated by the service sector in the G-7 group m 1993 (OECD, 1997, p. 7). While the US, the UK, Japan and Italy recorded shares of more than 50%, France, Canada and Germany achieved only 44, 42 and 43%, respectively. In particular Germany as a country with an underdeveloped service sector thus foregoes opportunities for higher economic growth and employment creation. In the mid-1990s the share of services in GDP was about 10 percentage points lower in Germany than in the US, the differencs in the respective shares of employment in private sector services was of a similar magnitude. This apparent gap in the service sector is a major structural deficit in Germany and overcoming obstacles to the expansion of this sector is a major policy challenge. This, however, could be difficult to meet since the high percentage of long term unemployed - often former workers and employees fiom industrial firms - will rarely have the matching skills required for new jobs in service companies. Moreover, workers fiom the manufacturing sector which, being a high capital intensity-high productivity sector, used to pay rather high wages, will often find it unacceptable to voluntarily switch to a new job in the less capital intensive service sector which often will pay lower wages but offer greater job security.

2.10. Challenges for Achieving Efficient R&D Policies in the EU

The post-war view of R&D policy, not just in Europe, but also in all the OECD countries was based on an implicit routinized model of innovation in an economy where the most important inputs were land, labour and capital. R&D and technological change itself were viewed as being simply supplemental to these main factors of production. This was also an economy of relative certainty and stability, in that it was known what was to be produced, how it was to be produced, and who was to produce it. The international competitive advantage was generally achieved through cost reduction resulting from large-scale mass production to exploit scale economies.

The supplemental role of R&D in the post-war economy was designed to reduce costs through process innovation and to generate incremental innovations. The routinized role of R&D was perhaps first articulated by Schumpeter (1942, p. 132) who observed that, "Innovation itself is being reduced to routine. Technological progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways."

Because of the relative certainty regarding markets and products, the appropriate policy response was to target outputs. That is, specific industries along with particular firms could be targeted for R&D through government programs. The targeting of specific firms in selected industries was clearly a successll policy for Japan in the post-war period and helped the Japanese achieve the competitive advantage in industries such as automobiles and electronics (Audretsch, 1995).

The routinized model of innovation in an economy based on relatively high certainty and large-scale production also shaped R&D policy in Europe. The prevailing view in Europe was that its competitive disadvantage in high-technology industries was the result of a deficiency in firm size, which m turn was attributable to small and restricted domestic markets. As a response to 'The American Challenge," in the form of the dynamism, organization, innovation, and boldness that characterize the giant American corporations," J.-J. Servan Schreiber (1968, p. 153) prescribed an R&D policy that would undertake "the creation of large industrial units which are able both in size and management to compete with the American giants" (p. 159). Because giant corporations were thought to be needed to amass the requisite R&D resources for innovation, Servan-Schreiber (1968, p. 159) argued that ''The first problem of an industrial policy for Europe consists in choosing 50 to 100 firms which, once they are large enough, would be the most likely to become world leaders of modem technology in their fields. At the moment we are simply letting industry be gradually destroyed by the superior power of American corporations." This R&D policy prescription of targeting outputs is echoed in the 1988 Cecchini Report to the Commission of the European Union, where the anticipated gains fiom European integration are measured in terms of reduced costs achieved through increases in scale economies when firms are no longer limited to domestic markets and can instead operate on a larger European market.

How relevant is this traditional approach to R&D policy which targets outputs and outcomes today? One has to wonder what would have happened to the United States computer semiconductor industry had IBM been selected as "a national interest" around 1980 and promoted through favorable treatment as well as protected fiom threats like Apple Computer, Microsoft, and Intel. Would the United States be as strong in the computer, semiconductor, and software industries? While the proclamation, 'What is good for General Motors is good for America" may have been sensible during the post-war period, it no longer holds in the 1990s. The reason is the routinized model of R&D no

longer holds. First, as described in Section 3, globalization has resulted in the comparative advantage of high-cost locations, as is the case throughout most parts of Europe, is no longer compatible with economic activity in mature, traditional industries. The shift in the comparative advantage of high-cost locations in Europe to new and *emerging* industries means that economic activity is characterized by a high degree of uncertainty. Along with this shift in the comparative advantage of Europe has also come a shift in economic activity that is less based on the traditional inputs of land labor and capital and more based on the input of knowledge. It is no longer relatively certain what products should be produced, how they should be produced, and by whom. This increased degree of uncertainty increases the difficulty of selecting the correct outcomes and increases the likelihood that the wrong firm and industry will be targeted. Rather, the appropriate R&D policies in what Paul Krugman (1994) terms as *The Age of Uncertainty* is to target inputs, and in particular those inputs involved in the creation and commercialization of knowledge. Such R&D policies involve basic and applied research at universities and research institutes, investments in the general level of education as well as advanced technical specialties, and the training and upgrading of the skill levels of workers.

Perhaps a newer aspect of R&D policy involves not just the basic and applied research but also the commercialization of the howledge resulting fiom that research. The main conclusion fiom Section 2.6 is that new firms are especially crucial in the innovative process because they embody the attempt to commercialize knowledge in a manner that would otherwise would not be commercialized, particularly where structural change is involved. The efficiency of R&D policy can therefore be enhanced in an environment where the barriers to starting a new firm are at a minimum.

There is a broad range of institutions that are complementary to R&D and therefore enhance or impede the efficiency of R&D. Nelson (1995) argues that such institutions combine to constitute what he terms as a ***National System of Innovation.*** For example, the system of finance seems to be an institution that is complementary to and determines the efficacy of R&D. Many of the financial *systems* found throughout Europe, especially on the continent, were designed to enhance R&D and technological change under the model of routinized R&D (see CRESSY and OLOFSSON, 1997). For example, something of a paradox has emerged with respect to the system of financing for the German ***Mittelstand,*** or small- and medium-sized enterprises in Germany. On the one hand, there is reason to believe that through the development of a finely layered system of institutions linking together financial institutions, govemments, and private *firms,* that the system of finance in Germany serves as a model for providing funds to small- and medium-sized enterprises. Not only was the *Mittelstand* the backbone of the German *Wirtschaftswunder*, or economic miracle, and subsequent rise to global economic power, but it also appears to have played a more important role in German economic development than in most other countries.

On the other hand, while the German Mittelstand has provided the backbone for Germany's economic success, one aspect has been noticeably lacking in recent years – the emergence of small high-technology companies in the emerging industries, such as software, biotechnology, and computers. And it may be that the lack of entrepreneurial activity in high-technology industries is directly attri'butable to rigidities and constraints in providing liquidity to new firms in new industries imposed by the German *system* of finance (Audretsch and Elston, 1997). There are two institutional features of the German financial system that sharply contrast with that found in the United Kingdom which may influence the efficiency of R&D. First, companies in Germany typically rely almost exclusively upon banks for external finance. The external capital market remains relatively undeveloped in Germany. Second, not *only* do the banks represent the major financial intermediary supplying capital

to firms, but they are also extensively represented on the supervisory boards of companies. Cable (1985, p. 119) refers to this peculiarity of the German financial system which links finance to supervision as a "quasi-internal capital market."

Perhaps the most striking feature of the Germany system of finance is the overwhelming importance of internal finance. During the 1980s about 90 percent of finance of physical and financial capital formation of large quoted German companies came fiom internal fimds. By contrast, in Britain, only about 58 percent of such finance came from internal fimds. There is at best only a limited market for corporate control in Germany. The negligible role played by the market for corporate control is evidenced by the small number of public corporations. In 1989, only 2,682 publicly limited companies, what are known as *Aktiengesellschaften,* or Ags, existed in Germany. And of these only 501 were listed companies (Deutsche Bundesbank, 1991). Still, as Edwards and Fischer (1994) point out, the bulk of the largest German companies are, in fact, *Aktiengesellschaften.* Of the one hundred largest German companies, 88 are *Aktiengesellschaften.*

Financial and non-financial enterprises exert a high degree of ownership and influence on German firms. In 1988, non-financial enterprises accounted for 39.1 percent of the total nominal value of *Aktiengesellschaften,* and banks accounted for another 11.6 percent (Deutsche Bundesbank, 1991). Edwards and Gordon (1994) observe that a network of institutions, including intercompany holdings and the proxy voting system *(Depotstimmrecht),* company law, code-termination law, stock exchange regulation, and the system of regulation has evolved providing a system of corporate control in Germany where the largest industrial enterprises exert a key influence.

The system of proxy voting, or *Depotstimmrecht,* enables banks to vote on the shares which are owned by customers of banks. When the indirect control is accounted for, the control of the leading Germany companies by banks is considerable. For example, in 1992, banks controlled 95.5 percent of the voting rights of Siemens, 44.1 percent of the voting rights of Volkswagen, 98.5 percent of the voting rights of Hoechst, 94.7 percent of the voting rights of BASF, 91.3 percent of the voting rights at BAYER, 45.4 percent of the voting rights at These, and 98.1 percent of the voting rights at Mannesmann (THE ECONOMIST, 1995).

While considerable attention has been placed on the role that the *Grossbanken* play in terms of financing the largest manufacturing corporations of Germany, substantially less emphasis has been placed o the other institutions comprising the German financial system. Audretsch and Elston (1997) point out that, in fact, the Big Three Banks – the Deutsche Bank, the Dresdner Bank, and the Commerzbank – account for slightly less than one-tenth of all banking assets. The bulk of credit fiom the Big Three private banks is channeled into the largest firms.

The largest financial institutions are the Sparkassen, which are essentially public savings banks, and the *Genossenschaftsbanken,* which essentially are co-operative banks. While the *Sparkassen* account for around forty percent of all banking assets, the *Genossenschaftsbanken* account for about 15 percent of total banking assets. These financial institutions are generally oriented towards financing the German *Mittelstand.*

One of the major concerns about the German system of finance is that it provides efficient finance for investments where it is well understood what is to be produced, who is to produce it, and how the product is to be produced. Thus, the German system of finance may have excelled at providing

finance efficiently for the largest companies in the traditional industries, as well as the traditional mittelstaendische firms producing traditional types of products.

However, the German system of finance is not well equipped for providing finance outside of the traditional industries, that is in high-technology and newly emerging industries. And it is in these emerging high-technology industries that Germany is straggling behind North America and Southeast Asia. Thus, a recent cover story of *Newsweek* is devoted to, "Why Europe is Losing the Technology Race"(NEWSWEEK, 1994). As the lead article of this issue points out,, "The problems at Siemens are far fiom unique. They are, instead, spread throughout much of Europe's high-tech landscape, and m particular m what the Germans like to call "telematik": the rapidly converging fields of computers, telecommunications and television. With *only* a handful of exceptions, in nearly every segment of the so-called information-technology industry, there is a rout underway."

Similar sentiment can be found in Germany, where ***Der Spiegel*** observes that, "Global structural change has had an impact on the German economy that only a short time ago would have been unimaginable: Many of the products, such as automobiles, machinery, chemicals, and steel are no longer competitive in global markets. And in the industries of the future, like biotechnology and electronics, the German companies are barely participating." (DER SPIEGEL, 1994). And the ***Wall Street Journal*** warns that in Germany, "If you look at the chip industry, it's a disaster. And the computer industry has been for many years. Energy technology as such is a disaster" (THE WALL STREET **JOURNAL,** 1994).

What does the inability of Germany to shift its economic activity out of traditional industries and into new emerging high-technology and high-information industries have to do with the system of finance? As one of the leaders m the German Bundestag, or parliament, observed, "A company like Microsoft would ever have had a chance in Germany" (THE ECONOMIST, 1995). This is because, "Big German banks and leading industrial companies *form* a closed cartel that stifles investment in budding entrepreneurs" (THE ECONOMIST, 1995).

The system of finance m Germany consists of a complex of financial intermediaries that may actually have provided more liquidity to *firms,* even small- and medium-sized *firms,* than their counterparts obtain in other countries both within Europe and in other OECD countries. Certainly the evidence is that during the *Wirtschaftswunder* and post-war period, the system of finance provided a key complementary role to promoting the R&D policies of Germany, The challenge currently confronting the German system of finance is even more urgent – how to modify the financial system in order to facilitate finance for new firms m new industries. That is, while the incumbent system of finance may have been highly efficient m channeling funds to *mittelstaendische* and large firms alike in traditional industries, it is not at all conducive to financing new ideas that lay beyond the boundaries of traditional industries and enterprises.

In the United States venture capitalists hire scouts to travel around Silicon Valley and other high-technology clusters to identify good targets for venture capital. Venture capital firms are then prepared to back promising start-ups with around $4-$5 million. By contrast, considerably more caution is shown by their European counterparts. For example, Dutch venture capitalists are more focused on later-stage financing, "They like to avoid risks, but they really should be more prepared to give money to people with good ideas" (THE NETHERLANDER, 1997). At the same time there is also evidence that the software companies themselves are not receptive to venture capital: "A

number ofventure capital companies are **willing** to supply money to software companies, so much **so** that they are investing in Israeli and French software companies...But many Dutch software companies are not looking for finance. The software industry itself exhibits a cautious approach to financing."

The United Kingdom has been more successll at implementing structural change than has Germany. One reason has been the existence **of** what is **known** as ***Business Angel*** *Networks*, which provide a channel of communication between private venture capital investors, commonly **known** as business angels, and entrepreneurs seeking risk capital (Mason and **Harrison,** 1997). These business angel networks typically operate locally **on** a non-profit basis and their costs are underwritten by the government. Even with the recent emergence of private business angel networks, there **still** seems to be an important role for support fi-om the public sector, since the evidence suggests that private sector business angel networks are primarily involved with larger, alter stage deals, whereas investments made through non-profit business angel networks generally involve smaller startups at an earlier stage of development. The emergence of private sector business angel networks has not eliminated the need for public sector support of locally-oriented business angel networks.

3. European R&D Policy from a Global Perspective

European **R&D** policy needs to be evaluated and formulated within the context of a global perspective. **Part** ofthe reason for the importance of a global perspective is the opportunity to learn fiom the experience **of** other countries. But the biggest reason is that globalization has shaped the types **of** R&D policies that tend to be successll in Europe.

There are **two driving** aspects of globalization. The **first** invokes the telecommunications revolution which has drastically reduced the cost **of** transmitting information across geographic space. The second aspect involves the emergence of competition from a broad spectrum of countries that were not competing with European nations only a few years, spanning from low-cost countries such as Indonesia and Malaysia, to countries with formidable stocks of knowledge and technological competence, such as Singapore and Taiwan. Taken together, these two forces have altered the way in which **R&D** policy can be effective **m** Europe.

Much of the **R&D** policy in Europe has been targeted towards the established European industries which have historically been the engines of European growth and competitiveness. Such traditional industries include automobile production, metalworking industries and machine tools. The industry life-cycle theory introduced by Raymond Vernon **(1966) is** typically considered to 'lirk trade and foreign direct investment to the stage of the life-cycle. There **do** not appear to be direct implications for **R&D** policy. But a more thoughtful examination **of** the fiamework **of** the industry Me-cycle suggests that the role of **R&D** policy is shaped by the industry life cycle.

There have been various renditions of what actually constitutes the industry life cycle. For example, Oliver Williamson **(1975,** pp. **215-216)** has depicted the industry life cycle as, 'Three stages in an industry's development are commonly recognized: an early exploratory stage, an intermediate development stage, and a mature stage. The **first or** early formative stage involves the supply **of** a new product **of** relatively primitive design, manufactured **on** comparatively unspecialized machinery, and

marketed through a variety of exploratory techniques. Volume is typically low. A high degree of uncertainty characterizes business experience at this stage. The second stage is the intermediate development state in which manufacturing techniques are more refined and market definition is sharpened, output grows rapidly in response to newly recognized applications and unsatisfied market demands. A high but somewhat lesser degree of uncertainty characterizes market outcomes at this stage. The third stage is that of a mature industry. Management, manufacturing, and marketing techniques all reach a relatively advanced degree of refinement. Markets may continue to grow, but do so at a more regular and predictable rate...established connections, with customers and suppliers (including capital market access) all operate to buffer changes and thereby to limit large shifts in market shares. Significant innovations tend to be fewer and are mainly of an improvement variety."

While not explicitly stated by Vernon (1966) or Williamson (1975), the role of R&D does not stay constant over the industry life cycle. In the early stages of the life cycle, R&D tends to be highly productive, so that there increasing returns to R&D. In addition, the costs of (radical) innovation tend to be relatively low while the cost of incremental innovation and imitation tend to be relatively low. Because innovation in newly emerging industries tends to be more radical and less incremental, it is more costly to diffuse across geographic space for economic application in lower-cost locations.

By contrast, as an industry evolves over the life-cycle, the cost of radical innovation tends to increase relative to the cost of incremental innovation and imitation. That is, strong diminishing returns to innovative activity set in relative to incremental innovation and especially imitation. An implication is that it requires an increasingly amount of R&D effort to generate a given amount of innovative activity as an industry matures over the life cycle. At the same time, it requires a decreasing amount of expenditures to transfer new technology to lower cost locations, because innovation activity tends to become less radical and more incremental.

An important implication of the life cycle model is that as an industry matures, the cost of limiting falls relative to the cost of innovating, so that it becomes increasingly economical to transfer that technological knowledge to less costly locations of production, either through trade or foreign direct investment.

Giersch, Paque and Schmieding (1992) point out that the German *Wirtschaftswunder*, or economic growth miracle, was fueled to a considerable extent by relatively low labour unit costs and an undervalued currency. Thus, technology developed in the United States could simply be adopted with the end result of lower unit costs of production and international competitiveness. But as the European countries caught up to the United States, and the unit cost of labour began to even surpass that of the United States in countries such as Germany, simply following a strategy of technology adoption is no longer sufficient to ensure international competitiveness in Europe. The 1994 mean manufacturing employee compensation (including insurance and other employee benefits was the highest in Germany, at $25.71 per hour. By contrast, the mean hourly manufacturing wage was just $19.01 in Japan and $16.73 in the United States.

Many of the industries which have been the traditional strengths in Western Europe have evolved towards the mature and declining stages of the life cycle. This means that the high-cost *Standort* in European countries become increasingly vulnerable, since the production of rather standardized technologies can be shifted to locations in central and Eastern Europe, or in Asia, with lower production costs.

While labour cost disadvantages can be offset through productivity increases and the substitution of technology for labour, innovative activity itself tends to become more incremental in nature as the industry evolves over the life cycle. Therefore, in mature industries it becomes increasingly difficult for European firms in mature industries to maintain their international competitiveness through innovative activity.

The divergence of real living standards between the developed and developing countries combined with the maturation of traditional industries in the developed countries dictates that either domestic firms lose market shares to foreign companies which are increasingly able to clone existing technologies and apply them to cheaper location-specific costs, such as wages, or else they maintain their competitiveness through foreign direct investment and shifting to production to lower-cost foreign locations.

The consequences of the maturation of traditional industries in high-cost locations is downsizing -- as a result of either a loss in market share or a shift in production out of the high-cost *Standort* to lower-cost locations -- is what has been termed in the press as corporate downsizing. The United States Labor Department recently reported that as a result of corporate downsizing "more than 43 million jobs have been erased in the United States since 1979" (NEW YORK TIMES, 1996). This includes 24.8 million blue collar jobs and 18.7 million white collar jobs. Between 1980 and 1993, the 500 largest U.S. manufacturing corporations cut 4.7 million jobs, or one quarter of their work force (Audretsch, 1995). Recent downsizing announcements by U.S. corporations include 123,000 job cuts by AT&T, 122,000 by IBM, and 99,400 by Boeing. Since 1986 IBM has reduced employment by about 45 percent (BUSINESS WEEK, 1995), Perhaps most disconcerting, the rate of corporate downsizing has apparently increased over time. During most of the 1980s, about one in 25 workers lost a job. In the 1990s this has risen to one in 20 workers (BUSINESS WEEK, 1996).

Such downsizing has not been at all unique to the United States but has become increasingly rampant throughout Europe. Consider the case of Sweden. Some 70 percent of Sweden's manufacturing employees work for large companies, most of them multinationals, such as Volvo, which have been constantly shifting production out of the high-cost location, Sweden, and into lower cost countries, through outward foreign direct investment. Between 1970 and 1993 Sweden lost 500,000 private sector jobs, and unemployment is currently 13 percent of the workforce. And Sweden is not an exceptional case. For example, every third car that is manufactured by a German company is actually produced outside of Germany (HANDELSBLATT, 1994). Similar corporate downsizing has taken place in Germany (DER SPIEGEL, 1995). For example, employment by the ten largest companies has generally fallen within Germany between 1984 and 1995. At the same time, employment by these companies outside of Germany has risen, drastically in some cases. Thus, there is considerable evidence that the largest German companies are shifting jobs outside of Germany, resulting in a wave of corporate downsizing within Germany.

As Die Zeit points out in a front page article, "When Profits Lead to Ruin -- More Profits and More Unemployment: Where is the Social Responsibility of the Finns?" the German public has generally responded to this corporate downsizing with accusations that corporate Germany is no longer fulfilling its share of the social contract (DIE ZEIT, 1996).

What is to become of the dislocated resources, in particular labour? The answer is nothing, unless either the price of those inputs, i.e. wages, fall sufficiently to compete internationally, or they are redeployed in new economic activity that cannot be so costlessly diffused across geographic space.

Combined with the telecommunications revolution, this means that information generated by R&D in mature industries can be transferred to lower-cost locations for economic commercialization. By contrast, the knowledge resulting fiom R&D in newly emerging industries cannot be easily transferred to lower-cost locations for economic commercialization. Thus, globalization changes the nature of the comparative advantage of the particular quality of R&D activity in Europe away fiom modifications along existing technological trajectories and towards new products and the creation of new technological trajectories. The importance of geographic location to knowledge spillovers and innovative activity in a world increasingly dominated by E-mail, fax machines and electronic communications superhighways may seem surprising and even paradoxical. After all, the new telecommunications technologies have triggered a virtual spatial revolution in terms of the geography of production. According to ***The Economist,*** "The death of distance as a determinant **of** the ***cost*** of communications will probably be the single **most** important economic force shaping society in the **first** half **of** the next century. It will alter, in ways that are only dimly imaginable, decisions about where people live and work; concepts **of** national borders; patterns of international trade (THE ECONOMIST, 1995).

The resolution to the paradox posed by the localization of knowledge spillovers in an era where telecommunications has dramatically reduced the cost of communication lies in a distinction between knowledge and information. While the marginal cost of transmitting ***information*** may be invariant to distance, presumably the marginal cost of transmitting ***knowledge,*** and especially ***tacit knowledge,*** rises with distance. **Von** Hipple (1994) persuasively demonstrates that **high** context, uncertain knowledge, or what he terms as sticky knowledge, is best transmitted via face-to-face interaction and through frequent contact. Proximity matters in transmitting knowledge because as Kenneth Arrow (1962) pointed out some three decades ago, such tacit knowledge is inherently non-rival in nature, and knowledge developed for any particular application can easily **spill** over and be applied for different purposes. Similarly, Zvi Griliches (1992, pp. 29-47) has defined knowledge spillovers as "working **on** similar things and hence benefiting much fiom each others research." Glaeser, Kallal, Scheinkman and Shleifer (1992, pp. 1126-1152) have observed that " intellectual breakthroughs must cross hallways and streets more easily than oceans and continents."

That knowledge spillovers tend to be geographically localized is consistent with frequent observations made by the popular press, business community, **as** well as by policy makers. For example, ***Fortune*** magazine points out that, "business is a social activity, and you have to be where important work is taking place" **(FORTUNE,** 1993). **A** survey of nearly one thousand executives located in America's sixty largest metropolitan areas ranked Raleigh/Durham as the best city for knowledge workers and for innovative activity (the survey was carried out in 1993 by the management consulting firm of **Moran,** Stahl & Boyer **of** New York City). ***Fortune*** magazine reports, "**A lot** of brainy types who made their way to Raleigh/Durham were drawn by three top research universities... **U.S.** businesses, especially those whose success depends **on** staying atop new technologies and processes, increasingly want to be where hot new ideas are percolating. **A** presence in brain-power centers like Raleigh/Durham pays **off** in new products and new ways of doing business...Dozens of small biotechnology and software operations are starting up each year and growing like ***kudzu*** in the fertile business climate" **(FORTUNE).**

And *Business Week* reports a cluster of innovative activity located in the Seattle region, "These startups clustered in and around Seattle are determined to strike it big in multimedia, a new category of software combining video, sound, and graphics. Why Seattle? First and foremost, there's Microsoft Corp. The $4.5 billion software giant has brought an abundance ofprogramming whiz kids to the area, along with scores of software startups. But these young companies also draw on Seattle's right-brain side: its renowned music scene, acclaimed theater, and a surprising array of creative talent including filmmakers, animators, writers, producers, and artists" *(Business Week, 1994).*

Considerable evidence has been found suggesting that location and proximity clearly matter in exploiting knowledge spillovers. Not only have Jaffe, Trajtenberg and Henderson **(1993)** found that patent citations tend to occur more frequently within the state in which they were patented than outside of that state, but Audretsch and Feldman **(1996)** found that the propensity of innovative activity to cluster geographically tends to be greater in industries where new economic knowledge plays a more important role.

As Archibuigi and Pianti show, along with the country studies in Richard Nelson's exploration of *national systems of innovation,* R&D policies in Europe are typically oriented towards mature and traditional industries. R&D in these mature and traditional industries do not tend to transmit into employment growth in the domestic country. Rather, the low-cost of diffusing the information tends to result in the transfer of the economic activity out of the high-cost location and into lower-cost locations around the globe.

Thus, the forces of globalization dictate that European R&D policy needs to shift away from the mature industries and towards new and emerging industries. Why has it proven so difficult to shift R&D out of traditional mature industries and into newly emerging industries? At least some insight is provided by the literature identifying the role that specific technological paradigms play in shaping the nature of innovative activity. This literature, which spans organizational theory and business history suggests that firm behavior and organizations are shaped by the specific technological environment in which firms are operating (Chandler, **1990).** In particular, this literature has generally identified that firm behavior is closely linked to core firm competence. That is, firms are organizations with a specific set of competencies within a bounded set of activities. As Nelson and Winter **(1982)** emphasize, firm core competencies typically have a tacit nature and are stored and organized in the routines which guide decision-making. The learning process through which capabilities and routines are developed and shaped is to a large extent local and path dependent.

The concept of *technological paradigms* links the technological environment within which the firm has operated to the core competence of that firm. Innovations that enhance the existing capabilities and routines are generally viewed as falling within the technological paradigm of the core competence of the firm. By contrast, innovations that detract and destroy the existing capabilities and routines of the firm are generally viewed as falling outside of the boundaries of the core competence of the firm.

Whether or not any given firm adopts a new technology will very much depend upon whether that new technology falls within the core competence of the firm or outside of the core technological competence. This is because the cost of adoption to the organization is considerably lower for competence enhancing innovations than for competence destroying innovations. As Dosi, Pavitt and Soete **(1990,** p. 45) point out, "Leadership in an old technological paradigm may be an obstacle to a swift diffusion of the new one, especially owing to the interplay between the constraint posed by

the capital stock to readjustment ofproductive activities and the behavioral trends in 'old' companies which may embody differential expertise and enjoy high market shares in 'old' technologies."

Archiiugi and Pianta (1992) have analyzed patterns of patenting for specific industries over a broad spectrum of countries and concluded that, even when considered over a long period of time, the technological capabilities of most countries remain remarkably specialized. Most countries, especially smaller ones, tend to specialize in technology in just several industries. Within the technological paradigms associated with these industries new technological developments apparently tend to diffuse fairly rapidly. However, there has been little tendency for countries, and especially European countries, to broaden their technological bases, suggesting that diffusion across technological paradigms is considerably more complicated and costly.

Cohen and Levinthal (1989) argue that firms can influence their ability to adopt new technologies by expanding the boundaries of core competence, or what they term absorptive capacity. While R&D is generally considered to generate new technological knowledge, Cohen and Levinthal argue that it also serves a dual purpose -- to assimilate and exploit existing knowledge, or to facilitate the adoption of existing technology. That is, economists (Arrow, 1962) have long observed that firms invest in R&D in order to internalize knowledge which is external to the firm. Cohen and Levinthal (1989, p. 569) similarly argue that, "While R&D obviously generates innovations, it also develops the firm's ability to identify, assimilate, and exploit knowledge fiom the environment."

Cohen and Levinthal refer to the two faces of R&D, but there is perhaps also a third face. The nature and direction of R&D activities undertaken, while serving to expand the absorptive capabilities of the *firm,* may also contribute to defining the boundaries and entrenching those boundaries of the firm's capabilities. Thus, Cohen and Levinthal make explicit reference to the numerous studies identifying that many of the important innovations in new industries come fiom outside of the emerging industry. For example, most of the computer industry's main innovations originated with developments outside of the industry, particularly in semiconductors. Similar evidence has been found for the aluminum industry. And an important study found that of the twenty-five major discoveries introduced into the United States by DuPont, despite the company's reputation for pathbreaking research, fifteen originated with work done outside of the company. Why weren't these innovations pursued by the firms creating the initial technological knowledge? Presumably because their (restricted) core competencies did not easily permit adopting new technologies beyond the boundaries of the firm's technological paradigm.

3.1. R&D Policies in the EU, the US and Far East Asia

It used to be that the literature identified the most obvious difference between R&D policies in the European Union, the United States and East Asia is that technology policies have been targeted towards accomplishing specific projects in countries such as France, the United Kingdom and the United States, while they have been more oriented towards the diffusion of technology in countries such as Germany and Japan (Audretsch, 1989;; Ergas, 1987; Audretsch, 1997). This dichotomy between *mission-oriented* and *diffusion-oriented* technology policies, which seemed important for the post-war period, seems less compelling today.

What seems more compelling m the contemporary world is a fiamework that focuses on R&D policy in terms of the production of new knowledge, the commercialization of that knowledge, and the diffusion of existing knowledge. This fiamework is better articulated by Richard Nelson (1993) in his *National* Systems *of* Innovation.

R&D policy has generally shifted in East Asia fiom targeting selected outputs and incomes, which was more typical during the post-war period, to targeting selected outputs and outcomes. An example of the more traditional R&D policy of targeting outputs and outcomes was prevalent in Japan during the post-war period, starting with automobiles and electronics and later spreading to consumer electronics and computers (Audretsch, 1989). The Very Large Scale Integration (VLSI) project targeted R&D m semiconductors, which was formed in 1976 and operated until 1979 may be one of the last examples of successll targeting of outputs and outcomes in Japan. The goal of the VLSI project was to develop large-scale integration and high-speed semiconductors for use in domestically manufactured computers. Five firms were targeted in the VLSI project – Fujitsu, Hitachi, Mitsubishi Electric, NC and Toshiba. The VLSI Technical Research Association consisted of these firms and was formed to help advance basic research in fields such as micro-processing, crystallization, design and device technology, all of which were essential for development and competitiveness of the Japanese semiconductor industry (IFO, 1997).

R&D policies in the Netherlands have been particularly effective in recent years. The Dutch high-technology industry has been booming. The number of personnel engaged in information technology m the Netherlands increased from about 760,000 in 1990 to around 835,000 by 1991. But then high-technology entered a slump, with employment falling to around 725,000 by 1994. However, as a result of government policies the sector has revived, so that by 1996 there were around 760,000 employed m information technology. One of the policies pursued has been to establish the high-tech company in Silicon Valley. This provides access to the most prominent knowledge source and also gives the company an edge in building a reputation. On the basis of the reputation built in Silicon Valley, the company then moves back to the Netherlands by persuading Dutch investors of the future viability of the start-up.

Still, start-up companies suffer fiom a lack of venture capital; there is a shortage of qualified people. And the best firms tend to be taken over rapidly by American high-tech companies. For every information technology worker seeking a job m the Netherlands there are an average of five vacancies. In addition, many of the highly-qualified people leave for the United States (THE NETHERLANDER, 1997). *The* Netherlander warns that, "The paradox is that while the IT industry is the biggest economic sector m the world, interest is waning in the Netherlands." One of the pioneers of the Dutch software industry, Bodo Douque, who founded the software company Inside Automation in 1984 warns that the high-technology sector "is a disaster. Software is a fantastic product and there are far too few women working in IT. But the politicians are too busy listening to old pre-war companies." In particular, the one billion Dutch guilders pumped into Fokker prior to its bankruptcy would have been better spent on giving one million guilders each to 1,000 start-up companies.

In order to promote investment in Dutch high-technology, two new indices have been introduced which track technology companies – the Microelectronics, Information Services and Telecommunications (MIT) and the MJT Smallcap. Both indices include all the bourse-listed companies in these sectors, with the exception of Philips and KPN, which are excluded fiom the

MITS. The index is the result of a government-private partnership combining the Statistics Netherlands (CBS) and the technology broker Wessilus. The idea behind the index was to increase the visibility of the Dutch high-technology sector. These indexes have contributed to the prediction of a 40 percent growth in the Dutch high-technology sector over the next three to four years.

One of the most promising fields in high-technology in the Netherlands is micromechanics. The industry is centered around the Delft Institute of Microelectronics and Sub-micro technology (Dimes). Dimes consists of around 300 researchers and is the largest microelectronics university institute in the Netherlands. In addition to a number of contracts with Philips, Dimes is also conducting studies for about 50 smaller companies.

Since the 1980s all OECD countries have established technology policies which are aimed at increasing through the development of scientific and technical resources. Most of this technology policy is undertaken at the national level and is predominantly concerned with levels of funding. Such national levels of R&D funding and national technology policies are problematic, because much of the innovative activity in high-technology is of a regional nature and is overlooked by national technology policies.

3.2. Basic Research in an International Comparative Perspective

The term "science" is understood to cover the creation, discovery, examination, classification, reorganisation and dissemination of knowledge on physical, biological or social subjects. "Technology" is science application know-how. As such, it belongs to a large group of like activities which embrace the creation and use of artefacts, crafts and items of knowledge as well as various forms of social organisations. Technology does not only signify the application of scientific results, but any purposive treatment, method, working method and skill m the exploitation of scientific knowledge together with the products of so doing.

The significance of the "research" process in the materialisation of the innovations nowadays is uncontested. According to the rules of present day research statistics, a distinction must be made between fundamental research, applied research and experimental development (OECD, 1993). The three subsequent differentiated concepts are often combined under the heading "research and development (R&D)".

'Basic research" refers to experimental or theoretical work geared primarily to the acquisition of new knowledge about the basic original phenomena and observable events without targeting a particular application or use. "Pure basic" or "fundamental research" is not initiated primarily, but exclusively with the aim of advancing knowledge without in so doing raising expectations of an economic or social increase of prosperity, not even as a long-term prospect, nor is it dedicated to solving practical problems. The term "application-oriented basic research" is used in situations where basic research targets certain areas of general interest like climate, cancer, energy saving research, or is focused in their direction. For this grey area between pure basic research and applied research, other concepts such as "strategic" or 'long-term application oriented" concepts have also been formulated. These are however, not component parts of the set of conventions specified by national and supra-national organisations.

Science and technology are often distinguished from research and development by institutional demarcations and then designate the place at which R&D occurs. However, this is a problematic concept. The term science includes college instruction, while R&D activity adds to the general availability state of the art knowledge. It represents knowledge production. Unlike college instruction, ie. caring for the knowledge base and its dissemination, knowledge production has the status of an economic activity, as it was obvious since long what impact research processes could have an economic growth. Thus, the concept science and technology should be kept separate from R&D and not be demarcated by the institutional approach. For is it not science for which an industrial researcher is awarded the Nobel price? And surely virtually everything that a college does is therefore already science? Basic research is not identical to science and experimental development is not identical to technology.

Therefore, owing to the partial overlaps between the science and technology systems, these are only clearly distinguishable in archetype. *Also,* R&D activities can only be subdivided into various types analytically but not always in practice.

With these reservations let us have a look at the breakdown of government budget appropriations of European countries fist. Some of these funds are used for definite areas of oriented research like the ones mentioned above, another part is dedicated for defence research. We have put all these application-oriented objectives of research under the term "oriented research" and kept separate the non-oriented part and general university funds.

Thus, in comparative perspective, it becomes clear that a series of smaller European countries is strongly oriented towards general universities and other non-oriented research and does spend comparatively little money on oriented research. The Netherlands, Italy, Sweden and Germany also belong to this group with a share of less than 50 per cent dedicated for oriented research. The other EU countries and notably the United Kingdom and France spent relatively little on general basic research and put more emphasis on oriented research (in case of the two last-mentioned countries, for armament also). Thus, we have to conclude, country-specific patterns of spending in basic research persist even within the European Union.

Reportedly the United States government with its large share of defence research spends least on general basic research, whereas Japan with a small defence R&D budget resembles the pattern of Germany. As these two major countries are not covered by EUROSTAT statistics in a comparable way, the data may not correspond precicely and are for 1992.

Most striking is the difference in national and European spending in this respect. The average of the EU 15 countries is included in the figure according to which between 40 and 50 per cent of government R&D appropriation is dedicated towards non-oriented research, whereas the European Commission nearly exclusively is engaged in oriented research. What we observe here is a clear distribution of labour between national European govemments and the Commission which hardly contributes to non-oriented basic research. What this means for future R&D policy is discussed in the sections below.

3.3. Links between Research and Industry

Basically, the relationship between non-industrial research institutions and industry should be described as "interaction" in contrast to the older concept of "transfer" (SCHMOCH et al., 1996, p. 57). Knowledge is not *only* transferred one way, fiom research institution to industry, but there exists a flow of know-how in the opposite direction. Our arguments that follow are based on a respective investigation of SCHMOCH et al. (1996).

As older studies have shown, basic science contributes to the progress of technology in a decisive way. However, it is difficult to trace the ways and to measure this impact precisely. As difficult as a definition of science vs. technology is the specification of knowledge-flows between academia and industry. As in many cases there is a large time-lag between scientific discoveries and their introduction into technology, there is furthermore the necessity to provide a sufficiently long observation period, a requirement which is often overlooked in questionnaire surveys.

The respective literature points to observations that the scientific input into innovation heavily depends on the industrial sector concerned and the technical area considered. Therefore, what maybe found in case studies maybe "stained" by the industrial sector of the case study. Some of the discrepancies which are reported on the subject are likely to disappear if account is taken for all these complex influence factors.

As scientific activities are performed in non-industrial research institutions as well as in industry, the notion of science-linkage (see next section) does not necessarily imply that an intensive flow of knowledge from academic circles exist. For example, in the case of the British industry, PAVITT (1984, pp. 346-348) reveals that the public research infrastructure heavily supports the development and manufacturing of electronic components, computers and electronic capital goods. In contrast to this, the public contribution to the area of chemicals is quite low, what reflects the fact that firms in this area rely more on their own scientific in-house research.

In Germany, however, GRUPP and SCHMOCH (1992, pp. 96-97) observe a high contribution of universities to chemistry and a much weaker reliance on the public research infrastructure in electronics. Obviously, the actual patterns of knowledge transfer largely depends on the national academic and industrial traditions that have occurred over time and shape the different systems of innovation. From the number of patents universities take out, one can even determine the share universities hold in direct technology production which resembles industrial R&D. Again, this share various between sectors and between countries.

Another important contribution to the linkage between research and industry is the existence of spill-overs. Knowledge created within an institution spills over for use by other institutions. This is so among enterprises and among academic institutions but also between the research and industrial sector. Enterprises and also individuals have access to knowledge external to them without any institutional transfer mechanisms. The empirical evidence clearly suggests that R&D and other sources of knowledgement not only generates these externalities, but studies also suggest that such linkages tend to be geographically bounded within the region where the new economic knowledge was created (AUDRETSCH and FELDMAN, 1996). That is, the new knowledge may spill over across firms and economic agents but the geographic extend of such knowledge linkages tends to be bounded and, thus, the specific national structures come as no surprise.

Coming back to the relevance of the linkage problems for globalisation we have to repeat that the importance of location to innovative activity in a world increasingly dominated by e-mail, fax machines, electronic communication and super highways, may seem surprising and even paradoxical at first glance (WELFENS et al., 1997). The resolution of this paradox comes into sight if we consider the distinction between knowledge and information. If we believe in the classic economic idea that the marginal costs of transmitting information may be invariant to distance, we presumably have to admit that the marginal costs of transmitting knowledge, and especially tacit knowledge, raises with distance, country, language, culture, and sector. What VON HIPPEL (1988), terms as sticky knowledge in our context, is knowledge best transmitted via face-to-face interaction and frequent contact. This limits the extent and the main distance of global R&D and reinforces that proximity matters in transmitting knowledge.

Despite the general consensus that knowledge linkages within the given locations stimulates innovative activity, there is little consensus as to exactly how this occurs if we think of the difficulties m establishing links between research and industry per sector and per nation. From this the desire of MNC headquarters to participate simultaneously in several national innovation systems, is perfectly understandable, even if the maintenance of several R&D labs in various countries is costly.

3.4. Position of EU Science-Based Industries

The notion of "science-based industries" is usually discussed on the basis of a typology by PAVITT (1984). He presented an analysis based on an earlier study of TOWNSEND et al. (1981) on industrial sectors. Therein PAVITT identified four main types of firms: Supplier-dominated firms, scale-intensive firms, specialised equipment suppliers and science-based firms.

Science-based firms, the most interesting type in the context of globalisation, are located in the sectors of chemical, electrical and electronic engineering following PAVITT (LOC. CIT.). These sciencebased industries rely heavily on the R&D activities of firms which largely profit from the rapid development of the underlying sciences in universities and elsewhere. The science-based firms develop a high percentage of process technology in their own laboratories. From this the share of large companies is relatively high as there are minimum levels or thresholds for a size to be relevant for performance m-house R&D. On the other hand a number of high technology start-up companies fall into the science-based sector.

Industrial sectors are not homogenous in their structure. They include companies which produce a broad variety of products, each of them rely more or less on science (SCHMOCH et al., 1996, p. 63). Thus, the sectoral approach which is the basis of PAVITTs approach only gives a rough idea of the underlymg patterns. That is why GRUPP and SCHMOCH (1992) have provided an attempt to define the area of science-based products in distinction to the one based on industries. They analysed 28 areas of technology by means of patent indicators and used the average number of references to non-patent literature in patent search reports as a measure for science intensity. This implicit definition of science, based on scientific publications, is not limited to the academic sector, but encompasses scientific activities in industry as well, because scientists and industry also publish articles in scientific journals.

Following this approach, the most science-based areas, genetic engineering and lasers are located in chemistry and electronics as already PAVITT has concluded in a coarser typology. Across-country comparison shows that Japan and the United States are more active than European countries in science-intensive technology. Within the European Union one can differentiatethe continental and the Anglo-Saxon cluster of countries whereby the latter are relatively more active in science-dependent area (United Kingdom, Ireland, the Netherlands).

If one brakes down the overall picture it is obvious that in the seventies and eighties, public research centres and universities concentrated a large part of their activities on the nuclear sector. Prior to this, for instance m Britain, public research centres made enormous contributions to the areas of iron and steel or coal mining. These national topics of public research are often linked to large prestige projects or the requirements of sectoral of local pressure groups and are, therefore, not necessarily science-intensive m the long-run. On the other hand, with laser technology, genetic engineering and other areas, new scientific opportunities are coming up fiom time to time which then undergo an intensive exchange of ideas with private industry.

Generally, science-dependent areas are international areas and there is little distinction between countries. The science dependence of technology is an intrinsic feature of technology. Yet, the difference between the countries lies m the fact that some national innovation systems are more active m some of the sciencebased sectors than others and thus - without considering the discipline specific breakdown - look m a macro perspective as if they were more or less science-dependent. So we have to differentiate between the mtrinsic properties in science and technology and the extent of activities which may differ between the countries.

Coming back to the position of the EU, we have to express clearly that in Europe the same areas are science-dependent as elsewhere in the world. However, the weaker performance of some (continental) EU countries in science-dependent sectors originates fiom the fact that they are less active there m comparison with non-science-dependent sectors. Thus, we may reduce the issue to a matter of profiling activities and not to any basic inefficiency in Europe.

3.5. Requirements for Future R&D Policies

Our arguments on the future requirements for R&D policies follow basically WELFENS et al. (1997). Thus, contemporary R&D policy has moved away fiom the inappropriate idea that the state could direct basic research over technological developments right down to individual national innovations. Equally outmoded is the idea that the State could be satisfied with the role of a subsidiary supporter of basic research and leave the control of technology to anonymous market processes. R&D policy for the start of the 21st century requires a middle way. An active role for the government as an intermediary between social players (companies, associations, interest groups, science communities, consumers, media, employers, and employees, etc.).

For the European R&D policy, this intermediary role must also take into account the fact that it is restricted m its scope fiom below. The activities of the European Communities must always be seen in contexts with the efforts of national policies and, in addition in some member countries, with below-national policies in federal states that promote research on a regional basis.

The new role of European R&D policy necessitates a policy process which is co-ordinated with industry, science and society. Cooperation does not, however, occur of itself since there are too many divergent interest m the foreground (and more of them m the background). If there is to be agreement over the possibly selective support of basic research with implications for technology at the start of the 21st century, dialogue with other social players must be initiated and pursued on a permanent basis. It cannot otherwise be expected that lasting cooperation can be achieved and that the platforms to be created for a subject-specific understanding will become more than simply forums for the exchange for information. The European R&D policy needs to organise knowledge flows in the sense above and not nearly flows of information.

3.6. Special Role of Small MNCs

As Fujita (1995) documents, there is considerable evidence that the transnational activities of SMEs have been increasing over time. As he point out, there are two major features that have been shaping the trends in foreign *direct* investment engaged m by SMEs over time. The first of these trends is that, overall, the share of total foreign direct investment activity accounted for by SMEs remains small in value but large in terms of the number of affiliates.

The second major trend exhibited m the foreign direct investment activities of SMEs is that they have a greater propensity to choose a host county among the developed countries than do large enterprises. Fujita (1995) reports that while large transnational corporations from the most developed countries had well over one-fifth of their affiliates located in host countries that are still developing, only about one-tenth of the multinational activity made by SMEs (fiom the developed countries) were located in the developing countries (MITI, 1991). Similarly, small and medium-sized transnational corporations based in developed countries accounted for a mean of 3.2 foreign affiliates between 1986 and 1987. By contrast, large transnational corporations accounted for a mean number of over 60 affiliates (UNTCMD, 1993).

There is at least some evidence that, not only has the absolute value of FDI activities by SMEs been increasing over time, but also their share of the total FDI, at least m several countries. For example, in Italy about one-fifth of the outward flow of FDI m the 1950s and 1960s was accounted for by SMEs (with fewer than 500 employees), but by the 1980s SMEs accounted for around one-third of all Italian FDI (European Network for SME Research, 1993). The number of foreign subsidiaries is 1.6 for SMEs, 2.0 for enterprises with between 500 and 1,000 employees, and 12 for enterprises with more than 2,000 employees.

About one-half of the Italian subsidiaries of SMEs in foreign countries are located in less developed countries. By contrast, the FDI activities of enterprises with between 500 and 2,000 employees tend to be more oriented towards the developed industrialized countries. But the very largest enterprises, with more than 2,000 employees, also orient their FDI activities towards the developing countries (European Network for SME Research, 1993).

Similarly, the Dutch National Bank has reported that the outgoing FDI has more than doubled between the 1984-1987 and the 1988-1990 periods. While Dutch FDI remains dominated by the largest transnational corporations, as evidenced by the fact that the ten largest multinational corporations are responsible for 40 percent of the total outgoing foreign direct investment, the

growth rate of foreign direct investment is actually greater for smaller enterprises than for the largest enterprises. That is, the growth rate of foreign direct investment by the largest ten multinational corporations is 110 percent, while the growth rate for outward foreign direct investment undertaken by SMEs is 163 percent (European Network for SME Research, 1993).

A report published by the MITI shows that foreign investment by SMEs in Japan (FUJITA, 1995) has generally followed the trend of their larger counterparts (MITI, 1991). While outward foreign direct investment activity reached a peak in 1988, the upward trend over time has been positive. Perhaps most striking is that the share of outward Japanese foreign direct investment accounted for by SMEs fell during the first half of the 1980s but then proceeded to rise during the second half of the 1980s. At its peak in 1988, SMEs accounted for around 60 percent of the number of Japanese foreign direct investment projects. At the same time, the share of the value of outward foreign direct investment accounted for by Japanese SMEs remained less than one-fifth of the total in the mid-1980s.

The UNCTAD (1993) study of technology transfer found that small multinational corporations use transnational relationships to transfer technology across national borders. The transfer of technology by small multinational enterprises tends to be less formalized than in their larger counterparts. As Buckley (1997, p. 75) reports, this is related to their management style and the crucial constraints. The channel of written instructions is used much less partly because of lack of personnel to codify the technology and partly because many of the skills are acquired through learning on the job. This suggests that policies emphasizing on-the-job training along with the supply of machinery and parts which embody the technology is the crucial transfer mechanism in small MNCs. In any case, manuals and technical handbooks are used only by a minority of small MNCs, and even blueprints and drawings are utilized in only 51 percent of the cases.

The UNCTAD study also identified three major types of technology which tend to be targeted for transfer by small MNCs – small-scale technologies, labour-intensive technologies, and specialized high-technology know-how.

As Gomes-Casseres (1997, p. 33) points out that "Students of international business have traditionally believed that success in foreign markets required large size. Small firms were thought to be at a disadvantage compared to larger firms, because of the fixed costs of learning about foreign environments, communicating at long distances, and negotiating with national governments." These costs "constitute an important reason for expecting that foreign investment will be mainly an activity of large firms," Caves (1982) concluded in his exhaustive review of the literature on the multinational enterprise. (HORST, 1972; VERNON, 1970; CHANDLER 1990)

Gomes-Casseres (1997) finds that small firms can overcome inherent disadvantages in engaging in multinational activities through forming strategic alliances. In particular, small firms typically follow one of two different approaches to forming strategic alliances to engage in multinational activities. Which of these two approaches are pursued depends upon the relative size of the firm. Firms that are small relative to competitors and to the requirements of the market tend to engage in strategic alliances to attain scale and scope. By contrast, firms that are large relative to the same benchmarks tend to rely on internal capabilities. This suggests that the importance of alliances in the strategy of a small firms will tend to rise with the importance of scale economies in its market and decline with the size of the firm relative to its competitors. That is, small firms seek to attain scale economies

through alliances if that is a requisite for competitive success in their market. However, they are less likely to resort to such an alliance if they occupy a niche in which they are large relative to their competitors. In addition, the benefits that a *small* firm can derive fiom a constellation of partners will increase with the sum of the capabilities assembled in the constellation as well as with the capabilities of the firm relative to those of its partners in the alliance. That is, small *firms* will benefit fiom the total value created in an alliance network. At the same time, the share of those benefits enjoyed by any given firm depends upon the *firms* bargaining power within the network.

As Fujita (1995) points out, small- and medium-sized transnational corporations tend to achieve greater productivity and are more export-oriented than SMEs in general. As enterprises, especially SMEs, become increasingly specialized, pursuing a strategy of niche development plays an important role. This can be observed in the strategies employed by a sector of the German ***Mittelstand.*** Many of these SMEs, such as Krones, Koerber/Hauni, Weinig, Webasto, and Tetra Werke are virtually unheard of by the public, in contrast to such household names as Mercedes-Benz, Siemens, Bosch, and Bayer. At the same time, the global market share of these companies typically far exceeds that of the giant companies of Germany. When calculated in terms of the specialized products they manufacture, these ***Mittelstand*** companies have global market shares ranging between 70 percent to 90 percent. What ranks among one of the biggest secrets of Germany, these enterprises account for the bulk of the trade surplus in Germany.

One of the major strategic instruments deployed by these Mittelstand companies in Germany is to combine product specialization with geographic diversity. The focus is typically upon a particular market niche, usually one that requires technical expertise. Mot of the companies resources are then devoted towards maintaining the market leadership in that niche. Diversification is generally considered to be an anathema to focusing upon the core product. Because of their degree of specialization and relatively small size, ***Mittelstand*** companies are often at a disadvantage in terms of economies of scale. This is where the second part of the strategy comes in – globalization. The product-market specialization is leveraged across broad geographic markets. Such globalization of marketing and sales provides sufficient scale to recover R&D expenses and to maintain costs at a reasonable level. ***An*** executive of a company that makes laboratory equipment explained that the typical ***Mittelstand*** strategy is, "If you are small, your fiont of attack has to be narrow. You'd better focus your business. And if you are focused, you have to find customers for your specialty all over the world in order to recoup your R&D investment." **(SIMON, 1992)**

Simon (1992) examined what he terms as the 39 ***hidden champions*** of the German ***Mittelstand.*** These companies accounted for an average of 22.6 percent of the global market share in the relevant product market, and 31.7 percent of the European market share. They had a total of 354 foreign manufacturing subsidiaries (not including agents, importers, and other forms of company representation). Each company has, on average, 9.6 foreign subsidiaries – certainly an extraordinarily high number of foreign subsidiaries given the rather modest size of the parent companies. By contrast, Fujita (1995) reports that, on average, small- and medium-sized transnational corporations based in the developed countries had 3.2 foreign affiliates between 1986 and 1987. The evidence fiom Germany does suggest that, in order to achieve a globalization strategy for SMEs, foreign direct investment plays a central role.

One of the keys to the success of the German ***Mittelstand*** in FDI activities has been the strong commitment to global expansion. This commitment generally takes two forms: investment in plant,

equipment and technology, and investment in human capital. Even when a high initial investment may not be justified in terms of short-term returns, the **SMEs** consider it important to undertake such global investments because of the demonstration effect – to show potential customers and business partners that they are committed and intend to participate.

A central element of the transnational strategies deployed by Mittelstand companies has been to set the same high standards in the host market as they do in the home market. In particular, this refers to the servicing of the production through the creation of strong reliable service networks. For example, the service network of Heidelberger Druckmaschinen, the world leader in offset printing, is as comprehensive in Japan, where there are a number of subsidiary establishments, as it is in the German home market. Another example of the presence of a strong service network created in a host country is provided by Weinig, which is the world leader in automatic molders, which are specialized woodworking machines. Weinig is closer to its customers in Japan than in Germany. This may be attributable to the fact that Weinig Japan has a service branch office **on** each of the four main Japanese islands. By contrast, **in** Germany, the service operation is centralized at the headquarters in Tauberbischofsheim. **All** of Weinig's Japanese service engineers have been trained in Germany for an average of one year. In addition, they receive additional training at the Germany headquarters each year.

By pursuing an aggressive strategy of expansion in foreign markets the German Mittelstand companies have been able to overcome the inherent size disadvantage that would otherwise confront them if they restricted their sales solely to the domestic market. Due to the limited size of the domestic market, these **SMEs** would not have been able to attain sufficient scale economies necessary to maintain their product niche at such a profitable level. This has enables the Mittelstand of Germany to overcome the risk inherent in a high degree of product specialization. The greater the degree to which **an** enterprise is specialized, the higher is the exposure to risk, especially in terms of its vulnerability to market fluctuations.

The German Mittelstand companies do not pursue a strategy of blindly searching for the technological frontier. Rather, the Mittelstand companies are much more focused **on** combining technology with customer orientation. This takes numerous forms. One example of this closeness to customers is customer training. As the complexity of products increases, the customer requires a greater degree in operating and maintaining the products. Such training is one of the strengths of the German Mittelstand. It is well known throughout the world, and certainly in Asia, that German technicians are superbly educated. In fact, some **of** the SMEs **of** Germany actually establish foreign subsidiaries mandated with providing training. For example, Festo, a leading manufacturer of hydraulic equipment, established Festo Didactic, which has become an important company devoted to training engineers in hydraulics and industrial automation. Through training of customers and engineers in host countries, the technological know-how developed in Germany is transferred to firms and employees in the host country.

It is the combination of being oriented to both a specialized product niche, typically combining both sophisticated technology with careful devotion to consumer needs, that makes a strategy of foreign direct investment so crucial to the German ***Mittelstand.*** In order to perceive and understand the peculiarities **of** each host market, the company benefits by producing at the location of the **host** market. Apparently the knowledge that is transmitted, which involves a large tacit element, can best be obtained **through** close geographic proximity, but not over a longer geographic distance. **A** second

reason why presence is important in the foreign market is to provide services, such as training to he customers. While such services could be contracted out, the asset specificity of the product, combined with the high technological sophistication, virtually bundles the service component with the manufactured product. The value of the manufactured product to the customer goes down unless he has access to high-quality service.

As described elsewhere in this report, innovative activity plays a central role in why many small and medium-sized enterprises come into existence in the first place. Entrepreneurs start new businesses m an effort to appropriate the potential economic value of their ideas. Not only do such innovative niches exist in the home country, but increasingly they also exist in foreign markets as well. As *Business Week* points out, "U.S. niche players actually create new markets." (BUSINESS WEEK, 1989) As to the type of firms that are involved in creating new markets through strategic niches, "They are companies you never heard of They produce car-wash systems in Europe and the Middle East, doughnut-making machines in Canada, and agriculture equipment in the Philippines. On the high-tech fiont, they make parallel-processing computers for Japan and satellite receivers for Germany." (BUSINESS WEEK, 1989)

For example, while the tradition m Japan has been to rest and sleep on floor mats, continual development and exposure to tastes in Europe and North America has resulted in the emergence of a demand for reclining chairs. A small company producing such reclining chairs experienced an explosion in orders after a trade show in Osaka. Another example of such an innovative niche that has resulted in outward foreign direct investment activity is provided by Aeration Industries, International Inc., which is a privately held company with $15 million in annual sales. The company produces motors set on floating platforms that send tiny bubbles of air down about eleven feet, aerating the water and rapidly cleaning up organic waste. While the company has its headquarters in Minnesota, it sells products m more than forty countries and has expanded specialized production to a number of other countries. The President of the company explains the success of its foreign direct investment, 'We don't really have any direct competition." (BUSINESS WEEK, 1989)

Another important way that inward foreign direct investment can promote the competitiveness of host-country firms is through providing finance. A number of high-technology industries, particularly fiom Europe, serve as an important source of finance for SMEs in other countries. One example is the biotechnology industry. It should be emphasized that the entire biotechnology industry in the United States has been developed by SMEs (AUDRETSCH and STEPHAN, 1996). While a few of these new start-ups, such as Genetech, have grown to become large enterprises, virtually all of the biotechnology companies remain SMEs. The reasons fiom the inability of the large pharmaceutical companies to successfully engage m biotechnology and the relative success of SMEs in biotechnology are presumably based on the competitive advantages of SMEs m newly emerging industries discussed elsewhere in this report.

While the biotechnology industry has been largely developed in the United States, which partially reflects a concentration of scientific and technological knowledge as well as finance capital, at the same time outward foreign direct investment by European companies is providing an important source of capital. As *Business Week* observes, 'The U.S. biotech industry is perpetually searching for money. And more and more of it is coming from Europe." (BUSINESS WEEK, 1994)

Outward foreign direct investment also can provide a mechanism for gaining access to knowledge sources that would otherwise be inaccessible. An example of an industry where knowledge transfers only within a geographically bounded region is biotechnology. Biotechnology is a new industry that is knowledge based and is predominately produced by new enterprises. The relative small scale of most biotechnology firms may be attributable to the diseconomies of scale inherent in the "bureaucratic process which inhibits both innovative activity and the speed with which new inventions move through the corporate system towards the market" (LINK and REES, 1990). Zucher, Darby and Brewer (1994) have provided considerable evidence suggesting that the timing and location of new biotechnology firms is "primarily explained by the presence at a particular time and place of scientists who are actively contributing to the basic science." More specifically, they find that firms are likely to locate in geographic areas where scientists who have published leading articles on gene sequencing are located. Studies have indicated that biotechnology firms are likely to be founded in close proximity to a research center (AUDRETSCH and STEPHAN, 1996). For example, a region such as the San Francisco Bay Area, which produces a disproportionate amount of research in biotechnology, is also the home to a disproportionate number of new biotechnology firms.

Biotechnology companies are defined by their scientists. Many of these scientists, particularly senior scientists with strong reputations, do not work for the company full time, but instead are members of university faculties. These university-based scientists fulfill a variety of roles within biotechnology companies. Some are founders, others serve as members of scientific advisory boards, while still others serve as directors. The degree of knowledge provided by university-based scientists varies according to the role played by the scientist (AUDRETSCH and STEPHAN, 1996). Certain roles, such as being a founder of a biotechnology firm, are more likely to dictate geographic proximity between the firm and the scientist than are other roles that the scientist play. This is because the transmission of the knowledge specific to the scientist and firm dictates proximity.

In order to gain access to these knowledge resources foreign enterprises interested in biotechnology rely upon a strategy of outward foreign direct investment in the geographic areas where the technical knowledge is most heavily located. For example, on 14 November, 1994 Rohne-Poulenc-Rorer (RPR) announced that it would invest $100 million in the first year alone in U.S. biotechnology companies in order to promote research and bring promising products to the market. (BUSINESS WEEK, 1994) On the following day, a rival European drug manufacturer, Ciba-Geigy Ltd., with the home country of Switzerland, responded by announcing that it was entering into a significant minority investment in an American-based biotechnology company, Chiron Corporation, located in Emeryville, California. As *Business Week* observes, "Europe's drug giants, with few local biotech innovators, are hungry for bigger pieces of the action." (BUSINESS WEEK, 1994) The specialized tacit knowledge in the biotechnology industry which is concentrated in just a few location is best accessed through outward foreign direct investment in small biotechnology companies at that location.

Similarly, there are numerous examples of European computer companies which have established affiliates in Silicon Valley in California. (THE ECONOMIST, 1994) This new knowledge can often be transferred back to the home country. Much of this transfer is in the form of human capital, as individuals move from one location to another. When employees of the SMEs have accumulated enough experience and knowledge in the knowledge cluster, such as Silicon Valley, they may in some cases return to the home country. They bring with them technological know-how, organizational capabilities, and established contacts that facilitate knowledge-based economic activity in the home country.

The examples of these high-technology European SMEs engaging in outward foreign direct investment in the United States illustrate two important points. The first point invokes the location of the foreign direct investment. What is important is not access to the United States *per se,* but rather access to the knowledge embodied in the individuals and network of firms located in a tiny geographic area – in this case, Silicon Valley. The second point is that the outward foreign direct investment was undertaken by these SMEs not with the aim of penetrating the market in the host country, but rather with the goal of accessing valuable scarce economic knowledge and then transferring it back to the home country in order to increase market share in the home country. The knowledge can then be applied in the home country which will subsequently enhance the competitiveness of that country.

As the competitive advantage of the OECD countries becomes increasingly shaped by new economic knowledge, for reasons explained elsewhere in this report, it is likely that SMEs will become more aggressive in undertaking foreign direct investment as a mechanism for gaining access to new economic knowledge.

4. The Future Role of R&D Policy: Policy Options and Recommendations

With economic globalization it is clear that national R&D subsidies are likely to have strong positive external effects for various reasons: There will be spillovers from innovative domestic companies to subsidiaries of foreign companies; foreign competitors could acquire the firm which benefitted fiom an R&D subsidy but has not yet brought the innovation fully to the market. As one may assume that uncertain future profits fiom such an innovation are not fully taken into account in the price for the respective merger or acquisition it is clear that there will be international external effects. There will be a technology transfer effect and positive growth and tax revenue effects abroad. All this could imply that government funded R&D will decline as the expected positive income, employment and tax revenue effects of subsidizing innovation becomes more uncertain in a world of high capital mobility. A falling R&D-GDP ratios is, however, not what is needed to improve EU competitiveness and the prospects for employment and income growth. On the contrary, EU govemments could agree on a minimum R&D-GDP ratio m order to stimulate economic growth. Such a European Innovation Pact would aim to internalize some of the positive external benefits of national R&D. At the same time there is no need to strongly increase supranational R&D expenditures, except possibly for some key areas in basic research and in R&D projects deemed important for progress in the global warming problem. Establishing transeuropean R&D networks and intranets/internets could be another expanding domain of EU innovation policy which certainly requires a critical minimum effort.

Policy options of higher supranational R&D expenditures largely will depend on the ability of the *Community* to *shift* the emphasis in the EU budget fiom agriculture to high technology. To illustrate the benefits of major policy shifts one might commission a study which analyzes which economic benefits are to be expected if the R&D budget had the size of the agricultural budget.

Improved monitoring and evaluation of R&D programmes at the national and supranational can be useful for achieving higher effiency of public funding of innovation project. More important, however, would be that governments launch an EU wide initiative to foster the role of venture capital markets. This would have to include adequate tax reforms.

Given the many political resistances against FDI liberalization in many countries there might be no immediate need in the South to accept foreign majority ownership in all sectors but EU diplomacy should be firm in pushing for full gradual liberalization in the field of foreign investment. From this perspective the WTO needs a partner organization which explicitly deals with the problem of international restrictions on foreign investment and problems in patent protection. One might consider to assign this task to the World Intellectual Property Organization (WIPO) in Geneva. This would lead to four organizations active m maintaing fiee trade and foreign investment in the world economy: WTO for trade, IMF for capital flows except foreign direct investment, WIPO for intellectual property rights and foreign direct investment and a reformed ITU (International Telecommunications Union) as a basis for fiee flow in information.

4.1. Innovation and Innovation Policy

High R&D expenditures of innovative sectors is only one key to high productivity growth, the other is rapid diffusion - ie. application - of new technologies. While most new technologies are developed in high technology manufacturing industries (information technology, pharmaceuticals, aerospace) the most important user is the service sector whose role in international technology trade increased in the 1980s.

Innovations and Technology Diffusion

Innovation together with technology diffusion are two keys for international competitiveness and employment creation in western Europe. Fundamentals of innovativeness are shown in Fig. 1. The basis for innovation and diffusion is a modem education system which allows to raise the number of skilled workers, engineers and managers to be raised. Education in school and universities is only one important aspect of "upskilling", retraining and training on the job are also crucial. Expenditures for education in a broader sense reached lower levels in most EU countries than in the US in the early 1990s. In a period of intensified global technological and economic competition EU countries that reduce the quantity and quality of education and training are bound to suffer in the long term. Compared to the US and even to some Asian NICs most EU countries have assigned a low priority to upgrading education. With more intense competition in goods markets and falling relative prices of labor intensive products - produced increasingly Asian countries and Eastern Europe - high wages of unskilled labor in continental EU countries are bound to contribute to unemployment. While it is not true that wage increases generally were too high in the 1980s and early 1990s it is obvious that wage dispersion should have increased at the expense of unskilled labor in Europe. Though wage dispersion increased m the US and the UK it remained flat and temporarily even reduced in Germany and other continental EU countries. This will not only stimulate rising foreign direct investment outflows from high wage EU countries, it will also reduce the incentive for higher education and thereby weaken future ability of EU countries to successfully compete in the global technology race.

Competiton is needed to ensure innovativeness where anticipated profits will play a major role for incumbent firms and newcomers. Only if market exit barriers are low will market entry barriers be rather small. High and rising subsidies for smoke-stack industries impair market entry in the EU. Moreover, the EU suffers fiom a lack of venture capital firms so that EU newcomer dynamics are relatively poor compared to the US. This partly explains why EU firms are underrepresented in new growth fields (biotechnology, laser, robotics). R&D expenditures are crucial for innovation. EU countries reached *only* about half the R&D-GDP ratio of Japan, and half a percentage point less than

the US m the early **1990s.** Germany recorded a marked fall in this ratio after **1989** when it declined fiom **2.9%** to **2.2 %** in **1996.** While one may anticipate a recovery of this ratio in the **long** term this steep fall is a serious problem since the advances of **NICs** and east European newcomers capturing increasingly medium and high technology shares in world markets should have been a starting point for Germany to raise R&D expenditures relative to GDP in the **1990s.** Moreover, a stronger focus **on** high technology **also** would have been appropiate. Smce the end of the cold war Germany has lost its historical advantage of a low ***military*** R&D-GDP ratio and both Germany and Japan will face much stronger high technology competition fiom the US, the UK and France in the long **term.** Finally, since high technology markets are rather narrow worldwide, the renewed civilian R&D dynamics of these countries will encourage US, British and French high technology *firms* to aggressively move into medium technology markets in which many German firms used to enjoy a rather strong and uncontested position. This position generated Schumpeterian rents which in turn were the financial basis for continuous innovations. About ½ of OECD R&D expenditures in the private sector, 2/3 of R&D investment is performed m the business sector. EU countries compare rather well with the **US** m this respect. However, the system of public R&D support of many EU countries overemphasizes subsidies **(40%** of all public R&D support in Germany) instead of tax credits which represented **almost 90%** of public support m the **US** m the early **1990s.** Subsidies are an easy prey for established big firms, while *small* and medium sized firms as well as newcomers - with poor political connections - are at a disatvantage. Tax credits are more neutral in this respect.

The information system of a society is crucial for for innovation as well as the **diffusion** process. With advanced communication networks and widespread computer use there are new global opportunities to learn about **new** technologies and products, store knowledge and disseminate know-how; one may even create virtual firms. Therefore, innovation cycles are shortening and Schumpeterian rents fiom **first** mover advantages and innovations, respectively, are declining for *firms* acting in regional markets. Smce privatization and liberalization of the telecoms sector in Europe and Asian countries will be fully achieved only at the turn of the century this tendency will be reinforced after **2000.** Continental EU countries still suffer fiom rather high telecoms prices reflecting monopolized markets for public voice telephony (until **1998** the liberalization date set by the European **Commission)** and barriers to entry for newcomers in many countries. The internet host rate of the US which has competitive **long** distance networks since **1984** is twice that of Germany, that of Finland which introduced full competition in the **1990s** is four times as high as that of Germany. There are many opportunities to improve the EU information ***system*** but key member countries such as Germany and France are moving rather hesitantly in this field.

Patent protection is important for innovators. The system of international patent protection has been strengthened in the context of the GATT Uruguay round **so** that incentives for innovators have increased worldwide. However, the new digitized information highways that are being built in the US, Europe, ***Asia*** and elsewhere improve prospects for imitators. Hence effective protection of innovators might be reduced m the long term. Innovative firms might react to this tendency with an even stronger tendency to serve markets by foreign subsidiaries which allows the flow of know-how to be controlled in contrast to (external) licensing and patent trade. For EU countries aiming to raise employment it will be crucial to offer locational advantages that stimulate foreign direct investment inflows. Germany and France recorded massive outflows but rather poor inflows in the **1980s** and early **1990s.** Germany's per capita inflows from the US in **1995** were only **1/10** of those in the Netherlands. **Small** foreign investment inflows and high outflows explain the low ratio of investment in machinery and equipment relative to GDP in **1995** (only some **8%).**

Venture capital financing is extremely important for technology-oriented newcomers in manufacturing and services. In continental EU countries traditional banking systems dominate, while specialized venture capital firms - a key ingredient to US innovativeness and employment growth - are a rare exception in most EU countries. As many big firms in OECD countries embraced downsizing as the dominant strategy for the 1990s it would have been quite important to make sure that the growth rate of newcomers is rather high. This is a major deficiency in continental EU countries.

4.2. Policy Options

In summing-up the policy options in the age of globalisation we shall structure our arguments along four cases of transnational R&D which have been worked out by GERYBADZE and REGER (1997). Type A company is dependent on excellence in R&D and is located in a large highly advanced home country with strong R&D capabilities in the particular field. Type B corporation is dependent on excellence in R&D but is located in a small country or in a country with a lesser developed R&D capability in the particular field. Type C firm can benefit from proximity to a world class lead market and can establish an effective coupling to lead markets, R&D and innovation. Most of these activities can be performed close to the corporate headquarter at least within the same nation state. And finally type D corporation is strongly dependent on access to an foreign lead market. Due to the small size of its home country or the small size of the markets, the firm is forced to perform critical functions abroad. Demand and corporate resource allocation will be geographically and often functionally separated.

In case of the EU, cases A and C apply to companies fi-om large countries and cases B and C applies for companies from small countries. From this, the first option for policy would be to differentiate between MNCs with headquarters in either large or small EU countries. It seems not to be possible to device a common European policy in this respect. On the other hand, types A and B relate to companies being active in an area of strong science-based and research-oriented innovation, whereas type C and D relates more to an efficient coupling to lead markets, demand articulation and innovation. The second option thus, would be that, again, a new policy in the science-based sectors and in the demand triggered areas should look different.

E we add to this the necessity to couple European level R&D policy with national (and region or state specific) actions it becomes entirely clear that a simple approach in R&D policy is not recommended. As many degrees of flexibility as possible should be allowed for.

To the extend that a supply side R&D policy prevailed in the European Union we have to emphasis that science-based innovation is important in many cases but not in all. In global innovation, down-stream related processes such as effective national lead-markets and demand stimulation and articulation are also important. In this sense, it is recommended that R&D policy should try to warrant that those lead-markets be in the European Union where strong global players are active in. In so far as by non-R&D measures the rapid and stable development of those markets can be facilitated, R&D policy should join in with other European policies in order to achieve the maximum benefit.

Avoiding naive policy planning which was sometimes pursued in the seventies, also means not to set up large planning bodies and to abstain from mechanical shaping and controlling of science and

technology institutions. Instead, the characteristics of an advanced science and technology policy on the European level should be based on the assumption that decision making occurs through negotiations of many diverse actors on various hierarchical levels. The top down approach is not usehl at the turn of the century: players have to seek alignment and consensus. The European Commission and the governments of member states should jointly behave as facilitators in offering two-way information channels and forums for the debates. Ifrequired the Commission should provide strategic information inputs using technology foresight, technology assessment and strategic policy evaluation in science and technology. In so doing, it should not rely on EC bodies and agencies but on - from the perspective of member states - unbiased organisations or multi-national groups of think tanks. It is always helpful to organise strategic information in terms of alternative scenarios that strategic choices become visible.

4.3. Adjusting Guidelines, Promoting Cooperation and Increasing Transparency

Facing increasing international competition EU countries should implement clear guidelines for innovation policy and encourage benchmarking studies on innovation policy. Future guidelines should put more emphasis on the information society and the creation of virtual technology-oriented firms, but one might also want to encourage "overlapping projects'' in which combining different science fields in an innovative meaningful way leads finally to profitable innovation projects.

In a globalized world economy potential partners might be found in much more countries than previously. In practice the number of international R&D joint ventures always will be rather limited and certainly be guided by positive experiences. However, with the economic opening up of eastern Europe and newly dwelopped R&D capabilities in Asia there are new options and opportunities for firms and government research centers to explore. Encouraging international research cooperation on the basis of selected demonstration projects - with positive international external effects - could an important policy area. Projects especially in the field of health, the environment and international traffic safety could be useful.

With rising public R&D spending adequate reporting on the basis of a standardized indicator system becomes important. At present it is unclear which indicators are usehl for which areas and to which extent one could monetize economic costs and benefits for all major R&D projects in which public subsidies are involved. It is clear that the EU requires much better data collection and data analysis in the field of patents, innovations and diffusion. Historically, most national statistics have developed without a strong focus on economic application or usefulness. For a modem Europe guiding principles for public statistics should also be its usefulness for economic policy and innovation policy in particular.

4.4. Environmental Problems and Growth: Some Policy Conclusions

Taking into account the problem of global sustainable growth is crucial if there is to be a coherent international and national policy approach to growth. For OECD countries reducing adjustment costs by higher flexibility in technologies and in factor markets is important in a global perspective. In the words of BRETSCHGER (1997c, p.31/32): 'To conclude, it should be remembered that the increase in prices of natural resources has to be effectuated by political measures if negative externalities of

natural resource use are present. This has to be accomplished first. *Also,* and even more importantly, the sectoral change that is required for sustainable development has to take place at low economic costs. Xadjustment costs are high, there is a drag in the growth process and the development path may become non-sustainable. The lower costs of the reallocation in the direction of sectors that generate a lot of spillovers and do not use natural resources intensively, the better the chances for sustainable development. The political aim to lower adjustment costs is a better measure to achieve sustainable development thatn the general promotion of savings. This holds true because higher savings are not unambiguous m favour of sustainability, as long as some investments have a pollutant effect. In the international context, efficient prices of environmental services also lead to an income transfer fiom developed to less developed countries that increases the chances for LDCs to achieve a sustainable development of their own."

Ressource-saving technological progress m the North leaves a larger pool of nonrenewable ressources for low income-low technology countries which therefore face reduced pressure to embark upon costly substitution technologies. With higher sustainable growth rates in the South higher growth rates in the North can be expected through trade-led growth. More recent technologies will become available in the South ifthe economic and political regime create an open environment for foreign investors, if patent protection is fully enforced and foreign majority ownership accepted.

4.5. Facilitating Network Building

Before we recommend some instruments of support for network building in more detail, it is necessary to emphasis the scope of already existing knowledge exchange systems managed by the partners involved without policy assistance. Above all, large companies with huge R&D resources at their own disposal are capable of establishing and keeping up relations with non-industrial research mstitutions and even competitive firms without any public support. Nevertheless, we think that the contacts between large enterprises and academic institutions can still be intensified, whereas the contacts among large enterprises themselves is probably less so a subject of EU policy. But small and medium size companies have problems establishing research linkages which they control themselves and which are not defined via partnership with a big MNC. Against this background a variety of facilitating options for the promotion of knowledge exchange has emerged over the last several years. We mention institutional arrangements, financial support, transfer agencies and also the exchange of personnel here.

During the first few years, many industrial countries have introduced new media of science and technology information in order to improve accessibility and transparency (see, for instance SCHMOCH *et al.*, **1996). Further** m this direction would be an improvement in European linkage of public library systems, for example, which is the case within countries but is not easily established across national borders. Special information services and data bases on science and technology related issues which are maintained in Europe can also be helpful here. Translation services would open access to non-native European innovation systems.

As to institutional arrangements, the establishment of contract research institutions in general outside of universities plays the major role. This sort of research is developed in some EU countries, but not so well established in others. Their research interests are medium in character and focus on the application of knowledge and thus can serve in network building.

The establishment of R&D networks by participation at conferences, the initiation of specific R&D corporations or other instruments is a quite difficult and time-consuming task. A decisive precondition would be a well developed private and public R&D base so that every partner can profit from joining the network; a win-to-win situation is always required. This calls for more coherence in national R&D systems.

The promotion of inter-European trans-border co-operation is permanently considered a challenge. It should also include the exchange of persons by special subsidies. Because of different career structures in universities and firms and the social problems of mobility, the transfer of personnel will always be limited compared to other measures. It is thus an area of high impact elasticities if policy can trigger of more exchange.

4.6. Exploiting Communication Opportunities

Innovative telecommunication technologies provide new opportunities for learning about market developments, research projects and for creating virtual research networks. After the full liberalization of telecommunications in 1998 one may expect rapidly falling international telecom prices and thus an endogenous incentive for greater intra-EU cooperation as well as for global competition and cooperation. Finland with its very competitive market - similar to the situation in US - shows very encouraging results. The number of internet hosts in the mid-1990s was more than twice that in Germany and higher than in the US.

System integration will be a big technological topic of the future. It is unclear whether telecom operators or software companies will be better suited to shape and detrmine future developments in this field. The advance of mobile telephone and wireless local loop technology plus developments in the satellite business will open up new options to create international networks.

The main challenge for the Internet is that present pricing schemes will not allow the establishment of a broader information society in a commercial sense. The Internet is overflowing with information but most providers have neither a clearcut profile nor are they able to generate business by selling specific sets of information. Flat rates are typical for the large internet providers and this points to inability to apply price differentiation and problems in selling information as a good in its own right. Since quality competition barely exists in the internet and price competition dominates, providers increasingly use advertisements to keep prices down. The Internet platform, therefore, degenerates almost to a white noise phenomenon of limited economic value.

It is well known that markets for information are rather imperfect because the supply side has to reveal part of its information in order to get business going at all. It is, therefore, practically impossible to recover costs on the same basis as in normal markets. One possible way of obtaining value-added from the Internet on a solid and broad scale is to encourage the build-up of reputations by competing top providers. A high reputation should allow internet users with a specific communication profile to create a club of users, which would rely on a fixed contribution and differentiated prices for specific bundles of information.

If EU countries were to simply follow US patterns, the commercial value of the internet would remain rather limited. One may recommend that the EU commission establishes a certification process which

assigns quality labels to internet providers. European internet providers could become leading players only if they first develop a thriving European information market. Government certainly has a role to play in the nurturing the information markets.

4.7. New Role for the EU in Education Policies

At first *glance* there is no economic justification for EU policies in the area of education. However, this assumes that there are neither international external effects nor opportunities for positive network effects in EU information markets and in learning and research. There is a role for the EU to play in the co-financing of basic research but also in helping with the establishment of special universities. Military academies in EU countries could become European military academies once common EU defence policies have been rooted more firmly than the present overlap between WEU and the community.

The European Commission should also have the right to establish special European universities considered to have strong positive external effects: European internet university programs and Continuous Civil Service Academies with a curriculum designed specifically for updating and upgrading the human capital of civil servants working on EU matters.

In order to stimulate innovation the European Commission could obtain the right to allocate more than the present 1% of EU structural funds to innovative projects. This share could be increased to at least 15%. One might also consider the redesign of regional policies in the EU, in a way that would emphasize less investment in capital equipment and instead have a twin focus on innovation and investment.

EU competences in other fields of education should remain mute since the principle of subsidiarity - and efficiency gains at a lower level of political governance - assigns competences to the nation state, the region or the municipality.

4.8. Improving Patent Protection

One of the most important topics in the area of intellectual property rights protection is the extent to which the private rate of return from investment in the production of new economic knowledge diverges fiom the social rate of return. As Mansfield (1988, p. *6)* observes, "To economists, the social rate of return fiom such investments is important, because it is a measure of the payoff to society fiom these investments. A high social rate of return indicates that society's resources are being used effectively and that more should be devoted to such investments, if the rate of return remains high."

The theory of legal protection for intellectual property is built around the assumption that the process of innovation is to some extent deterministic and to some extent stochastic (Cohen and Klepper, 1991 and 1992). The deterministic aspect of technological change stems from purposeful activities undertaken by economic agents to produce new knowledge that can be commercially exploited. Such a commercially viable outcome from the application of such new knowledge, which results in either new products or new processes, constitutes an innovation. Probably the most important and certainly

the most visible activity undertaken to generate new knowledge is research and development (Scherer, 1991 and 1992).

The stochastic aspect of innovative activity is the result of considerable uncertainty inherent in the process of technological change. According to Scherer and Ross (1990, p. 615), 'Technical innovations do not fall like manna fiom heaven. They require effort – the creative labor of invention, development, testing, and introduction into the stream of economic life. To some extent innovative effort is a haphazard thing...'

The relatively large weight of the stochastic component m the process of innovation gives rise to what has been termed in the industrial organization literature is a the *appropriability problem* (Cohen and Levin, 1989), which refers to the ability of firms to reap the economic returns accruing fiom their investment in knowledge-generating activities, such as R&D. The theoretical justification for the protection of intellectual property is to prevent such erosions of the return accruing to firms investing in new economic knowledge. If the costs of imitation are sufficiently low relative to the costs of innovating, it is conceivable that the innovating firm will no longer be able to recover the costs incurred in generating the new product.

The patent system has been shrouded with controversy longer than most other economic institutions have been in existence. Ever since the Republic of Venice began granting patents in 1474, the relative merits of patents have been hotly contested. At the heart of the debate has been the virtues of disrupting the competitive process by awarding what in some cases amounts to a virtual monopoly. Exclusive patent rights to inventions are generally granted for three main reasons:

To promote inventive activity,

1. To foster the development and commercial utilization of those inventions, that is innovative activity, and

2. To facilitate the disclosure of inventions to the public, thereby ultimately promoting their diffusion.

Whether, in fact, the patent system actually is conducive to these three aspects of technological change remains controversial, however, because the central mechanism for spurring innovative activity is through granting some degree of monopoly power. On the one hand, disrupting the competitive process might not only result in higher prices but also in less subsequent technological change. On the other hand, as Schumpeter (1942, pp. 89-90) argued, monopoly power is an important incentive to undertaking innovative activity. Anticipated market power in new products may provide essential incentives to innovate, since, "enterprise would in most cases be impossible if it were not known fiom the outset that exceptionally favorable situations are likely to arise." Schumpeter (1942, p. 83) saw little contradiction in the patent system, because "A system that at every given point of time fully utilizes its possibilities to the best advantage may yet in the long run be inferior to a system that does so at no *given* pomt of time, because the latter's failure to do so may be a condition for the level of speed of long-run performance."

By contrast, Scherer and Ross (1990, p. 624) acknowledge a clear dilemma involved in the granting of lengthly monopoly power through exclusive patent rights, 'The patent system makes a deliberate

trade-off, accepting during the patent grants life dead-weight surplus losses in order to ensure that new products and processes, along with the surpluses they create, will not be discouraged by fear of rapid imitation. Only after the patent expires, when competitive imitation can run its full course, are consumers able to have their new product along with the extra surplus competitive pricing brings."

It should be emphasized that the impact of the patent system on actual competition and technological change is much more complicated than has been captured in theoretical models. Such complications moved Scherer and Ross (1990, p. 624) to conclude that, "Although devised to solve an important incentive problem, the patent system is a crude and imperfect instrument. Because of diverse real-world complications, the patent protection given an innovator may be too little, too much, or of the wrong kind."

One of the major challenges confronting the effectiveness of the patent system is the propensity for competitors to *invent around* a patented invention. The patent that can totally pre-empt access to an entire class of products or processes technologies is by far the exception. In addition, Mansfield (1983, p. 138) points out, "In some fields, reverse engineering – which crudely speaking, involves analyzing and tearing a product apart to see what it consists of and how it is made – is a well developed art. Even if a new product or process is not subject to reverse engineering, it may be possible to invent around the patents on which it is based (if it is patented)." To the extent that the relevant technology can be transferred at a relatively low cost, the cost incurred by imitating an innovation made by a competitor can frequently be substantially lower than the cost of developing and mtroducing the innovation itself. The advantage of being among the first adapters may actually be superior to the well-publicized advantage of being the first mover.

The link between the protection of intellectual property rights and global competition revolves around the question, *How **can the institutions protecting intellectual property be developed in order to enhance the competitive advantage of a particular country's firms?*** and *How **can the institutions protecting intellectual property be developed in order to enhance economic activity undertaken within that country?*** Although these two questions sound deceptively similar, in fact they are not. This is because of the increased degree to which companies are engaged in multinational activities. Policies that enhance the competitiveness of firms may not enhance the level and type of economic activity within the country m which the firm declares as its home base.

But more than anything, these two questions suggest that an answer can only be provided by comparing the regimes of intellectual property protection across countries and, perhaps, over time. In fact, such analyses have been virtually non-existent. There have been very few studies explicitly linking the regimes of intellectual property protection to the international competitiveness of *firms* and industries over countries.

One line ofresearch has attempted to identify the manner in which perhaps the most obvious aspect of intellectual property protection – the number of registered patents – vanes from country to country. In an exhaustive study based on the number of patents registered in the United States, Archibugi and Pianta (1992) compare the patent activities of the major OECD countries over the decade of the 1980s. They find that the growth rate of patents within the domestic country (that is, patents awarded to residents of the country) grew fastest in Japan. Similarly, the growth rate of external patents (that is, patents awarded to residents within the country by other countries) has also been greater in Japan than in any other country. Japan has registered almost as many patents in the

United States as has all of the (twelve) member countries of the European union combined. In fact, all countries exhibit a rapidly growing involvement in foreign patents, with the presumed goal of appropriating the returns fiom their inventions in global markets.

But what are the implications of these trends m patent activity for international competitiveness? The Royal Swedish Academy of Engineering Sciences has linked patent activity to international competitiveness in comparing Japan and Sweden. One of the major conclusions is that, "It may be due to a lack of patent culture in Swedish companies, while Japanese companies have consciously built up a patent culture... Differences in patent positions may indicate more substantial difficulties in the ability to generate and capture the returns on innovation. The failure to compete with companies at the frontier of development depends more on a lack oftechnical competence rather than legal or informational barriers" (Royal Swedish Academy of Engineering Sciences, 1993, p. 41).

On the basis of a more detailed comparison of Swedish and Japanese multinationals, the Royal Swedish Academy of Engineering Sciences (1993) determined that the Japanese companies value the importance of patents much more highly than do their Swedish counterparts. The Swedish companies tend to emphasize the importance of superior marketing and production cost reductions. In addition, the Japanese companies value the advantages of patents in protecting both product and process technology much more highly than the Swedish companies. The advantages bestowed by patents include protecting proprietary product technology, protecting proprietary process technology, creating retaliatory product technology, enhancing the possibilities for selling licenses, and increasing the possibilities of accessing technology through cross-licensing. Japanese companies also clearly indicate an increased strategic role for patents than do their Swedish counterparts.

This increased strategic role extends not just to patents, but also to licenses, standard setting, and cross-licensing. It is not surprising that companies in Japan report a much greater degree of attention by top management to patent matters than do their counterparts in Sweden.

In reviewing the patent system of Japan, Ordover (1991, p. 48) has concluded that, "The Japanese patent system is a complex web of policy choices more or less consciously structured to affect R&D diffusion while maintaining overall incentives for R&D investment. The Japanese patent system subordinates the short-term interests of the innovator in the creation of exclusionary rights to the broader policy goals of diffusion of technology. Because the scope of the patent is narrow under the Japanese patent law and the novelty requirement is quite weak, it rewards those who reverse engineer and modify, often m minor ways, the existing inventions and penalizes those who wish to protect their major technological breakthroughs."

The Japanese patent system, which, combined with weak trade secret law, serves to induce innovators to disclose strategic information sooner than does the American system. In particular, "its institutional features encourage diffusion by creating strong incentives for licensing and cross-licensing of patents" (Ordover, 1991, p. 45). For example, m Japan a patent is granted to the first filer and not, as is the case m the united States and Canada, the first to invent. By awarding the patent to the first to file, inventors are given a clear incentive to register with the Patent Office as soon as possible. This has the effect of disseminating the information faster than it would be otherwise.

Under the Japanese patent system an application must lay *open* for 18 months subsequent to being filed. This speeds up the diffusion of the knowledge contained in the patent. The patent system in

Japan also permits third parties to oppose the granting of a patent. By contrast, in the United States and in Germany the patent examiner makes the initial determination of where the statutory requirement have been in granting a patent. Intervention by third parties is only possible after the patent has been granted. Allowing pre-grant opposition enhances the incentives for firms to license the innovation for several reasons. First, licensing the invention is a pre-emptive tactic which decreases the incentives for competing firms to oppose the patent application. The opposition phase creates strategic incentives for early bargaining between the innovator and those potential rivals who would be disadvantaged if the patent is granted. In addition, during the opposition phase the applicant can be opposed by a large number of filings which have been prepared by expert staffs over a long time period. The applicant has only a limited time period of several months to respond.

Under Japanese patent law, an inventor is entitled to royalties only fiom those who utilized the potentially patentable invention knowingly after the application has been made. This provides a strong incentive for an inventor to notify all likely users of the contents of a patent. In addition, the Ministry of International Trade and Industry (MITI) can compel a patent-holder to cross-license the invention if it is deemed that the patent comprises a technology of national importance.

Both Gilbert and Shapiro (1990) and Klemperer (1990) have pointed out that the scope of patent claim is distinctly different between Japan and the united States. Prior to 1988, Japanese patent law limited each application to a single independent claim, which was referred to as a head claim. Klemperer (1990, p. 114) provides the example of an invention for a bicycle, which would not only have to patent the bicycle, but also the separate bicycle parts that comprise the bicycle. As Ordover (1991, p. 48) points out, "It is not clear how the restriction to a single independent head claim affects R&D incentives of dissemination. It clearly leads to a multitude of patents, with all the negative costs that this *imposes* on the innovator and the society." The second dimension of the scope of the patent claim is a delimitation of the scope of the coverage of the patent. Scope is defined as the portion of an abstract product or technology space covered by the patent. The rather narrow scope of coverage granted by patents tends to reduce the exclusionary value of the patent right (Scotchmer and green, 1990). This again enhances the incentive to engage in cross-licensing among firms.

The regime of intellectual property protection in Japan tends to bias technological development towards externally acquired technologies. Mansfield (1988) compares the composition of R&D expenditures between 50 matched pairs of Japanese and American firms. He finds that the Japanese tend to have cost and time advantages over their American counterparts in making innovations based on extemal technology. However, for innovations based on internal technology there is no significant difference in the average cost or time required to develop the innovation between Japanese and American firms. The ratio of innovation *cost* or time for a new product based on external technology to that for a new product based on internal technology tends to be much lower in Japan than in the United States. In particular, Japanese firms take about 25 percent less time, and spend about 50 percent less, in developing an innovation based on external technology than one based on internal technology. By contrast, m the united States the commercialization of an innovation based on external technology requires about the same expenditure of effort as does the commercialization of an innovation based on internal technology.

Whether the Japanese system of protecting intellectual property has found an optimal way in which to offset the conflicting tensions posed by the need for appropriability, exclusion and diffusion is certainly debatable. It must be remembered that the system of protecting intellectual property rights

in Japan evolved in an economy that was focused on imported technology (Audretsch, 1997). Consistent with that is the well-known capability of Japanese firms to adapt, to modify and commercialize imported technology. It may be that the system of protection for intellectual property in Japan could be more effective in meeting the needs of a technological follower rather than those of an intellectual leader. As Ordover and Willig (1990) point out, a technological leader is more likely to value the aspects of appropriability and exclusion rather than diffusion. As they show, this is even more the case when the market power of an innovative firm can be dissipated by competition from foreign firms.

The production and application of intellectual property deserves special attention in economics, because as Arrow (1962, p. 616) emphasized some three decades ago, new economic knowledge is decidedly distinct from other economic goods: 'The central fact about the processes of invention and research is that they are devoted to the reproduction of information. By the very definition of information, invention must be a risky process, in that the output (information obtained) can never be predicted perfectly from the inputs." Arrow (1962, p. 619), in fact, provided for an economic rationale for government intervention in the form of protection of intellectual property, 'We expect a fiee enterprise economy to under invest m invention and research (as compared with an ideal), because it is risky, because the product can be appropriated only to a limited extent, and because of increasing returns in use.''

The need to balance appropriability on the one hand against competition and diffusion on the other has been the subject of a fairly large literature. However, when it comes to the five basic regimes of intellectual property protection – patents, copyxight, trademarks, trade secrets, and misappropriation, there has been considerably less analysis undertaken. The main issues involved in what research has been done involves the scope and the duration of protection. These elements are generally viewed as shaping the appropriability conditions as well as the ease of diffusion. Generally it is thought that a broader scope and longer duration correspond with greater appropriability and therefore a greater incentive to innovate. However, the degree to which competitors are excluded reduces the degree of competition and presumably static efficiency and the extent to which diffusion of new knowledge is impeded reduces dynamic efficiency. Most of the knowledge in the economics literature invokes the relationships between patent protection, exclusion and diffusion. Considerably less is known concerning the links between the other regimes of intellectual property protection and the appropriability conditions, as well as exclusivity and diffusion.

This is also true for the links between appropriability on the one hand and technological change on the other. This large literature has not been reviewed here, but one of the central conclusions is that patent activity tends to increase where appropriability conditions are greater. (COHEN and LEVIN (1989). But the use of patent activity to measure innovative activity has been challenged in the literature. For example, Pakes and Griliches (1980, p. 378) argue that "patents are a flawed measure of innovative output; particularly since not all new innovations are patented and since patents differ greatly in their economic impact." In addressing the question, "Patents as indicators of what?' Griliches (1990, p. 1669) concludes that, "Ideally, we might hope that patent statistics would provide a measure of the innovative output...The reality, however, is very far from it. The dream of getting hold of an output indicator of inventive activity is one of the strong motivating forces for the economic research area." In any case, whatever the qualifications in measuring the link between appropriability and patent activity, very little is systematically known concerning the link between technological change and the appropriability conditions afforded by the other regimes of intellectual

property protection. This represents a clear and unfortunate oversight of economic research. This may be particularly so because, as Scherer (1983, pp. 107-108) points out, the propensity to utilize any particular regime of intellectual property protection may vary from industry to industry, "...the quantity and quality of industrial patenting may depend upon chance, how readily a technology lends itself to patent protection, and business decision-makers' varying perceptions of how much advantage they will derive from patent rights. Not much of a systematic nature is known about these phenomena, which can be characterized as differences in the propensity to patent."

Scherer (1983) found a lower propensity to actually rely on patent protection as a mode for protection of intellectual property in the office equipment industry. (Scherer, 1983) Such a disparity in the propensity to patent across industries is explained by Mansfield (1984, p. 462), 'The value and cost of individual patents vary enormously within and across industries...many inventions are not patented. And in some industries, like electronics, there is considerable speculation that the patent system is being bypassed to a greater extent than in the past. Some types of technologies are more likely to be patented than others." In any case, neither Scherer nor Mansfield, nor virtually anyone else for that matter, has even attempted to systematically identify which regime of protection of intellectual property protection is being substituted for patent protection or how the reliance upon specific regimes of intellectual property protection varies from industry to industry.

4.9. Mobilizing Entrepreneurship in Universities

Universities in the EU offer a rich pool of students and academics. Universities could play a more positive role for entrepreneurship - thus also for creating new jobs - if universities were encouraged to incorporate in some curricula complementary modules on business and entrepreneurship. While it is true that the typical time lag between final examinations and creation of an own business is rather long for academic entrepreneurs (eg some 10-15 years in Germany) optional courses on business creation for all students could turn out to be a usell investment for society. Such reforms would widen the long term entrepreneurial basis and it would create a generally more receptive climate for entrpeneurs m Europe. The European Commission could stimulate adequate reforms in EU member countries.

The present university system in most EU countries is dominated by state universities which have insufficient incentives to nurture entrepreneurial talents. More private universities which face pressure to find external research funds will consider a strong track record of alumni which are entrepreneurs as important. Therefore the European Commission could support - eg via an endowment for a chair - creation of private universities m countries in which such universities are quite rare.

4.10. Perspectives: Globalization and Political Innovation in a Democracy

The globalization ofthe economy in the sense of a growing international trade network - with more products and more countries covered - and a rapid rise of foreign direct investment implies both rising trade in differentiated products and more complex internationalized production networks of multinational companies. With the advance of Asian NICs - disregarding transitory problems in their financial markets m 1997 - m medium technology fields Schumpeter rents of EU countries are melting away. Moreover, as innovation cycles are shortening EU firms face the problem to appropriate an

adequate rate of return on investment plus innovation expenditures within a shorter period so that the one hand exploiting economies of scale becomes more important. On the other hand, for innovative firms marketing expenditures are likely to increase because they are an option to reinforce market segmentation across customer groups and countries so that profitable price differentiation remains a valid strategy for improved recovering of innovation costs.

Facing an internet revolution worldwide in the coming years - namely more powerful browsers in combination with advanced hardware plus wider international access to the internet as a consequence of falling PC and telecoms network user prices it is clear that the EU's firms will face stronger innovation competition around the world. It will become more difficult for firms fiom OECD countries to recover R&D investment costs by first mover advantages and high prices in a rather long pioneer stage. With the pioneer stage shortening and imitation threats strengthening worldwide innovative firms could pursue more intensive patenting strategies on a global scale. At the same time it holds that with faster worldwide imitation the time span of effective patent protection is shortening. One way for innovative firms to secure an adequate rate of return on innovation will be to pursue international mergers & acquisitions in order to build up market power in the world market. The aircraft industry, pharmaceuticals and electro turbine industry are examples for this development.

Globalization implies that the quest for mobile capital will intensfy so that competing locations will have strong incentives to create hospitable economic fiameworks and an attractive system design. This development implies a growing role of the economic system worldwide and (transitorily) less influence for the political *system.* With more mobile production factors and trade in more diversified products and intermediate inputs governments in European welfare states typically face problems in maintaing a broad tax basis - corporate tax revenues relative to GdP are declining across Europe. At the same time govemments face pressure for privatization because state-owned companies are poorly positioned for becoming a fully accepted partner in international business cooperation and M&A ventures.

Free trade is considered to be the natural way for expanding prosperity m the globe. While there is no doubt that fiee trade supports economic catching-up processes it could be more doubtful whether there will be full convergence in the long run as the new growth theory and the new trade theory argue that there will be core-periphery developments. Moreover, with scale economies gains fiom trade will be rather asymmetric depending on international specialization patterns of country I and II. Facing rather large gains in industries with scale economies one cannot rule out that nations' competing R&D efforts could lead to excessive national expenditures for such sectors. Too much R&D support indeed can be expected if large gains in the market plus major employment effects in state-owned firms are at stake. A first step towards more rationality in the R&D policies therefore is partial (or full) privatization by an initial public offering in the stock market. Discretionary power of both managers and bureaucrats typically will be restricted by the critical eye of analysts in the stock market.

Due to the revolution in telecommunications and the internet technology which bring unprecetended transparency across countries and regions mobile investors are fully aware of advantages and disadvantages of alternative locations for investment projects. This in turn raises pressure on governments to adopt policy innovations fiom abroad. At the same time govemments in EU countries could decide to adopt more cooperative policies in order to avoid the pressure for reform. It should be clear that a certain amount of pressure on govemments to adopt reforms is quite useful in

democracies m which pressure groups and the bureaucracy are two forces that typically slow down adjustment and innovations.

The presence of foreign multinational companies can be a catalyst for political efficiency in the sense that MNCs fiom abroad will request and require that internationally competitive solutions be adopted. Multinational companies will increasingly be influential vis-a-vis the political systems in Europe. Their influence could even rise furthermore after the start of the Euro since full transparency in costs and prices will encourage MNCs to largely disregard any traditional preferences in their investment decisions m favor of the headquarter country. If some EU countries would suffer major and sustaining outflows of foreign direct investment along with declining inflows a falling investment output ratio, slower growth and higher unemployment will be unavoidable results. In a world with rising FDI flows each EU country should emphasize steps for raising FDI inflows while not discouraging FDI outflows that are natural and necessary for an efficient international division of labor.

Innovation in Economic Policy

Globalization of the economy requires for EU countries to step up their R&D policy and to stimulate the creation of new technology oriented firms. Given the vested interestes of incumbant firms the lobby for innovative newcomers certainly is weak. Few countries - like the US and the UK - have established functional venture capital markets. Certainly continental Europa is facing major problems in this field. Even more difficult could be to achieve the necessary increases in government R&D spending. European monetary union and the stability pact, respectively, impose a maximum deficit GDP ratio of 3% on Euro countries after 1999. Disregarding the smaller EU countries which except for Greece record an almost balanced budget m 1998 the major EU countries - narrowly reaching the 3% margin - have little room to maneuvre on the expenditure side. With pressure for government expenditure cuts public R&D spending is likely to fall as a ratio of GDP in the future in the Community. Given the high rate of unemployment m most EU countries there are, however, favorable prospects for stepping up programs for the support of new technology-oriented firms. The basic economic rationale to do so lies in the positive external effects of such firms. Given the rising social security contribution rates caused in continental EU countries' pay-as-you-go systems by ageing of society there will be political resistance against high income tax rates in the future and this in turn could force governments to reduce R&D expenditures relative to GDP. This would be exactly contrary to what is required m the European information & high technology society. Politicians might consider to shore up support for R&D projects by implementing a new policy field related to innovation policy, namely communication policy. In the information society the creation of fast integrated networks, including access for universities, schools and small and medium-sized firms is important as are new services offered via the mternet - possibly including a venture capital market m the internet (launched in the US m 1997).

In the field of economic policy m a democracy innovations are rather difficult to launch. This typically has five reasons:

- Market entry m the political market is often difficult since there are minimum voter shares in many countries
- The need to achieve majorities in parliament makes innovations more difficult than in the marketplace where even small minorities of flexible consumers can help to successfully launching a product innovation;
- Coalition governments which often include a small innovative party are often themselves unstable.

- Rent-seeking of vested interest groups helps the incumbant government to survive by supporting existing industries - not the small innovative sectors of the economy which are rarely effective in political lobbying.
- There is a political constitution which can be invoked by conservative forces to defend the status quo. The judicial system has a tendency to interfere in favor of incumbant firms because those have more financial clout and thus can mobilize more expertise than innovative newcomers.

Systemic competition therefore is quite important. From this it follows that economic policy in general and R&D policy in particular must be willing to adopt successll procedures fiom partner countries and that political interference should be limited in Western Europe in order not to unduely restrict market dynamics. At the same time it holds that government should assume its responsibility at the various government layers and pursue clear-cut policies which must include standardized reporting procedures.

FOOTNOTES

1. MACHIN also summarizes results fiom using a finer definition of the skill structure based on education shares. These shares are shown to be strongly correlated with the share of nonmanual employees.

2. Factor content analysis studies suggest that trade can account for between 10 and 20 percent of the fall in demand for unskilled labor.

3. MCKELL and BELL accept the facts of lower wage flexibility in continental Europe but argue that the favorable German record - favorable in the sense that wages are rigid but unemployment no worse than m the U.K. or the U.S. (sic) - reflects the superior training of bottom-decile German workers. This, we are told, has "enabled the German economy to respond to demand shifts towards the skilled in a far more robust fashion" (MCKELL and BELL, 1996,308).

4. However, the proportion of the total change in unemployment resulting from changes in occupational structure can vary greatly within these broad occupational categories.

5. The study disaggregates the two skill groups by (5) categories of labor market experience, a crude proxy for differences m human capital The fixed effect thus captures (other) time-invariant factors that differ between industries and experience groups

6. MACHIN also calls for investigation of within-industry shifts in the female-male employment and in full time-contingent worker employment.

7. But, for a *criticism* centering on the indirectness of the test procedure, see RICHARDSON (1995).

8. The ISC is defined as the half the sum of the absolute value of the change m the share of employment m the relevant grouping (region/industry/establishment/occupation). It provides the percentage point change m the distribution of workers that would equate the distribution of employment in two periods. Higher values of the index are supposed to indicate that the labor market responds well to substantive shocks.

9. The proviso being that the need for flexibility has not grown in recent years.

ANNEX I

TABLES AND FIGURES

Tab. A1: Import penetration and export coverage in manufacturing

				Average annual growth	
	1970	1980	1991	1970-80	1980-91
	Imports as a percentage of total domestic demand				
United States[1]	5.1	s.7	14.0	5.5	4.5
Canada[1]	25.3	30.7	35.9	2.0	1.4
Japan	4.0	5.5	6.1	3.2	1.0
Denmark	41.1	43.8	52.5	0.6	1.7
France	15.8	21.3	30.9	3.1	3.4
Germany	13.3	19.6	27.3	3.9	3.0
Italy[1]	15.7	19.9	70.9	2.4	0.4
Netherlands	42.0	53.0	66.4	2.3	2.1
United Kingdom	14.7	22.9	30.2	4.5	2.6
Finland	27.9	27.8	30.3	0.0	0.8
Norway	39.8	38.7	43.3	0.3	1.0
Sweden	29.5	35.9	40.6	2.0	1.1
Australia[1]	16.2	21.6	25.4	2.9	1.5
	Exports as a percentage of production				
United States[1]	5.3	9.2	11.0	5.6	1.6
Canada[1]	26.7	30.2	34.5	1.3	1.2
Japan	8.5	11.9	11.4	3.4	-0.4
Denmark	34.6	41.9	54.4	1.9	2.4
France	16.9	22.6	30.2	2.9	2.1
Germany	1s.4	25.0	30.0	3.1	1.7
Italy[1]	18.3	22.1	25	1.9	0.2
Netherlands	40.9	55.3	65.3	3.1	1.9
United Kingdom	16.3	23.4	7s.o	3.7	1.7
Finland	27.5	32.4	35.4	1.6	0.8
Norway	31.1	30.0	36.0	-0.3	1.7
Sweden	29.6	3s.o	45.0	2.5	1.6
Australia[1]	11.4	16.1	13.5	3.5	-1.6

[1] 1990 data used instead of 1991

Source: OECD (1997). Globalisation of Industry. Paris, 24.

Tab. A2: International sourcing compared with domestic sourcing

International Linkage Index', mid-1980s

	Canada	France	Germany[2]	United Kingdom	Japan	United States
Motor vehicles	0.92	0.34	0.23	0.39	0.06	0.17
Aerospace	0.40	0.28	0.24	0.50	0.57	0.09
Communications/semicond	0.46	0.20	0.22	0.37	0.08	0.13
uctors	0.68	0.43	0.28	0.42	0.10	0.13
Computers	0.33	0.36	0.35	0.51	0.16	0.11
Textils	0.22	1.10	0.72	0.35	*0.75*	0.13
Petroleum refining						

Calculated taking into account both direct and indirect (upstream) inputs. For methodology, see OECD (1993)

2 Electrical machinery includes communications and semiconductors.

Source: OECD (1997), *Globalisation of Industry, 29.*

Tab. A3: Intra-industry trade indices, all products', OECD-Countries 1970-90

	1970	1980	1990
United Kingdom	53.2	74.4	84.6
France	67.3	70.1	77.2
Austria	60.4	73.2	75.2
Spain	41.7	48.9	74.2
Belgium/Luxembou	61.4	67.5	72.8
rg	***55.8***	56.6	72.2
Germany	44.4	46-5	71.8
United States	63.4	60.5	69.8
Netherlands	52.3	58.2	64.2
Sweden	*55.0*	54.8	62.2
Denmark	52.5	59.8	60.2
Switzerland	52.1	51.5	60.0
Canada	48.7	54.8	57.4
Italy	48.2	55.1	56.9
Ireland	32.4	28.3	50.5
Greece	39.8	39.5	49.2
Portugal	29.4	37.8	45.7
Finland	52.3	42.5	41.9
Norway	6.7	12.5	34.6
Turkey	21.4	17.1	32.4
Japan	20.7	21.6	30.5
Australia	10.6	16.3	25.9
New Zealand			

1 Grubel-Lloyd indices calculated on SITC Rev. 2 3-digit level, adjusted for overall trade imbalances.

Source: OECD (1997), Globalisation of industry, Paris, 30

Tab. A4: International portfolio investment"

	1980	1985	1990	1991	1992	1993	1994	1995
	as a percentage of GDP							
United States	9,0	35,1	89.0	95,6	106.6	128.8	131,1	135,5
Japan	7,7	63,0	120,0	91,9	71.8	77.8	60.0	65.7
Germany	7,5	33,4	57,3	55,6	85,2	170.8	159,3	168,3
France	-	21,4	53,6	78.7	121,8	186.8	201,4	178,2
Italy	1,1	4,0	26,6	60,3	92,1	191,9	206,8	250,9
Canada	9,6	26,7	64,4	81,3	113,2	152,9	209,7	192,0

* Gross purchases and sales of securities between residents and non-residents.

***Source:BIS** (1996), 66th Annual Report, Basle, 122.*

Tab. A5: Trade and investment in the OECD area

Annual growth rates of					Percentages of OECD GDP			
	International investment flows[1]	Trade[2]	GDP	GFCF		International direct investment flows	Trade	GFCF
1970-80	15.9	18.9	13.8	14.1	1970	0.5	13.0	22.1
1980-89	16.3	6.2	7.2	6.8	1980	0.6	20.0	22.8
1989-90	-2.6	16.6	11.9	10.6	1990	1.2	18.9	21.8
1990-91	-21.7	1.9	5.3	1.8	1991	0.9	18.3	21.1
1991-92	-8.3	7.2	6.8	4.0	1992	0.8	18.4	20.5
1992-93	7.2	-3.6	0.7	-0.5	1993	0.8	17.6	20.3

1 Average of OECD inflows and outflows.

2 Average of imports and exports.

*Source: **OECD** (1997), Globalisation of **industry.** Paris, 22.*

Tab. A6: intra-regional international investment: 5 largest home and host countries

Percentages of total investment stock at year-end

	1982		1991	1993	
Outward investment to region as share of total outward investment stock					
United States to North America	20.9		15.1	12.8	
Japan to Asia	26.7		15.0	15.5	
United Kingdom[1] to Europe	19.5	(EC 15.8)	30.0	35.0	(EC 32.0)
France? to Europe	58.4	(EC 46.4)	65.0	61.3	(EC 55.0)
Germany! to Europe	40.7	(EC 32.4)	60.6	57.1	(EC 48.0)
Inward investment from region as share of total inward investment stock					
United States from North	9.4		8.7	8.9	
America	37.3	(EC 29.7)	40.5	39.6	(EC 31.1)
United Kingdom[1] to Europe	n.a.		72.3	72.93	(EC 58.8)
France3 from Europe	74.8		64.1	64.7	
Canada from North America	**48.8**	(EC 30.5)	58.7	61.1	(EC 41.7)
Germany[1] from Europe					

Note: Regions are: North America = United States + Canada: Europe = OECD Europe: EC = EC(12), Asia = DAEs + Indonesia, Phillipines, China.

1 1984 data.

3 1987.

3 1992.

Source: OECD (1997), Globalisation of Industry, Paris, 34

Tab. A7: Indicators of internationalization, selected countries

1993 in percent

Indicators	German!,	USA	Japan	France	United Kingdom	Canada
	activities abroad					
Share of exports in gross value added of production (export dependence)	29.9	12,;	11.6	30,2	29.7	44.8
Number of foreign employees relative to domestic employees	23,5	22.4	8,1	32,5		
Direct investment[a] abroad relative to exports	26.2	51,7	32,6	30,9[b]	59,0	34,1
R&D expenditures of companies relative to domestic R&D expenditures	15.0	10,0	2,0			
Share of patents of domestic companies where the invention took place abroad	14.9	7.8	1.0	14,3	42.1	33.0
	domestic activities					
Share of imports in domestic demand[c]	25.4	15.9	5.7	28.8	33.7	46.2
Number of employees in foreign owned companies relative **to** total domestic employees	15.9	11,6	1,1	23,9	16,2[d]	48.0
Foreign direct investment'' relative to imports	19.5	32.2	10.3	20.9	31.7	48,4
Share of R&D expenditures by foreign owned companies in total domestic R&D **expenditures**	15.8	14.9	**8.2**	15,2	25.8	40.8
Share of patents of foreign companies where the invention took place at home	17.0			18.0	41,0	

a) stock at the end of the year
b) direct investment stock in 1992
c) imports as a share of gross value added in production minus exports plus imports (in percent)
d) 1990

Source: DIU' (I 996). *DIW Wochenbericht 16/1996,* 263.

Tab. AS: Share of foreign enterprises in manufacturing production and employment
Percentages

	Production				Employment			
	1980		1991		1980		1991	
United States'	3.9		14.8	(1992)	5.1		12.3	(1992)
Canada	50.6		49.0	(1989)	37.8		38.0	(1989)
Japan	4.6		2.8	(1990)	1.6		1.2	(1990)
Denmark			14.2	(1986)			12.4	(1986)
France'	26.6		26.9		18.5		22.1	
Germany	15.7		13.8	(1992)	9.0		7.2	(1992)
Ireland	46.1	(1983)	55.1	(1988)	37.9	(1983)	44.7	(1988)
Italy	19.2		22.3	(1988)	15.8		17.2	(1988)
Portugal	23.6	(1984)			17.7	(1984)		
United Kingdom	19.3	(1981)	25.5		14.9	(1981)	17.2	
Finland	2.5		6.7	(1992)	3.1		6.2	(1992)
Austria			25.7				15.6	
Norway'	11.5		10.5	(1990)	6.5		7.7	(1990)
Sweden	7.9		18.0	(1992)	6.1		16.9	(1992)
Australia'	33.5	(1982)	32.0	(1986)	26.3	(1982)	23.8	(1986)
Turkey	6.2	(1986)	5.9	(1991)	2.3	(1986)	4.4	

- Includes minority holdings (equity holdings > 10 or >20 per cent up to 50 per cent) for countries indicated. Percentages are calculated as a share of production from the annual census of production in most cases. This may overstate the share of foreign firms. if small firms (<20 employees) are excluded from the annual census. as small firms are predominantly domestic.
- Includes joint ventures and minority participation (<50%). Values for France are unweighted by share of minority ownership.
- *Source: OECD (1997). Globalisation of Industry, Paris, 30*

Tab. A9: Shares of international stock by broad sectors

Percentage shares

		Outward			Inward			CDP shares (1992)		
		Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
United States	1982-84	30.5	40.3	29.3	17.0	33.7	49.4			
	1991-93	13.0	37.3	49.7	10.2	37.9	51.9	4.0[7]	20.6[7]	75.4[7]
Canada[1]	1982-84	22.4	45.2	28.6	31.4	40.1	24.3			
	1991-93	7.6	43.1	49.3	15.1	51.5	33.4	6.7[7]	20.7[7]	72.6[7]
Japan[1]	1982-84	20.5	30.8	46.3	n.a.	74.7	25.3			
	1991-93	5.5	26.9	65.8	n.a.	57.5	42.5	2.6	29.5	67.9
France	1991-92	6.2	40.7	53.2	5.3	37.4	53.1	4.1	25.6	70.3
Germany[1]	1984	3.8	59.7	30.1	0.2	53.1	46.1			
	1991-93		50.6	44.8	0.1	48.6	51.1	1.9	33.9	64.2
Italy	1982-84	20.7	39.4	39.8	7.5	55.0	37.5			
	1991-93	6.4	31.1	62.5	3.3	39.9	56.8	3.7	24.0	72.3
Nether-lands	1984	0.1[3]	68.6	31.3	0.3[1]	54.0	45.7			
	1991-92	0.1	54.7	45.2	0.1	52.1	47.8	7.8	21.6	70.6
United Kingdom	1984	33.3	31.8	34.8	33.9	40.8	25.3			
	1991-93	17.9	37.2	45.0	25.1	34.0	40.9	4.3	25.5	70.2
Finland[1]	1982-84	n.a.[3]	60.0	41.7	n.a.	n.a.	n.a.			
	1991-93	n.a.	73.2	19.0	n.a.	51.4	36.2	7.0	28.6	64.5
Norway[1]	1991-93	15.1	57.8	25.4	34.8	11.6	53.1	20.9[1]	17.4[7]	61.7[7]
Sweden[1]	1991-93	n.a.	60.9	35.3	n.a.	46.5	48.2	3.4	25.8	70.8
Australia	1982-84	18.2	30.9	51.5	21.2	30.1	48.6			
	1991-93[4]	16.1	28.6	50.9	17.1	25.2	51.4	7.6	15.0	77.5

[1] Unallocated is 2% of outward investment. [2] Unallocated is 3-6% of outward investment. < ½% of inward investment, [3] Mining, oil, petroleum included in chemicals

[4] Unallocated fluctuates widelyk. [5] Unailocated is 2-6% outward investment, fluctuates for inward investment. [6] 1983-84, [7] 1991

Source: OECD (1997). Globalisation of Industry. Paris. 35.

Tab. A10: Stock market capitalization in selected OECD countries (End November 1996)

Country	Stock Circulation (Bill. DM)[1]	Stock Market Capitalization Coefficient[2]
USA[3]	13.354	122
Japan[4]	4.881	63
Great Britain	2,544	152
Germany	1,002	27
France	892	38
Canada[5]	756	88
Switzerland	624	135
The Netherlands	555	93
Italy	386	23
Sweden	357	103
Spain[6]	332	39
Belgium	180	44
Denmark	105	40
Finland	90	47
Norway	85	38
Austria	48	14

Notes: 1 - prices of domestic stocks listed on the stock exchange; 2 - stock circulation in percent of the 1995 nominal GNP: 3 - New York Stock Exchange and NASDAQ; 4 - Tokio Stock Exchange; 5 - Toronto Stock Exchange; 6 - Madrid Stock Exchange

Source: Deutsche Bundesbank (1997). Monatsbericht Januar 1997, Frankfurt/M.

Fig. A1: Competition and Innovation in Telecommunications

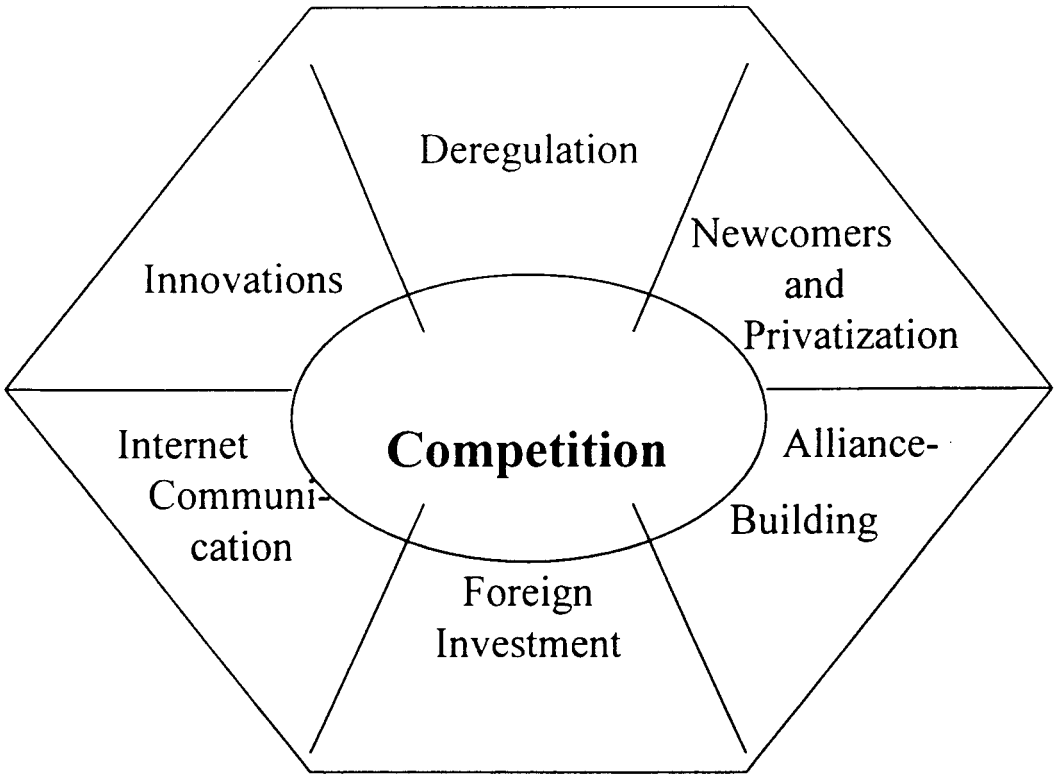
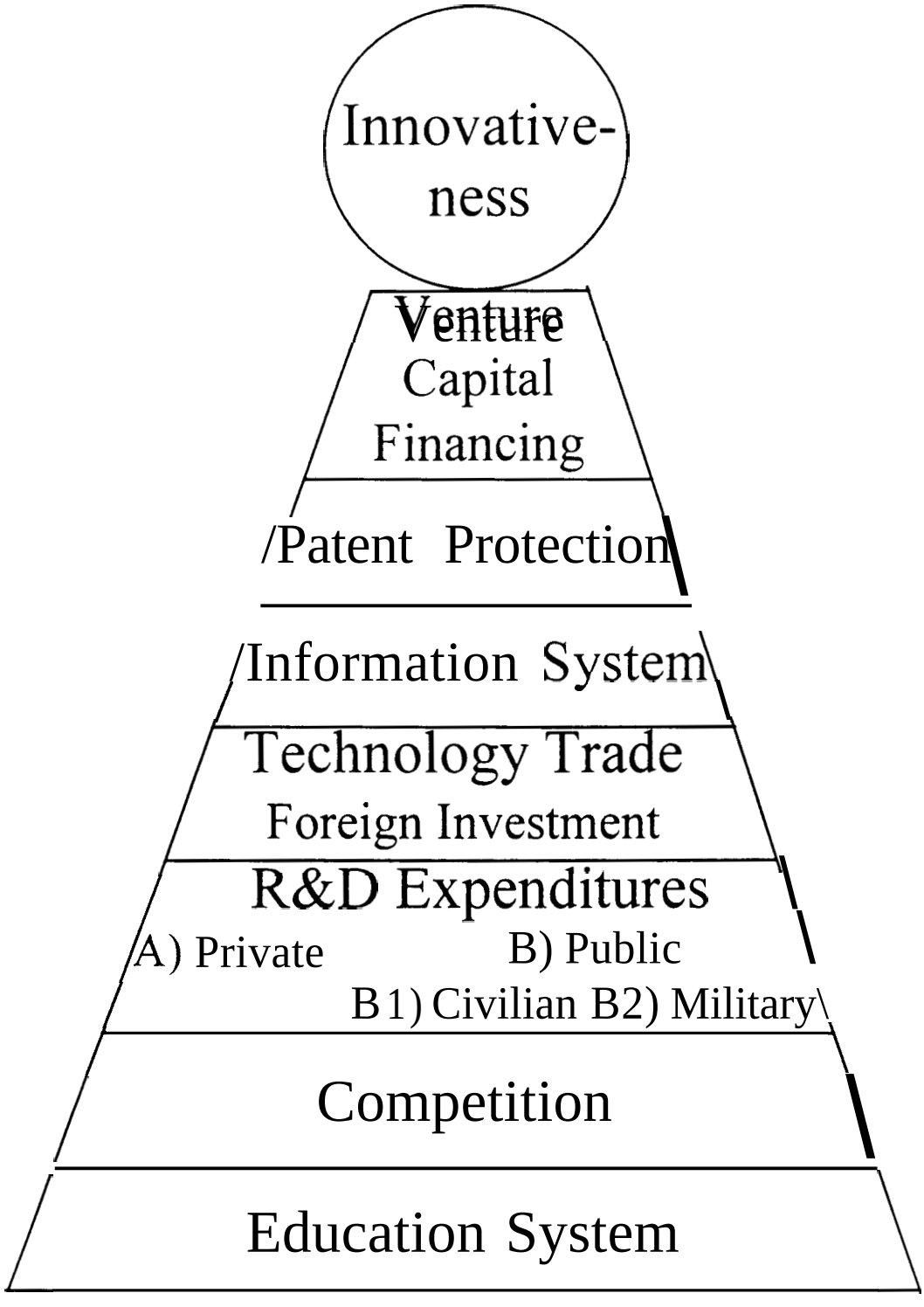


Fig. A2 Fundamentals of Innovativcness



Tab. A11: Foreign Direct Investment **(FDI)** relative to Gross Domestic Capital Formation

		1981 to 1985	1986 to 1990	1991	1992	1993	1994	1995
		yearly average						
Germany	I	**0,6**	**1,1**	**1,0**	**0,6**	0,4	**0,2**	1,7
	II	**3,2**	5,9	**6,0**	4,3	3,7	3,7	6,7
	III	**20,4**	19,9	23,0	23,1	21,8	22,0	21,7
France	I	**2,0**	3,9	5,9	8,2	9,0	7,1	7,3
	II	**2,4**	7,9	9,4	11,8	**8,8**	9,5	6,4
	III	**20,4**	20,5	21,2	20,1	18,5	18,0	18,0
Italy	I	**1,2**	**2,2**	**1,1**	1,3	2,3	1,3	
	II	**1,9**	2,4	3,2	**2,5**	4,5	3,1	
	III	**21,8**	20,0	19,8	19,1	16,9	16,4	
United Kingdom	I	**5,5**	13,9	9,4	9,0	10,2	6,8	17,9
	II	**11,8**	19,3	9,4	**11,5**	18,1	18,6	22,8
	III	**16,4**	**18,8**	17,0	15,6	14,9	14,8	**15,0**
Netherlands	I	**6,1**	12,7	10,7	12,1	12,7	8,7	13,2
	II	**15,4**	20,2	22,9	22,1	19,5	26,0	15,5
	III	**18,8**	21,0	20,4	20,0	19,3	19,3	19,7
Belgium	I	**7,9**	15,7	24,9	27,0	28,6	18,7	
	II	**1,5**	14,9	16,7	27,3	13,1	1,5	
	III	**16,6**	17,8	18,9	18,8	17,8	17,3	17,6
Denmark	I	**0,8**	2,9	7,3	4,6	**8,5**	23,1	15,0
	II	**2,0**	5,6	8,7	10,1	6,8	19,2	10,7
	III	**16,7**	18,8	16,5	15,6	**15,0**	14,8	16,0
Schweden	I	**1,5**	3,9	13,7	**0,0**	14,0	23,3	42,8
	I1	**7,3**	21,2	16,7	**1,0**	**5,6**	24,6	32,2
	III	**18,8**	20,3	19,4	17,0	14,2	13,6	14,5
Spain	I	**5,2**	9,9	9,9	**10,5**	**8,6**	9,8	**5,4**
	II	**0,9**	**1,8**	3,5	1,7	2,8	**4,0**	3,1
	III	**20,4**	20,7	23.8	21,9	19,9	19,8	20,8
Switzerland	I	**4,1**[a)]	**5**,3	5,4	**2,2**	1,7	6,3	
	II	**9,4**[a)]	10,3	11,1	9,9	**16,8**	17,9	
	III	**23,5**	26,1	25,6	23,7	22,5	22,8	23,1
United States	I	**2,8**	**6,1**	2,5	1,9	4,1	4,4	4,8
	II	**1,1**	**2,9**	3,6	4,s	7,5	4,8	7,7
	III	**19,2**	18,0	15,3	15,6	16,3	16,3	17,2
Canada	I	**1,0**	5,9	**2,4**	4,2	**5,0**	7,2	11,o
	II	**4,7**	5,1	4,9	3,4	**5,8**	7,4	5,9
	III	**20,9**	21,3	**19,5**	18,7	18,1	18,5	17,3
Japan	I	**0,1**	**0,0**	**0,1**	**0,2**	**0.0**	**0,1**	**0,0**
	II	**1,5**	3,9	3,0	1,5	**1,1**	1,4	1,6
	III	**28,6**	29,8	**31,8**	30,7	29,8	28,6	28,4.

1) Based on national accounts.

Tab. A12: Foreign Direct Investment in Transformation Countries

1993 - **1996''**

Stock figures in million US- $

Hostcountry/ -region	1993	1994	1995	1996	01.07.96[2]
CEFTA"	8701	13891	18958	30659	32568
Poland"	1370	2307	3789	784.3	9045
Slovak Republic	231	366	547	726	803
Czech Repuplik	1598	2166	3029	5587	6045
Hungary	5502	8342	9965 1	13740	13868
Slovenia[4]	...	710	1629	2762	2806
Balkan region	581	844	1547	2115	2498
Bulgaria	65	192	412	517	610
Rumania"	516	652	1135	1597	1888
Baltic region	166	487	978	1483	1551
Estonia[6,]	59	221	442	646	680
Latvia	33	75	294	485	496
Lithuania"	74[5]	192[5]	242[5]	352[4]	375
Eastern middle Europe total	9448	15222	21483	34257	36617
CIS countries among these:	8	4537	6045	9866	11225
Kazastan	...	1271	1910	2769	3244
Russian Federation	...	2783	3365	5875	6550
Ukraine	...	219	484	891	1083
Belarus	8	264	287	331	348

(...) = not available

[1] At the beginning of each year

[2] preliminary

[3] Central European Free Trade Association

Source: UN-ECE 1996: Calculated by the DIW on the basis of national statistics

[4] Figures are expressed in national currencies calculated on year-ended exchance rates

[5] Cumulated foreign shares of nominal capital owned by firms with foreign participation

[6] Cumulated flow figures of the balance of payments

[7] New system of data collection since 1996

I) FDI inflows relative to domestic investment.
II) FDI outflows relative to domestic investment.
III) investment relative to GDP.

a) 1983 to **1985.**

Source: *SVR (1996),* ***Reformen vorantreiben, Jahresgutachten*** *1996/97* ***des Sachverstandigenrats*** *zur* ***Begutachtung der*** *gesamtwirtschaftlichen Lage,* ***p. 67***

Tab. B1: Changes in the Employment and Wage Bill Shares of Nonproduction Labor and Between- and Within-Industry Decompositions, U.S. and U.K. Manufacturing Industn

Sample	Employment Share			Wage Bill Share		
	Total Change"	Between - industry component	Within - industry component	Total Change"	Between - industry component	Within - industry component
U.S., 1959-73	0.069	-0.009	0.078	0.051	-0.018	0.069
U.S., 1973-79	0.299	0.112	0.187	0.293	0.085	0.208
U.S., 1979-87	0.552	0.165	0.387	0.774	0.306	0.468
U.K., 1979-90	0.367	0.066	0.301	0.668	0.114	0.554

Note:[a] Annualized percentage point rate of change in the relevant share.

Sources: **U.S.**- Berman, Bound, and Griliches (1994). Table IV. p. 37;
U.K.- Machin (1996), Table 7.2, p. 134.

Tab. B2: Changes in Relative Demand[a] for Men by Wage Percentile, U.S. Nonagricultural Sector

	Interval	
Percentile	1939-49	1979-89
*Total **employment** shift*		
1-20	-.07	-.08
21-40	-.00	-.08
41-60	.04	-.09
61-80	.07	-.07
81-100	.08	.03
Employment** shifts across **industries only		
1-20	-.03	-.03
21-40	.01	-.04
41-60	.03	-.06
61-80	.05	-.07
81-100	.06	-.04
***Employment** shifts across occupations only*		
1-20	-.04	-.05
21-40	-.02	-.04
41-60	.00	-.02
61-80	.02	.00
81-100	.02	.07

Note:[a] see text for definition of relative demand construct

Source: Juhn and **Murphy** (1994), Table 10.4, **p.** 356

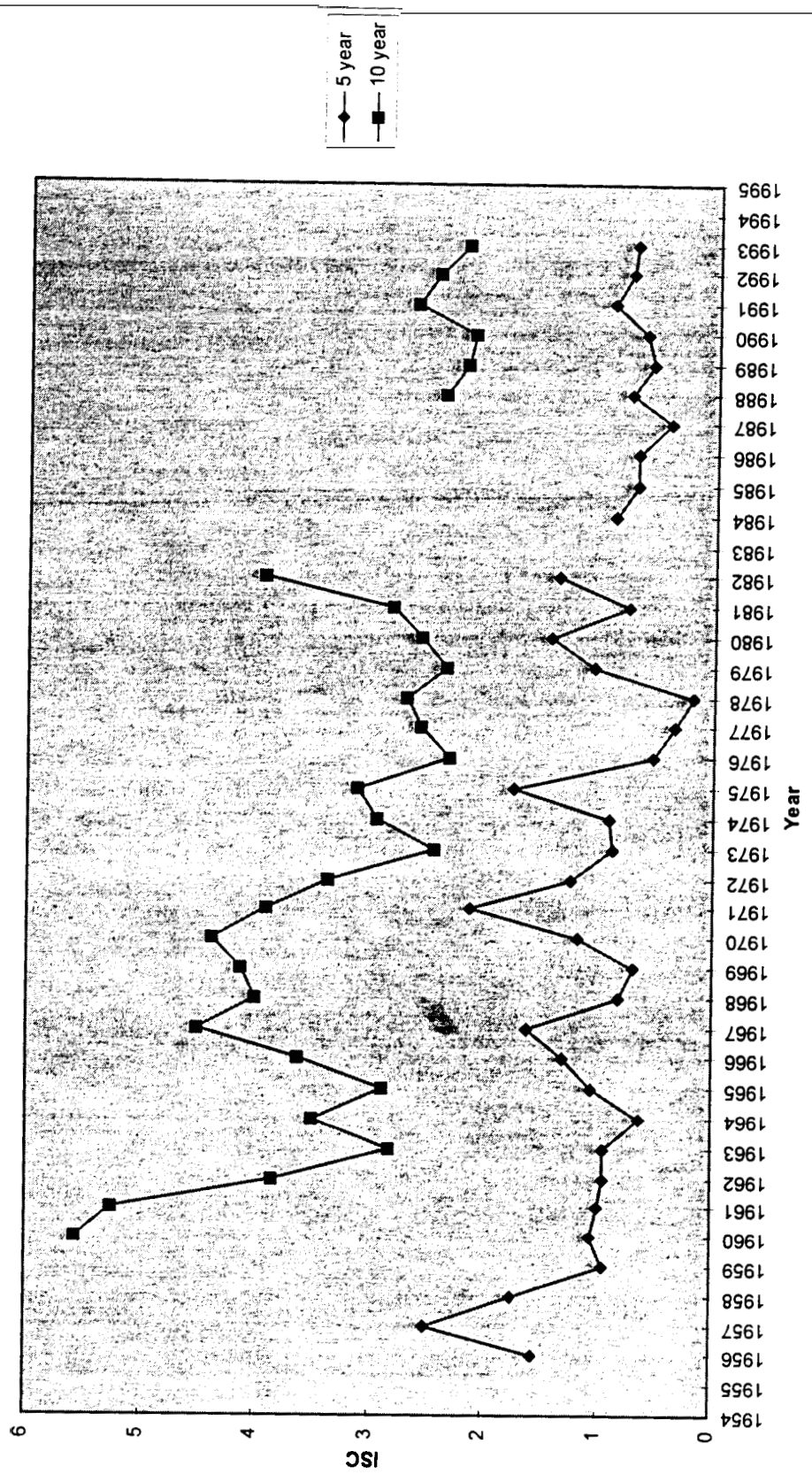


Fig. B1: ISCs for One-Digit Occupations, At One and Five Year Intervals, United States 1955-93

Tab. C1: Change in employment in industry and services in the five large OECD countries 1981/83 to 1991/93 (Source: OECD, calculations of DIW; in some cases the distinction between services for private persons and services for firms is not exact)

	Germany (West)	France	UK	USA	Japan
	in 1000 employees				
Industry	118	-805	-1.040	-821	1,642
R&D-intensive branches	374	-287	-456	-542	1,127
Other branches	-257	-518	-584	-279	516
Services	3,007	2,128	1,306	18,540	5,804
Distributive services	633	74	489	4.917	622
Services for firms	164	651	817	5,597	562
Government services	305	879	na	2,027	6
Services for private persons	1,906	525	na	5,998	4.614

Fig. C1: Number of technology areas with significance for German industries and their heterogeneity (for details see GRUPP, 1997; the survey data originate from **BEISE** and LICHT, 1996, p. 13)

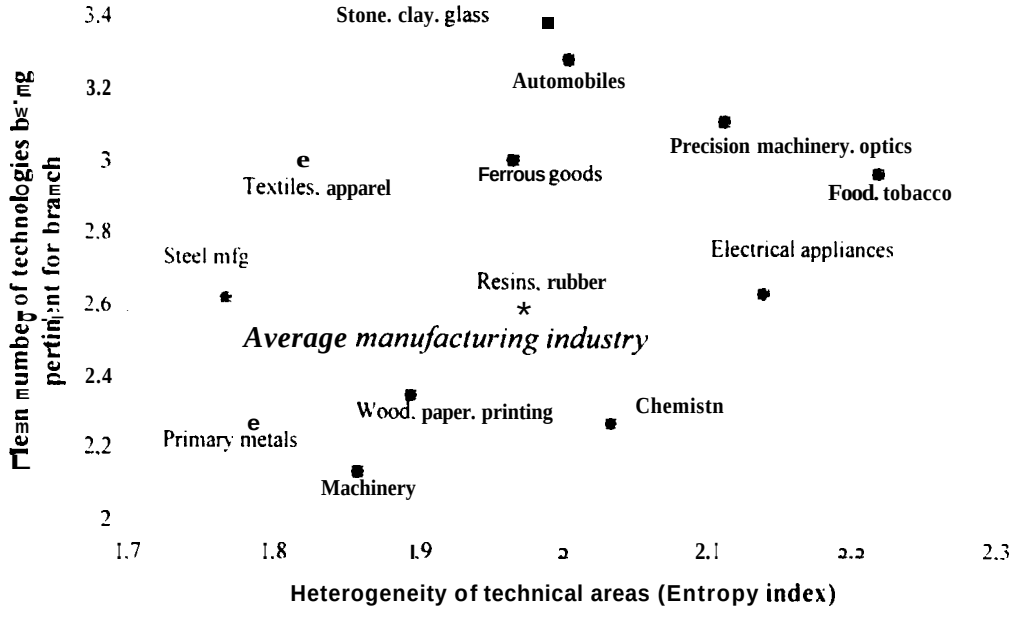
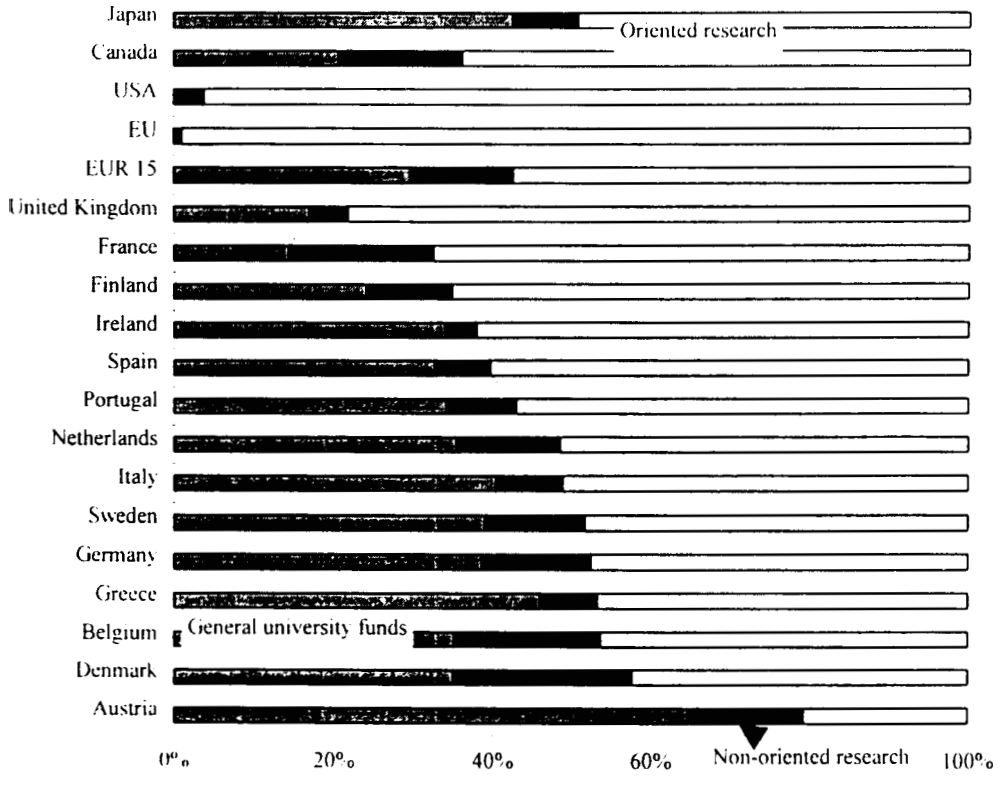


Fig. C2: Breakdown of government R&D budget appropriations between oriented, non-oriented and general university funds of the EU and overseas countries and the Commission of the European Union 1994



Source: EUROSTAT, NSF

ANNEX II

Statement of Professor Welfens before the EIIW Annual Meeting, Potsdam, Dec. 5, 1997

Globalization, the Information Society and Economic Catching-up in the World Economy

Globalization and Economic Catching-up

Economic globalization means that the international network of trade, foreign investment, portfolio investment and information has intensified to such an extent as to create strong worldwide economic interdependence. Trade between OECD countries mainly consists of intra-industry trade and thus has a pro-competitive impact in the tradables sector of these countries. In contrast, trade between the North and South and among developing countries usually constitutes inter-industry trade. Thus pro-competitive impulses fiom the world market are quite limited, and this often is reinforced by uncompetitive domestic financial markets and a lax domestic competition policy. Consequently allocative inefficiencies - in terms of static efficiency criteria - are a major cause of low per capita income in both eastern Europe's postsocialist economies and m many developing countries. Economic growth and catching-up, therefore, require initiatives that increase competition in both the nontradables and the tradables sector m poorer countries. As the aspiration levels of people in poorer country continues to be raised by the Internet and the modern media, achieving economic growth will become ever more significant in political terms. From a EU perspective it is also important to encourage such economic catching-up, since it reduces political conflicts and slows down international migration pressures. This holds for the EU vis-a-vis eastern Europe and Northern Africa, but also applies to the US and Mexico and Latin America.

From a political economy point of view it is, however, clear that there will be strong resistance within developing countries to a strict competition policy. Such a policy could indeed be phased-in gradually and linked to some form of industrial policy, while being embedded in an outside-oriented policy approach (under a strategy of long term capital inflows). To some extent membership of the WTO, WIPO and other international organizations could be a substitute for a domestic competition policy - mainly in the tradables sector.

According to neoclassical models of fiee trade economic convergence is to be expected. Moreover, under neoclassical conditions transportation costs will encourage regional convergence processes within a county However, innovations and differentiated products plus scale economies imply both core-periphery developments within a country and across countries (VENABLES, 1985; KRUGMANN, 1991). In the information society the range of tradable services will increase, with international trade in R&D intensive services being particularly attractive. Thus, firms will be eager to spread R&D costs over many domestic and foreign consumers. As innovative firms appropriate first-mover advantages and Schumpeterian economic rents, they will attempt to reinforce their market position, on the one hand through further investment in innovation and on the other hand through early application of technological innovations developed in other sectors. In the US and the UK the services sectors were the most important users of new technologies in the 1980s - in Germany the industrial sector continued to be the leading user.

In a period of ever more intensive global competition, access to information about new technology and market trends is crucial. As information itself is a usell input for the firms operating in the modem information society, the exchange, storage and processing of information becomes important for prosperity. However, given the monopolistic structure of the telecommunication sector in most non-OECD countries, prospects for faster learning about new international trends and innovations are poor. Under monopoly the scale of the network will be smaller (and repair service less reliable) than under competition so that access will be rather limited and prices higher. Such conditions reduce producers' ability to learn about new market trends and innovations and also impair growth due to lower investment by foreign investors. Since multinational companies typically establish production facilities across several countries and partly rely on intra-company trade, the price of international communication is important to their investment decisions. As multinational companies are typically active in technology intensive sectors, cheap and reliable access to the global information network and the company's intranet as well as extranets are crucial. In a global intensified quest for mobile real capital, countries with modem and cheap telecommunication networks enjoy strategic advantages as host countries for foreign direct investment.

Monopoly prices in telecommunications are like a tax on communication and learning. Telecommunications in general and the use of new technological paradigms are characterized by network effects (WELFENS, 1995). This means that in the networklparadigm expansion stage users A and B will benefit more if there is a rising number of other users C, D,...N which also use the network/paradigm. Hence, a government monopoly has very high social opportunity costs in the sense that the consumer rent would be much higher ifnetwork effects were fully developed and the relevant demand curve had shifted outwards.

In the era of globalization the international interdependence is asymmetric, i.e. small countries are less exposed to the international economy than large countries. Large countries with high per capita incomes enjoy the additional benefit of having a big domestic market allowing economies of scale to be exploited swiftly. While foreign exporters might have access to this big market as well, there is little doubt that biased government procurement and the reputation enjoyed by established domestic firms reinforces domestic firms' opportunities to exploit scale economies at home. Trade in scale intensive goods will create uneven benefits for the home and foreign countries. Depending on the significance of scale effects in the respective product the home country or the foreign country will reap the relatively larger benefits. In the case of foreign direct investment (FDI) such scale benefits could be largely appropriated by the major source Countries of FDI assuming that foreign direct investment mainly takes place in technology and scale intensive sectors. From this perspective, the ability of a country to catch up crucially depends on competitive domestic firms that finally become successll investors abroad. A country that is only a host country for FDI can appropriate Schumpeterian economic rents abroad only via trade but not via foreign direct investment.

Information Technology, Innovation and Catching-up

The enormous advances made in computer technologies, the fall in computer prices and the recent technical progress in telecommunications facilitate access to information and reduce the price of communication in those countries where deregulation and privatization has taken place. These developments have created new opportunities for international economic convergence: poor countries may tap the pool of knowledge and know-how worldwide more easily, and there are new options for the creation of virtual firms and the realization of electronic commerce via the Internet. However, in

terms of using the worldwide pool of knowledge and combining pieces of information for entrepreneurial purposes, the leading economies might actually be better placed than developing countries, namely for four reasons:

- Firms producing scarce hardware and software for the information society are mainly located in the OECD countries. Their innovative products will help to appropriate Schumpeterian rents in information technology products worldwide.

- Even if information were easily available on the Internet, usell commercial application and exploitation requires basic, sometimes sophisticated computer literacy and other knowledge. As is well known fiom the innovation literature (COHEN/LEVINTHAL, 1990, and GEROSKI, MACHIN and VAN REENEN, 1993) the absorption capacity of firms is crucial for profitability in the innovation and imitation race.

- In order to tap the pool of knowledge abroad and benefit fiom R&D spillover effects it will be usell to have subsidiaries already established abroad, especially in those countries where proximity to leading research centers and universities promises considerable positive spillover effects. The ability of subsidiaries to learn abroad and route new knowledge to the parent company, which m *turn* will distribute it to all the subsidiaries, is crucial for positive supply multiplier effects. Outside the OECD group of countries only some countries m eastern Europe, which attracted high FDI inflows and already constitute source countries, are poised to benefit in a similar way to the leading market economies (WELFENS, 1995).

- High technology multinational firms will have to send skilled staff over extended periods to subsidiaries abroad. Few experts will volunteer to countries with political instability and unattractive working conditions, prevalent in many developing countries, so that very high wage premia will be needed to make sure that sufficient skilled personnel is moving abroad. Indigenous skilled personnel often is very scarce, though some Asian countries improved their education systems significantly m the 1970s and 1980s. In many cases it will be simply unprofitable to maintain a foreign subsidiary at all. There are few countries m eastern Europe and the developing world where domestic markets are sufficiently large to make unattractive political conditions of minor importance for MNCs and warrant long term FDI inflows.

In a period of rising capital mobility countries which are major sources of FDI will particularly benefit fiom sustained global economic growth. It is important to understand the dynamics of profits. From a Schumpeterian perspective high differential profit rates are needed to bring about high investment-GDP ratios. Such profit rate differences can be expected m countries with intensive competition. Moreover, experience and simulation studies in OECD countries (on Sweden see BALLOT/TAYMAZ, 1997) have shown that the R&D stock per employee, general training stock per employee and specific training stock per employee are significant variables for growth and the profitability of firms. The fact that stock figures are so important implies that catching-up will always require efficient accumulation processes. According to BALLOT/TAYMAZ, 1997, the timing is important for different types of investment. The optimal sequence for the allocation of a firm's resources is as follows: (1) accumulate of a general human capital stock before the change in the techno-economic paradigm, (2) invest in R&D, and (3) invest in specific human capital. Moreover, innovators fare better than other firms because they are not only innovative but also build a competence base which supports learning fiom other firms. From this perspective Europe and the US

plus parts of Asia and Latin America are well positioned to take advantage of a more intensive global technology race in the era of the information society. Since a valuable general human capital stock has already been accumulated, there exists a high potential for raising the absorption capacity with respect to innovations. However, only in the US and in some EU countries innovative firms face adequate conditions for the financing R&D. This suggests that both within the OECD and between the North and South per capita income differentials could increase in the future. In many east European transition countries and m most developing countries there exists a serious risk that volatile capital inflows will be reversed at some point, making contractionary macroeconomic policies necessary and thereby undermining improved prospects for the financing of investment and innovation.

Smce the EU will mtroduce a common currency in 1999 and become a country group with relatively less foreign trade (external trade relative to GDP), it is likely to take a benign neglect attitude towards the exchange rate development, thus following the US, and the world economy might witness higher global exchange rate volatility than before. New information technologies and the increased global transparency of markets and countries will reinforce the contradictions between slowly adjusting real sectors and increasingly fast reacting financial markets. Higher volatility could impair the prospects for the financing of long term investment and innovation especially in poorer countries.

Future development policy of the EU (and the US) might partly switch to a strategy supporting the use of modern information technology m developing countries. This will not always be welcomed by such countries because access to information could imply a new potential for political unrest. As the move towards the information society and a knowledge based worldwide economy raises international income differentials between the North and South, informational development policies could indeed be an adequate remedy. This is the case provided that developing countries are willing to on the one hand invest in human capital and encourage investment in modem telecommunication networks and services and on the one hand implement strict competition policies.

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