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STI REVIEW

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
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FOREWORD

Prepared by the OECD Directorate for Science, Technology and Industry, the STI Review, which is published twice yearly, presents studies of interest to science, technology and industry policy-makers and analysts. It covers all areas related to scientific, technological and industrial development, with particular emphasis on cross-country comparisons, quantitative descriptions of new trends and identification of recent and future policy problems. Because of the nature of OECD work, the *STI Review* explores structural and institutional change at the global, regional, national and sub-national levels. Issues often focus on particular themes, such as surveys of firm-level innovation behaviour and technology-related employment problems.

Issue 15 of the *STI Review* is devoted to technology, innovation and employment. The articles presented are part of the overall efforts of OECD to analyse, understand and develop policies to reduce unemployment. They were presented in earlier versions at the Helsinki Conference on Technology, Innovation Policy and Employment. Together they show that despite the negative impact of technology on some jobs and skills, firms, regions and national systems must be able to innovate and absorb new technology in order to create viable, high quality jobs. They also show, however, that widespread social and organisational change must occur for the potential benefits of the new technologies, especially information technologies, to be reaped.

The views expressed in this publication do not necessarily reflect those of the Organisation or of its Member governments. The *STI Review* is published on the responsibility of the Secretary-General of the OECD.

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INTRODUCTION

The articles presented in this special issue of the *STI Review* are part of the overall OECD effort to analyse, understand and develop policies to reduce unemployment. They were presented in earlier versions at the Helsinki Conference on Technology, Innovation Policy and Employment. Together they show that even if the impact of technology on some jobs and skills is negative, the capability of firms, regions and national systems to innovate and to absorb new technology is crucial for the creation and viability of high quality jobs. They also show, however, that there is a need for widespread social and organisational change if the potential benefits of the new technologies, especially information technologies, are to be reaped.

Background

Unemployment is probably the most serious problem policy-makers have to face today. In 1994, 35 million people in OECD countries were without a job, and at least 10 million have either given up looking for work or unwillingly accepted a part-time job. As many as one-third of young workers in some OECD countries have no job.

In June 1992 OECD Ministers asked the Secretary-General to undertake a major interdisciplinary study on employment and unemployment. This request was prompted by their concern about the disappointingly slow reduction of unemployment in most OECD countries during the expansionary period of the middle and late 1980s. This two-year study was finalised in the spring of 1994 and the Analytical Report and the Policy Report were presented to Ministers at the Council Meeting in June 1994.

The relationship between technology and employment is one of the important themes in the ongoing debate about the current high levels of unemployment and the capacity of OECD countries to create jobs. Technological change is central to the process of growth and employment creation. Yet in periods such as the current one, when technological change is considered to be particularly rapid and

widespread and when growth is sluggish, technology is often blamed for increases in unemployment.

In this situation, the Finnish Government and the OECD jointly organised a Conference on Technology, Innovation Policy and Employment which took place in Helsinki in October 1993. A fundamental goal of the conference was to link innovation and innovation policy to other policy areas such as macroeconomic policy, industrial and trade policy, and, finally, labour market and education policies.

Policy conclusions at the conference

The conference, which was opened by the Finnish Prime Minister, Mr. Aho, brought together about 200 experts from administrations, universities, private firms and trade unions. The debate was lively and spanned a wide set of policy issues and policy recommendations. There were of course big differences in opinions, but there was also some convergence of opinions, especially on important issues:

- while the introduction of specific technologies might have a local negative impact on employment, on balance the focus of firms and government policy should be on promoting rather than hindering innovation;
- while participants recognised the need to avoid high inflation, several pointed out that growing aggregate demand makes it easier to integrate new technologies and that it creates a better environment for innovation and for the creation of high value added jobs;
- it was noted that there are big differences, especially between Europe and Japan, when it comes to developing a competitive high-technology industry and that this fact presents European industrial policy with a specific challenge;
- while some participants argued for wage flexibility, it was generally agreed that flexibility in other respects (working hours, flexibility of employees between functions within firms, capabilities in learning new skills, flexibility of managerial response to change) were at least as important for long-term employment creation;
- there was broad agreement that workers, as well as firms and governments, must adapt to the new situation where the knowledge base and the capability to learn new skills has become increasingly important for competitiveness.

The articles

The issue opens with an article by Petit which gives a broad overview and an analytical framework for studying the main relationships in the technology-employment nexus. It analyses the impact of new technology, and especially information technology, not only on work organisation and skills but also on the macroeconomic process. The author demonstrates how income formation and distribution as well as each of the major components of aggregate demand – exports, investment and consumption – have been affected by changes related to new technologies, and argues that any attempt to respond to the unemployment problem must address these broader concerns.

Then follows an overview of innovation in the new context by Freeman. His paper outlines, with references to the history of economic thought, a theory of technical innovation and structural change based on Schumpeter's concept of long waves. The theory is applied to the contemporary case of information and communication technology (ICT) to show that the successful diffusion of this technology depends on a wide variety of institutional changes. The paper points to a number of policies – flexible working hours, training and less restrictive macroeconomic demand policies – which would help to overcome the mismatch and generate higher levels of employment. It ends up by recommending for Europe a proactive strategy of the type proposed in the Clinton-Gore technology policy statement.

Caracostas and Muldur also discuss the employment problem in the light of long waves. The fundamental question posed in their article is about why Schumpterian dynamism no longer appears to work: why does a new cluster of radical innovations not lead to sustained growth in investment, output and employment? Why have the scientific discoveries and technological innovations which were made in the period 1945-75 not produced expected outcomes in terms of economic growth and employment creation in the 1980s and 1990s? Two different sets of explanations are considered: the absence of major social innovations to match the radical technical innovations and the very characteristics of information technology and other major prevailing technologies. Both sets of factors tend to limit the expansion of demand for products and services based on new technologies. The paper proposes two lines of action for policy: to develop demand by approaching new markets (especially through adaptation of technologies for their co-development with the countries of the South and East and less favoured regions inside the industrialised world) and to orient R&D efforts to the development of products, systems and services responding better to societal needs which are insufficiently satisfied at present by "market forces" (in particular public goods, or quasi-public goods, such as eco-technologies, health, education-training, urban development).

The paper by Boyer relates the development of human resource development policies to changes in the production system. Its central hypothesis is that present high rates of unemployment reflect the fact that human resource development policies have not kept pace with changes in the way production is organised. The declining share of unskilled jobs in the labour market is part of a long-term trend and reflects a transition towards increasing flexibility which increases the need for a skilled, versatile and flexible workforce. In this context ill-adapted public education and vocational training policies can stand in the way of an acceptance of new principles of production. However, it is not easy to reform national education systems. Drawing lessons from the experience of specific national systems must take into account the framework and practice of industrial relations, the type of labour market, the system of values and perceptions of a specific country.

The papers by Sakurai and Papaconstantinou present empirical analyses of employment in the light of structural change and globalisation. Applying input-output techniques to OECD's STAN database – a database which combines IO data with trade statistics and R&D data – Sakurai analyses how and to what extent observed changes in aggregate employment reflect changes in the sectoral composition of employment. For each major sector, as well as for the economy as a whole, aggregate employment developments are broken down in changes to be ascribed to changes in aggregate demand, labour productivity, international trade and IO co-efficients. The analysis, which covers eight major OECD countries in the 1970s and 1980s, points to expanding domestic demand in services as a common important factor in job creation but it also displays very substantial differences between countries.

Papaconstantinou's paper examines the evidence on the relationship between globalisation and employment. It concludes that the impact from trade on aggregate employment is weak while its impact in specific low skill industries may be more substantial. The employment consequences of foreign direct investments are difficult to determine because of lack of data, but existing data tend to show a growth in the share of jobs emanating from inwards foreign investment and that the jobs created are more productive and better paid than the domestic average.

The issue finishes with Soete's analysis of some of the major structural transformations which have taken place during the last two decades. On the basis of an analysis of the growing importance of services, high technology manufacturing and of the changing pattern of international competition, the paper identifies a number of future challenges ahead for policy-making. These challenges relate especially to the European production and innovation system. Europe's relative weakness in technology-based products is confronted with the fact that previously protected sectors are increasingly transformed into tradeables and that protection

is correspondingly weakened. It concludes with a call upon the OECD, as an international economic advisory "think tank" organisation, to come up with long-term, lasting solutions to the present steady growth in (structural) unemployment.

Conclusion

There is a clear case for examining unemployment from the perspective of technological change. The macroeconomic instabilities of the OECD economies, the changing pattern of world trade, and the phenomenon of rising and persistent unemployment, all co-exist with a process of radical technological change: the decades of economic stress since the mid-1970s have also seen the emergence of co-evolving generic technologies, with pervasive effects across sectors, and major impacts on company organisation and work. This is a period of technological revolution, comparable in scope with the First Industrial Revolution and with the period of emergence of large firms and new industries in the last quarter of the 19th century.

Although the technological changes of the past two decades have led to major programmes of research on the economics and management of innovation, and to significantly increased knowledge of innovation processes at industry and firm level, this has not been particularly oriented towards employment issues. In general, economists have taken the view that technology (usually understood as productivity-enhancing process change) may cause local and temporary unemployment, but it also causes demand to grow. If demand growth offsets productivity growth, and if wages are flexible downwards, then unemployment will not be a problem; within this type of approach, therefore, there is no general problem of unemployment as a result of technological change. Recent innovation theory, however, suggests other perspectives. Firstly, technological change is seen not just as an economic change but as a social process: it involves the acquisition of new skills, a complex process of learning and competence development at all levels within firms – maintaining the level of employment means, *inter alia*, adapting to often dramatic changes in the character and organisation of production and work. All of this is dependent on public acceptance of new technologies and a general social flexibility. If such capabilities for change are absent, then the potential for persistent unemployment is present, both locally and globally. In various ways the papers presented here explore the implications of these ideas and chart a way forward in this complex yet increasingly urgent set of problems.

TECHNOLOGY AND EMPLOYMENT: KEY QUESTIONS IN A CONTEXT OF HIGH UNEMPLOYMENT

CONTENTS

This article was written by Pascal Petit, Head of Research at the CNRS, economist for CEPREMAP.

The author would like to thank B.A. Lundvall for his contribution to an earlier version of this article.

INTRODUCTION

The purpose of this article is to assess some crucial links between technology, growth and employment in developed economies in the 1980s and 1990s. This period has been marked in these countries by the steady spread of new technologies, especially information technologies; however a concomitant feature is slower economic growth in most OECD countries with rising and persistent unemployment and changing income distributions. The co-existence of these phenomena raises the question of the extent of causal links between them. Is the nature of the new technologies partly responsible for the problems in the labour markets? Or is the size of the labour force or its skill structure preventing the use of new technologies, which would generate higher growth rates in the economy? It is not possible to provide a complete answer to such questions. However, in seeking to understand the different situations of OECD countries, and in making policy assessments, it may be helpful to review how the questions can be addressed, and to outline the relevant facts.

The argument here is developed in three sections. Section I outlines the central issue and positions it within a theoretical framework. Section II briefly reviews the main relationships between technology and employment in relation to their treatment in economic theory, and presents the results of some empirical studies on the issues. Section III summarises some key points and places them in a policy perspective.

I. THE CONTEXT AND THE ISSUE

Large, systemic changes in technologies

In pre-modern societies, where new technologies were developed in isolation for specific uses, the idea of general technological progress had no reason to exist. The idea only appeared in its modern sense when changes in techniques proved to have interdependent and cumulative effects on production (see Landes,

1969). Innovations in the modern economy thus take advantage of all the advances made in related activities. Such links can be strengthened over time or weakened when an old technological system gives way to the spread of a new system. In our time, the development and dissemination of information and communication technologies (ICT) has made a clear break with the past and installed a new system of relationships (although this is certainly not the only current form for radical technical change). In a period of change from one system to another, which we have arguably been experiencing for over a decade, technological change appears all the more revolutionary. Innovation becomes a key factor in reshaping or conditioning all economic relations to some extent. Such major technological changes in production processes are now under way. This is reflected by the widespread circulation of new IT equipment, which now represents a good third of investment. Over 80 per cent of all firms in OECD countries have already used these technologies (see Northcott, 1990).

These process changes concern more than just corporate work organisation. They have also profoundly restructured intercorporate relations: improvements in telecommunications and developments in computer networks and quality requirements have all led to a redefinition of inter-industrial relations and the use of business services. The service sectors have thus grown more quickly than the average (the share of employment in producer services more than doubled in two decades, reaching 10 per cent on average in the leading OECD countries).

At the same time these changes have also been accompanied by the regional and national relocation of activities. Information technologies obviously free firms from some of the constraints regarding location and working hours. This reshuffling becomes all the more extensive as the new information technologies (from satellite communications to high-performance mini- and micro-computers) diffuse, since the diffusion process itself affects the ability to spread worldwide more rapidly. Transport and telecommunication technologies have speeded up the process of internationalisation and globalisation, with the growing importance of multinational enterprises and direct foreign investment. This process has in turn created a basis for the rapid worldwide diffusion of technology, by either trade in durable goods or specialised business services. This has both increased the volatility of jobs wherever they are located and intensified competition between sites endeavouring to attract investment. It has also changed the forms of competition and induced firms to develop all kinds of co-operation and alliances for specific projects and markets.

The outcome in terms of organisation and employment is far from clear, as firms are still looking for and learning new practices. However, some trends and threats have become clear. At corporate level, the new technologies tend to be used to obtain more flexible production processes, increased quality control and innovative capabilities. This gives rise to a need for more highly qualified human

resources. The search for more flexible processes can also increase contracting out and the relocation of tasks, which, in some cases may increase dualism among firms with respect to the quality of jobs.[1] It may also relocate too many jobs, with detrimental effects at the macroeconomic level.

Thus, in the search for a competitive, flexible and innovative production capacity as a result of their modernisation processes, the industrialised countries risk ending up with depressed economies suffering from excessive dualism.

How can this be avoided? One way of striking the right balance is through an understanding of the role of the new demand characteristics. Changes affecting the formation of demand are similar in magnitude, but often less clearly perceived, than those affecting process change. In addition to new products, the diffusion of information technologies and telecommunications has also helped to change the way in which markets operate and, in particular, the role of price and non-price factors in determining competitiveness.

It is worth summing up the main lines of these developments, starting with the determining factors of external demand. In recent years a new emphasis has been placed on the importance of non-price factors in determining the competitiveness of export and import flows (see Dosi *et al.*, 1990; Mathis *et al.*, 1988; Dollar and Wolff, 1993). This non-price or technological competitiveness has many components, with the most important being the ability of a country to position itself in buoyant international markets, to keep in touch with market changes, and to efficiently organise deliveries and after-sales services. Expertise in information technologies emerges as a decisive factor in developing such ability and in producing innovative products with a relatively high level of demand (for organisational capability see Fagerberg, 1988; and Magnier and Toujas-Bernate, 1992; for the advantages of competitiveness in high-tech products see Verspagen, 1993; Amable and Verspagen, 1993). Nonetheless, a number of questions remain about the way in which such know-how can be acquired.

The part played by technological change in altering the factors determining investment is equally important. The changes in investment processes in the last decade, for example the apparent erosion of the relevance of the old accelerator model, have been extensively studied (see Catinat *et al.*, 1987; Evans, 1985), even though equipment investment remains the main vehicle for productivity gains (as stated by DeLong and Summers, 1991; and Scott, 1989). Many reasons have been put forward to explain the sluggishness of investment. They range from the new financial pressure brought about by a complete (technological and regulatory) overhaul of the banking and financial systems to the growing uncertainty surrounding global markets in a world that is radically redefining its boundaries. In this context, the extent of technological changes has increased investors' uncertainty in the future. All these factors may have contributed in the short and medium term to the overall slump in investment. Conversely, technological

change is supposed to stimulate investment in new processes and lead to the scrapping of old ones. Studies of investment by types of equipment clearly show that the two above-mentioned pressures have resulted in a steady growth in the proportion of IT equipment amidst stagnation in equipment investment as a whole (Evans, 1989; Norotte *et al.*, 1987).

The shift towards new technologies may even reduce levels of productive capital stocks by prompting the accelerated scrapping of production capacity. In itself, such a reduction would be combined with an increase in productivity growth (to use Freeman's metaphor, a Verdun effect to contrast with the growth effect implicit in the Verdoorn law). It moreover suggests the appearance of some kind of capital shortage, which could lead to unemployment. Furthermore, investment in new technologies often requires the use of intangible investments. The ability to make such intangible investments could therefore limit the spread of new equipment and affect its efficient use.

Consumption patterns and life styles have also undergone appreciable changes. The boom in consumer electronics is still absorbing a modest share of household budgets. Direct changes in consumption and work patterns are somewhat restricted to categories of households with the requisite cultural background. However, the bulk of the impact of ICT on life styles and consumption patterns has been mainly indirect, through the wide use of ICT in public and private services as well as its extensive use in improving the quality of most goods. How far it will eventually change the factors determining mass consumption remains to be seen. Furthermore, in order to gain an idea of the impact of the changes in the overall consumption structure on employment, it is important to consider the extent to which ICT-based services used directly by consumers are substitutes for, or complements to, the consumption of manufactured goods and professional services (Gershuny, 1983).

As technological change is currently such a driving force in reshaping economic relations, it could reasonably be put forward to account for some of the mismatches hindering market expansion and labour market adjustment and increasing unemployment and/or poverty. The issue is problematic, as each aspect has favourable and unfavourable effects. An attempt to link and compare them can only be undertaken within a general theoretical framework, to which we now turn.

Are rising inequalities in the distribution of employment and income transient or permanent effects of technological change?

In the debates of the 19th century, the fear that technological change could create unemployment arose mainly from the fact that job losses resulting from the

Table 1. **Unemployment rates in OECD countries: level and structure**

	Unempl. rates (average)	Unempl. rates	Youth relative to adult rates	Female relative to male rates	Upper secondary education	University education rates	Standard deviation of regional rates		Average duration in months	
	1985-89	1992	1990	1990	1989	1989	1970	1987	1979-82	1987-89
United States	6.2	7.4	2.5	1.0	4.6	2.2	1.27	1.73	2.4	2.2
Japan	2.6	2.2	2.5	1.1	6.5	2.3	0.38	0.67	5.0	5.6
Germany	6.3	4.7	1.2	1.5	6.8	4.5	0.26	2.33	9.4	16.4
France	10.1	10.3	2.4	1.7	6.6	3.0	0.75	1.75	14.2	18.2
Italy	11.6	11.2	4.6	2.3	7.7	4.8	2.49	5.60	24.0	36.6
United Kingdom	9.6	10.1	1.6	0.5	5.6	2.4	0.82	2.70	9.6	10.2
Canada	8.2	11.2	1.8	1.0	6.8	3.6	1.35	2.70	3.2	3.3
Australia	7.5	11.0	2.6	1.0	4.2	3.7	0.36	1.33	5.0	5.4
Austria	3.4	4.0	–	–	2.4	1.1	1.27	1.19	3.0	3.7
Belgium	11.0	9.8	–	–	4.7	2.0	–	–	20.0	54.2
Denmark	8.5	10.9	–	–	7.1	3.4	–	–	11.4	10.0
Finland	4.7	12.4	2.2	0.7	3.1	1.7	1.23	2.21	2.8	–
Greece	7.5	9.4	–	–	–	–	–	–	9.4	17.2
Iceland	0.9	2.3	–	–	–	–	–	–	–	–
Ireland	16.9	17.0	1.6	0.6	6.6	2.6	–	–	6.5	36.9
Netherlands	8.7	5.6	1.7	2.0	4.8	5.0	0.29	1.37	7.2	22.5
New Zealand	4.9	10.9	2.4	0.9	4.9	2.9	–	–	–	–
Norway	3.0	6.2	3.0	0.9	–	–	0.54	0.72	2.6	3.4
Portugal	7.1	4.7	3.1	2.1	6.4	6.1	–	–	–	–
Spain	20.0	17.9	2.7	2.0	13.1	10.7	2.81	5.48	27.8	86.7
Sweden	1.9	5.2	3.0	1.0	0.9	1.0	0.66	0.73	3.3	3.3
Switzerland	0.6	2.8	–	–	0.6	0.8	–	–		
Turkey	10.3	11.8	–	–	–	–	–	–		
Average			1.4	0.4	5.7	3.4	1.03	2.18		

Source: OECD statistics.

spread of new technologies concerned well-defined jobs, while gains in employment belonged to unknown places in an uncertain future. The question then as now is whether the nature and speed of "destruction" will allow enough time and opportunities for "creative" and fair adjustments to occur in the labour market and in the formation of incomes.

Adjustments take time and resources, as jobs shift between regions, sectors and qualification levels, Therefore, a crucial question is whether the types of adjustment underway are currently showing transitory or permanent effects. This is in turn complicated by difficult conjunctural circumstances throughout the OECD economies.

The various, turbulent business cycles of the last two decades have seen unemployment on the rise in most countries and especially in Europe. At one stage, this was thought to be the result of failures or shortcomings in the fight against inflation, which led to changes in the international context (from the collapse of Bretton Woods to sharp rises in oil prices). However, once inflation had been curbed in most industrialised countries, the problems encountered in reflating the economy and reducing unemployment made it clear that unemployment was closely linked to certain specific structural factors. In other words, standard macroeconomic policies appeared unable to deal with the nature of the structural changes under way, with the consequence of growing mismatches on labour markets.[2] This notion was strongly supported by significant shifts in labour-market behavioural indicators[3] and the characteristics of unemployment in most countries. Long-term unemployment rose considerably, the number of unemployed educated people increased and the variation between regional rates of unemployment grew (see Table 2).

A key element to a better understanding of the dynamics of unemployment is the persistence of shock effects causing successive short-term rises in unemployment. A growing number of studies acknowledge such hystereses on the labour market (Blanchard and Summers, 1986; Blanchard and Diamond, 1989; Jackman *et al.*, 1990; and Lindbeck and Snower, 1990). However, the reasons for such lasting effects remain debatable; they may involve or combine many types of restrictive practices on the labour market or new rigidities in labour supply and demand.

Studies and experiments have shown that these effects vary from one country to the next, especially in terms of magnitude, but it appears that the overall situation has deteriorated in all countries over time. High employment countries such as Sweden, Norway and Finland have recently experienced growing unemployment. Even in Japan, full employment now seems threatened.[4] In the United States, a marked slowdown in productivity has contributed to maintaining unemployment around its past (high) level, but the cost of this has been a sharp increase in the proportion of low-wage earners.

Table 2. **Diffusion of ICT**

	Net business fixed investment % of value added[1]		Business R&D expenditure BERD % of invest.[2]		Software % of BERD[3]	Use of microelectronics[4]				Office machinery and telecom in % of exports[5]	
						in product		in processes			
	1970-79	1984-89	1970-79	1980-88	1985	1976	1986	1976	1986	1980	1989
United States	7.2	6.6	14.8	17.9	34.3	–	–	–	–	8	13
Japan	15.4	13.4	5.8	9.2	13.5	–	–	–	–	14	28
Germany	10.1	7.7	11.5	16.2	13.3	8	22	25	80	–	–
France	11.4	6.2	8.0	11.1	29.5	4	16	15	60	4	7
Italy	11.1	7.7	3.2	5.1	31.5	–	–	–	–	–	–
United Kingdom	9.5	6.9	10.4	12.1	23.4	10	24	15	65	5	9
Canada	11.3	12.9	3.2	5.4	–	–	–	–	–	3	4
Australia	12.8	11.3	1.8	2.5	–	–	–	–	–	–	–
Austria	14.0	8.9	2.8	4.6	42.0	–	–	–	–	–	–
Belgium	9.6	7.2	6.7	10.5	28.5	–	–	–	–	–	–
Denmark	13.0	11.9	3.9	6.0	55.8	4	20	25	80	–	–
Finland	13.3	9.6	3.0	6.0	n.a.	–	–	–	–	–	–
Greece	13.7	7.6	–	0.7	n.a.	–	–	–	–	–	–
Iceland	19.2	15.5	0.2	0.8	–	–	–	–	–	–	–
Ireland	16.0	9.0	1.7	3.3	79.8	–	–	–	–	–	–
Netherlands	9.6	5.9	8.3	10.0	–	–	–	–	–	–	–
New Zealand	14.7	15.3	1.1	1.3	35.0	–	–	–	–	5	7
Norway	18.1	14.0	–	–	–	–	–	–	–	–	–
Portugal	17.3	6.2	0.4	0.7	38.3	–	–	–	–	–	–
Spain	13.6	8.4	1.0	2.3	49.2	–	–	–	–	–	–
Sweden	10.2	10.4	9.1	15.1	39.3	10	22	–	–	–	–
Switzerland	9.5	11.0	13.5	14.0	19.1	–	–	–	–	–	–
Turkey	12.2	7.8	–	3.5	n.a.	–	–	–	–	–	–

n.a.: not available.
1. OECD statistics.
2. OECD statistics.
3. Soete in OECD (1991).
4. Northcott (1990).
5. GATT statistics.

Thus, during the 1980s, mass unemployment has been in many cases accompanied by increases in income inequality (a marked phenomenon in the United Kingdom, see Goodman and Webb, 1994, as it is in the United States, but more moderate in France, see Atkinson, 1993). In addition, increased dispersion in wages as well as in non-wage incomes, together with reduced welfare allowances and unemployment, seem to have contributed to a widespread increase in family income inequality in OECD countries (Gottschalk, 1993).

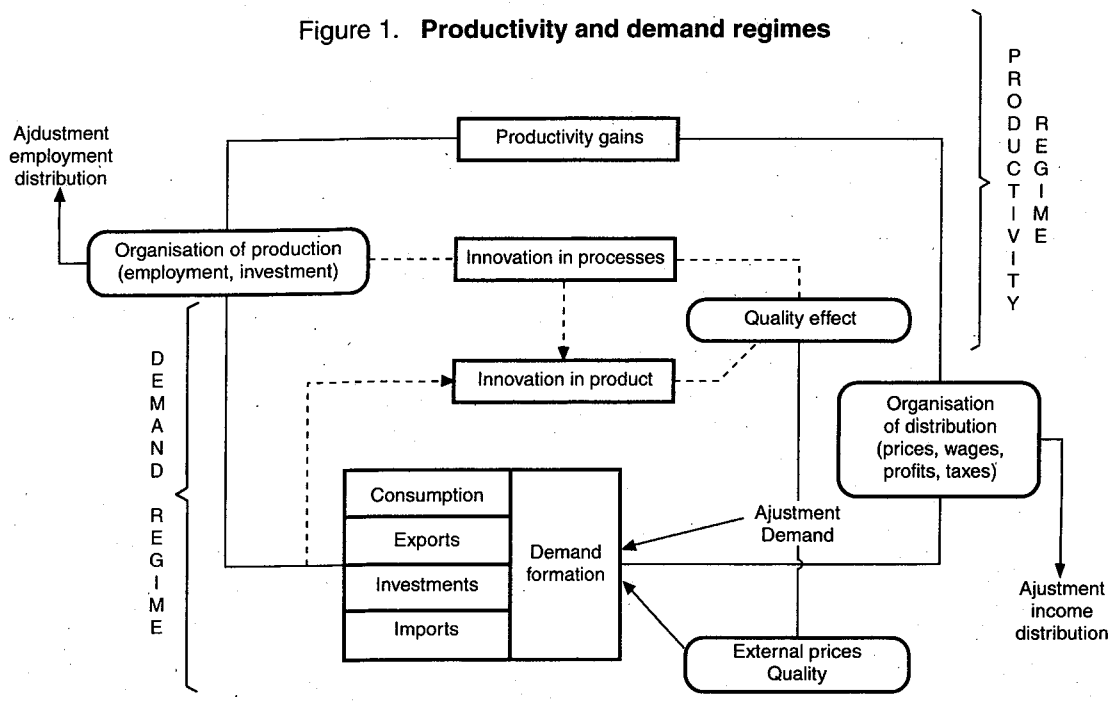
When looking at the complex processes which may, in times of large technological change, lead to such rises in unemployment and poverty, it helps to simultaneously consider the dynamics of supply and demand. Only in *ceteris paribus* universes is a faster increase in productivity synonymous with lower employment growth and more unemployment. The whole experience of the golden years of capitalism stresses the contrary: unprecedentedly high levels of productivity gains were accompanied by full employment. The issue relies on the dynamic interplay between the processes generating productivity gains on the production side and their distribution, which leads to the formation of the various components of demand on the other side. The initial question of whether technological change is too slow or too fast can thus be replaced by questions concerning the imbalances or mismatches occurring during the different stages of this interplay.[5]

The effects of technological change on the distribution of employment and income can thus be negative. A theoretical framework has been retained in order to link the various issues that appear to be central in this process. For the sake of clarity, the framework will be kept to its essential linkages, as summarised in Figure 1 and described below.

Productivity gains (labour productivity) can stem from three combined factors: the reorganisation of work, investment substituting capital for labour, and specific technological change. The combination and efficiency of these factors (leading to process innovations) depend primarily on demand (nature and prospects of the markets concerned), which defines what can be called a productivity regime. These productivity gains in turn give way to prices, wages and profits (not to mention taxes), which contribute to the formation of the different components of demand in accordance with the various collections of regulations and other institutions governing a demand regime.

One of the aims of this simple general framework is to provide a chance to remember that productivity and demand are linked, not only by taking into account uses and resources, but also by a set of agreements or institutional arrangements tying elements of production organisation to elements of the formation of demand. The links between work organisation and wages and between investment rates and tax incentives are standard examples of such relationships. These arrangements support certain patterns of economic growth and, con-

Figure 1. **Productivity and demand regimes**



Source: P. Petit.

versely, economic growth reinforces these supporting institutions. Figure 1 presents the cumulative links between market expansion and productivity gains and the main nodes of adjustment. In such a framework, inequality on the labour market is on a par with inequality in incomes. Both maladjustments can be more or less binding in that they are more or less bearable for society.

As regards the general framework presented in Figure 1, certain issues that would seem crucial to the interplay between technological change and the distribution of employment and income have been selected and explored. The assessment endeavours to show the main issues to be clarified, their likely implications and the kind of policy conclusions called for. With this in mind, Section II opens with some issues relating to changes in production processes and concludes with questions concerning the formation of demand.

II. REVISITING THE MAIN LINKS

In this section four issues, currently considered to be crucial to the overall question of the effects of technical change on employment in developed economies, have been chosen because they present:

i) either an identified break with past trends:

a) demography of manufacturing jobs;

b) new characteristics in the rise of services;

ii) or an unprecedented level of uncertainty:

a) the employment effect expected from product innovation;

b) the consequences of globalisation.

The main facts concerning these issues are given below in such a way as to show in Section III how they interact within the theoretical framework, and the policy prospects they proffer.

New patterns of job losses and creation in manufacturing

The old compensation theory of the relationship between technlogical change and unemployment overlooks the dynamics of job creation and losses. It is necessary, particularly in times of major structural change, to take a close look at the demography of jobs at the regional and sectoral levels in order to appreciate the extent and effectiveness of the adjustments required.

Even in times of sustained economic growth, some industrial activities axe jobs while others create jobs. To a certain extent, these trends reflect company start-ups (or bankruptcies). It is instructive therefore to take a close look at job demography, which shows whether new patterns are developing in the industrial fabric at branch level and how the employment structure is affected by external trade (attraction and relocation effects). The following discussion therefore endeavours to sum up the main contemporary features of job demography in industrialised countries.

A common characteristic of the post-1970s is that no manufacturing activity has been a strong net job creator. The general trend has been one of decline in the number of jobs, albeit of varying profiles and magnitude, even if industries producing IT products did better than others.[6]

A second important characteristic of the 1980s is that job creation tended to occur mainly in small and medium enterprises. Northcott (1993) stresses that, in the late 1980s, only in SMEs was the diffusion of ICT followed by some increase in employment; he also underlines the fact that job losses were even greater in firms which did not invest in ICT technology. It follows that, in an overall context of de-industrialisation, the use of ICT represented a means of survival, if not of renasence as suggested in Abernathy and Clark (1985,1988).

A third characteristic is the fact that local regions were affected very differently by these new and generally depressed patterns of employment changes in

manufacturing industries. In old industrial regions where traditional industries had been dominant, employment has declined even in those activities which are growing rapidly elsewhere. De-industrialisation evolves in a cumulative way at a local level. Therefore, new growing industrial activities tend to be located at new sites.[7] Nevertheless, this process of redistributing employment growth among regions has not been progressive, but seems to follow on from the depressive effects of large job losses in heavy industries in the early 1980s. Most of the workers laid off at the time remained unemployed for a long time and/or left the labour force; this discrimination particularly affected unqualified workers.[8] Such rigidity in reallocating the industrial labour force reveals the importance of the mismatch between old qualifications and new requirements.

A fourth characteristic is that, in most OECD countries, this "relocation" of industrial jobs at national level is accompanied or followed by an increasing delocalisation of industrial jobs towards developing countries. This process has developed in stages. In its early phase, up to the mid-1980s, it was mainly driven by large differences in unit costs of production resulting from low wages. It affected labour-intensive industries and benefited low-wage countries all over the world. In the more recent period it has spread to more knowledge-intensive and high-tech activities and has also affected more skilled jobs.

This shift was made possible by the development of information and telecommunication technologies and by their diffusion worldwide, which allowed production systems to be organised on a global basis. When real advantage of new (IT) communications, services and transport facilities is taken, all kinds of outsourcing, including teleworking, become possible.[9] A subsequent section will return to the organisational issue raised by this process of globalisation.

Such an overall de-industrialisation process suggests the possibility that a too rapid diffusion of new technologies and reorganisation of productive activities worldwide has jeopardised compensation effects. The local impact of these job losses, which often impact on "old" industries concentrated in certain regions, strengthens this fear.

This may lead to an overestimation of the magnitude of the delocalisation of jobs towards low-wage countries. Estimations are difficult to make, as they have to take into account the direct and indirect effects of trade and capital mobility (which, as shown below in the discussion on globalisation, are complex). However, the total of such job losses remains relatively modest when compared with the magnitude of unemployment; Mathieu and Sterdyniak (1994) estimate that the number of jobs in France lost to developing Asian countries is approximately 200 000, *i.e.* around half a percentage point of unemployment. Unskilled jobs are more threatened than others by this process,[10] but these jobs are also at risk from new trends in the organisation of work. Delocalisation is thus one facet of the downward pressure on unskilled jobs. The resulting challenge of employing

unskilled workers is met in quite different ways, depending on the country (as demonstrated below) and, in part, on the nature of the service jobs developed.

The outcome for more qualified jobs will also depend on the restructuring of activities between firms, including the increasing use by firms of a full range of services.

Steady rises in services ... with diversified use of technology, and diversified job structures

In contrast to the new downward trend shown in manufacturing employment, the long rise in service jobs (Maddison 1987) seems to have been steady over the last two decades. It is true that the nature and purpose of these service jobs have greatly changed over time, between personal services, social services, distributive services and producer services.[11]

However, the first point to note is that these groups of services have not expanded uniformly in the post-1973 period. Careful international comparisons by Elfring (1992) show that, on average, between 1973-87, shares in total employment only increased for producer services and social services, *e.g.* for activities concerning respectively the intermediary uses of firms and collective needs (see Table 3).

The expansion of producer services underlines changes in organisational processes with firms opting increasingly for external suppliers for their "personnel", sale or production functions. This involves a mix of poor jobs and good jobs, the latter often being knowledge-based, qualified activities. There is widespread diversity among countries in the amount and organisation of such outsourcing.[12] The development and diffusion of ICT has clearly boosted this expansion, either by training or assisting firms to use ICT, or by developing new capacities to collect, transform and circulate information to other firms.

The case is slightly different for distributive services, which are equally important in characterising the changes in the organisation of production activities. Overall the share of employment in these activities, already high in the 1960s, has grown only very slightly over the last three decades (see Table 3).[13] As these activities have also been great users of ICT recently, it is tempting to think that substitution effects of ICT capital for labour have so far prevailed over, or counterbalanced, the kind of complementary effects mentioned above for producer services. This characterisation remains all the more vague the more diverse the distribution activities, from retail trade, where small traditional firms are numerous, to such highly concentrated and modernised activities as communications. Nevertheless, the spread of ICT has profoundly changed the organisation and output of

Table 3. **Service employment by sub-sector as a percentage of total employment**

percentage

	Producer services	Distributive services	Personal services	Social services	Total services
France					
1960	3.5	16.8	7.9	16.0	44.1
1973	6.0	18.6	7.5	19.2	51.3
1987	9.0	20.1	7.9	26.4	63.4
Germany					
1960	3.4	17.5	7.4	10.3	38.6
1973	5.2	18.1	6.5	16.3	46.1
1987	7.7	18.1	8.1	21.6	55.4
Japan					
1960	3.3	18.5	7.5	8.2	37.4
1973	6.5	23.3	8.9	10.5	49.1
1987	10.2	25.1	10.2	13.0	58.6
Netherlands					
1960	4.2	20.4	8.5	14.7	47.8
1973	7.3	20.5	6.5	22.8	57.7
1987	10.8	21.3	6.5	28.4	69.1[1]
Sweden					
1960	3.5	19.4	8.4	16.3	47.7
1973	5.1	19.8	6.6	26.2	57.7
1987	7.2	19.2	5.9	35.1	67.3
United Kingdom					
1960	4.4	20.6	8.0	15.8	48.8
1973	6.5	20.1	7.9	20.8	55.4
1987	10.4	21.3	10.1	25.3	67.0
United States					
1960	6.4	22.2	11.3	21.2	61.1
1973	8.7	21.5	10.9	25.3	66.4
1987	13.6	21.5	12.5	26.0	73.5
Average					
1960	4.1	19.3	8.4	14.6	46.5
1973	6.5	20.3	7.8	20.2	54.8
1987	9.8	20.9	8.7	25.1	64.5

1. Includes 2.1 per cent temporary workers employed at employment agencies who cannot be allocated to one of the four sub-sectors.

Source: Derived and updated from Appendix D in Elfring (1992).

these distribution service activities, creating, by means of network externalities, strong indirect effects on the working of the overall economy.

The other type of services which have shown an above average expansion in employment – social services – concerns a completely different aspect of the

changes undergone by industrialised countries. Part of this development in collective services has been non-market; in most cases it has been largely driven by the continuing demand for health and education services successively fuelled by private demand in times of rapid economic growth and by counter-cyclical economic policies in times of recession. In comparison the development of personal services has been relatively modest (around 1 per cent a year), with the exception of Japan and the United States which grew at twice that rate, even though the shares of personal services in employment were already higher than elsewhere. Conversely, it should be noted that Japan still has a relatively low share of employment in social services.[14] All of which suggests that the organisation of these activities, respectively social or personal services, is linked to country-specific patterns of social integration and welfare care.

One should not conclude from the above employment survey that services are recession proof. The late 1980s and early 1990s showed some slowdown and downturn in service employment, especially in producer services, which may indicate that the peak of the reorganisation mentioned above has passed.

Let us now return to the relationships between these employment perspectives and the spread of ICT.

Technological change can present specific features in services as it often combines product and process innovations, which cannot be easily separated (hence productivity gains cannot be measured easily). Secondly the important role of (network) externalities, information biases and rents makes it difficult to analyse the issue at a firm or even at a sectoral level.

For the above reasons the effect of technological change on employment in services is not always the same. It may be either product- or process-oriented, but the precise content of product or process innovations and the magnitude of these changes can very much depend on the interplay between processes of adjustment on the production side (learning by doing in a broad sense) and processes of adjustment on the demand side (learning by using in a broad sense).

The very nature of ICT suggests that these technologies will considerably change the processes of producing services, where many tasks involve the routine treatment of information. It is more difficult to assess the way in which ICT and the broad knowledge base will rejuvenate services or help to create new services. These difficulties are emphasized by the fact that in the 1980s, growth in real services output has appeared to be rather modest and productivity gains have undergone a slowdown relatively more marked than in the manufacturing sector (see Table 4).

Given that ICT has spread widely in most service sectors, such a notable slowdown in productivity gains emphasizes the celebrated paradox.

Table 4. **Productivity slowdown by sector**

Sector	Goods-producing industries				Non-goods-producing industries				Community, social and personal services	Producers of government services
	Farming	Mining	Manufac-turing	Construction	Transport. storage, communi-cation	Utilities	Trade	Finance, insurance, real estate		
United States										
1960-73	0.04	3.35	3.32	–2.87	3.28	4.57	1.59	–0.24	1.14	0.15
1973-85	3.07	–3.19	2.31	–1.99	1.21	1.16	0.16	–1.51	0.60	0.12
1973-85/1960-73	3.03	–6.54	–1.01	0.88	–2.07	–3.41	–1.43	–1.27	–0.54	–0.03
Germany										
1960-73	6.04	3.56	4.85	2.72	3.82	5.47	3.43	1.10	2.92	0.77
1973-85	4.04	–1.26	2.73	1.02	3.86	1.83	1.66	2.31	2.02	0.43
1973-85/1960-73	–2.00	–4.82	–2.12	–1.70	0.04	–3.64	–1.77	1.21	–0.90	–0.34
France										
1960-73	4.94	n.a.	6.24	3.11	n.a.	8.70	n.a.	3.18[1]	n.a.	3.93
1973-85	4.28	n.a.	3.31	1.13	1.99	2.20	1.06	0.51	–0.62	0.30
1973-85/1960-73	–0.66	n.a.	–2.93	–1.98	n.a.	–6.50	n.a.	–2.67[1]	n.a.	–3.63
United Kingdom										
1970-73	5.88	n.a.	5.83	–1.32	5.59	10.06	2.14	0.83	0.82	0.25
1973-85	4.02	6.81	2.19	–0.07	2.25	1.40	–0.09	0.78	–0.47	0.32
1973-85/1960-73	–1.86	n.a.	–3.64	–1.25	–3.34	–8.66	–2.23	0.05	–1.29	0.07

n.a.: not available.
1. 1960-73 excludes real estate and is obtained directly from the French national accounts.
Source: OECD international databank, in Gordon and Baily (1991).

Three basic explanations (E1, E2, E3) can be given to account for this puzzle. One is mismanagement (E1): firms have invested in ICT and use it inefficiently with poor work organisation which raises prices and not demand. In the mid-1980s the banking industry seemed to have suffered from such myopia. Bankers themselves feared they had over-invested in ICT. However, the mismanagement thesis is incomplete if it does not explain why managers were misled.

Did they overestimate the efficiency of equipment and why? Or was it that increased uncertainty about innovative equipment led to under-investment? There are no good reasons to speak of mismanagement at a time when managers were receiving new support from specialised staff and producer services; but there are grounds for assuming that expectations were wrong, that some conditions were not met in due time, and that the expected effects were delayed due to a failure to reap the benefits of network externalities.

The second explanation (E2) would account for the marked slowdown in productivity because of lags in adjusting labour in services or by means of delays in learning by doing. If information technologies were supposed to: *i)* take over all routine activities dealing with information; and *ii)* use the larger knowledge base to increase the scope of tasks, then some activities would have to make large adjustments in job structures (insurance, finance, communications and transport), while some others would expand their qualified tasks in enlarging their range of products, as in the case of specialised business services or leisure.

The general trends in employment by service sub-sector, mentioned above, are in accordance with these suggestions.[15] However, when investigating in more detail the productivity slowdown in the US service activities, Roach (1991) noticed a sizeable lag in the adjustment of the structure of employment in comparison with what was observed in manufacturing activities for similar levels of diffusion of ICT equipment. The capacity to postpone the shedding of routine white collar jobs would thus explain, if present across all services activities, a large part of the marked productivity slowdown. These results are too much driven by the assumptions that innovations brought about by ICT equipment are fully process-oriented. For the same manufacturing and service activities in the United States, Osterman (1986), in a longitudinal study of the adjustment process following the implementation of ICT equipment, stresses that reductions in employment are often followed in the medium term by some catching up in employment. It hints at the fact that either the process innovations or the adjustment of the job structure are not really effective or that products innovations are slowly emerging stressing the length of the delays in that direction.

The third possibility (E3) is precisely that one can't properly measure the mix of product and process innovations in service activities. Their capacity to shift boundaries and to innovate has the effect of redefining the division between routine and knowledge-based jobs. This change in quality may not be reported in

measures of output (which is consistent with the relative slowdown of output growth in real terms). In effect there is a measurement problem, worse in some services such as producer services where crude indicators of the production activity are used to measure output in real terms (see Gordon and Baily, 1991). This is not only a problem of accounting. There may be some mismatch between the value of innovations in the eyes of suppliers and the value acknowledged by the market.[16] Such gaps may disappear by means of some learning by using processes (as suggested by Rosenberg, 1982) or by developing user/producer relationships (as invoked in Lundvall, 1988). Quality of services has been continuously improved by increasing use of ICT but the widespread and continuous nature of these changes leaves them somehow unnoticed, considering that they do not seem to affect the trends and structure of demand. The fact that spending on services has increased is mainly attributed to price rises due to relatively low productivity gains (productivity inflation), when we could well have some kind of "quality inflation".

Finally all three explanations amount to assigning lags and inefficiency either to organisational slack on the side of producers or to inertia on the side of consumers. In fact the two factors are interacting strongly. To put it schematically, services reorganise their production processes aiming to substitute ICT for routine tasks. This first phase helps them to perceive ways of improving products, of developing new markets. Studies on the difficulties met by firms when new and old processes co-exist display such learning patterns (see Liu, 1989; Johansen, 1988). Such two stage processes can also be observed with firms when they start to co-operate on new telecommunication networks (see Bar, Borus, Coriat, 1989).

Finally, one finds a great variety of solutions in the way ICT technologies are used in any one type of service activity. It can vary within a branch in one country[17] and this differentiation of processes can often be considered in service activities as deliberate differentiation of products. It also varies between countries. In this case national characteristics are in play, such as the "propensities" to create "good jobs" or "bad jobs" (which has to do with the more or less constraining nature of the prevailing system of labour relations).

However one should not take too static a view of the above determinants; these characteristics can evolve with changes in human capital. Formal initial education brings new vintages of workers more familiar with the new technologies, thus allowing new combinations. But this endogenous process, rightly celebrated in the New Growth Theory, also has clear limitations in the course of a systemic and rapid technological change where equipment and techniques are rapidly obsolete. The unemployment of computer specialists[18] illustrates this effect. It partly explains the diversity in work organisation that one can observe in modern service industries, where on the job training or specific in-house training courses can still play an important role. Banking activities offer a good example of

such latitude, practising both on the job training and the hiring of highly educated persons to deal with information technologies.

The diffusion of ICT could also have led to the expansion of work sharing and home (tele)working schemes in service activities, by nature more open to this kind of work organisation. Redesigning jobs in these directions could have deeply changed the unemployment issue. So far, teleworking schemes have had only limited development, and that mainly towards foreign countries where it is possible to take advantage of low paid skilled labour forces (a point which is discussed in the following section on globalisation). Expanding part-time work was a more realistic alternative, especially in service activities where it could be linked to better service. In Europe for instance, where the pressure of unemployment was rather high, the level of part-time work did not increase significantly with the clear exception of the Netherlands.[19] The noticeable differences between European countries, and especially between the rich northern countries and the poor southern countries where part-time work is uncommon, remained unchanged.

There are good reasons for this: the status of work in our societies has changed very little over the last three decades. Furthermore, in times of slow economic growth, it is more difficult for families to accomodate to part time wages. However the pressure of unemployment and some loosening of the work ethic among the young generation, as well as the opportunities generated in concentrated urban areas, could lead to a redesigning of service jobs using information and telecommunication technologies.

The employment effects of product innovation

It is inherent in the economic method to focus on process innovations rather than on changes in products. While it can be assumed that process changes are immediately expressed in rates of productivity growth, it is less easy to determine how product innovations can be translated into quantitative changes – the only type of change economic theory regards as legitimate (Georgescu, 1971). Economic analyses thus tend to understate the growth and employment effects of technical change as a whole. It follows that in order to challenge the technological unemployment thesis, our ability to assess and measure the impact of product innovation on volumes of production should be questioned. All the more so since this measurement problem is tied to the radical nature of technological change, creating uncertainty about measures of production in real terms for an unusually wide range of products. These problems are serious in the core products of the information technology revolution – microelectronics and computers – but, as we have seen, they also concern widespread service activities where the use of ICT enhances product differentiation.

However, it is not so much a problem of measurement and accounting, but rather a problem of perception by users and consumers. The challenge relates to the capability of the economy to sustain economic growth without running into barriers of consumer satiation. As pointed out and analysed by Pasinetti (1981), the most fundamental reason why economies can keep growing and sustain employment is that new products are developed and diffused through consumer learning. This adjustment process on the demand side (as mentioned in Figure 1) seems to present some deficiencies.

The impact of new products as a driving force boosting growth and employment remains rather limited. On the one hand, new technological opportunities indicate that there is ample room for developing new products and services, using ICT intensively. On the other hand, there are barriers of various kinds to their diffusion and absorption by consumers.

One kind of barrier reflects the lack of the infrastructure necessary to support the efficient use of new products and services. The weakening of the role of public leadership in building infrastructure in the 1980s may have seriously hampered the development and diffusion of IT products, an issue which has been largely ignored (Freeman, 1993).

The second kind of barrier relates to consumer characteristics and behaviour. Sometimes the willingness to pay for advanced new services seems to be limited. This may be because consumers prefer old fashioned service systems which are more intensive in personal contacts (a fact which would prove advantageous to aggregate employment). Design of new services sometimes risks oversubstituting new ICT equipment for labour (and human relationships), while a complementary approach would help to enhance the product innovation content of the new service. In other areas it reflects the fact that consumption has become very demanding in terms of competence – for example, this is the case for personal computers where the market, even if still expanding, has definite limits. In such areas the rapidity of consumer learning becomes extremely important.

It may be the case that new types of "infrastructure" are required which could co-ordinate and support all the intangible investments that are sometimes required of consumers. Educational systems so far only partly provide such supportive actions. Institutional arrangements facilitating standardisation and learning procedures may therefore be necessary in order to develop large markets.

A related barrier affecting the growth of new markets is the degree of inequality in the distribution of skills and incomes. In a polarised society, markets will remain narrow and will cover only the upper range of skills and income, without differentiating between ICT products to stimulate demand across the board of consumers. The widespread urban crisis affecting the metropolises of most industrialised nations illustrates some serious splits within the group of consumers and

the magnitude of the challenge. New products and services could surely help to address such urban problems but the types of products and the channels to provide them in terms of social networks, public facilities, and subsidies remain largely to be investigated. Structures of employment and organisation of working time are central issues to be considered in these investigations.

Direct interactions between users and producers are also a likely solution to stimulate the general process of learning that we are considering. It is interesting to note that producers of IT products and services currently tend to blame the stagnation in their markets on their own strategies related to product innovation and to emphasise that they are considering alternative strategies involving end users in a much more intimate interaction in the process of innovation (Special Session of CSTP, 1992). In important product areas, the institutional relationships between users and producers of innovation can thus be crucial for the success of the innovation (Lundvall, 1988, 1992).

The future development of the production structure and its impact upon job creation may very well become dependent upon firms and governments developing new institutions making it easier to strike a balance between diversity and customer-designed products on the one hand and standardisation and compatibility between components and sub-systems on the other hand.

The relative lack of policies to stimulate and renew demand on a more comprehensive basis has much to do with the primacy given to external competitiveness, based on the view that in a globalised world economy these objectives are conflicting. Before drawing conclusions on the potential for employment that any "reconstructed" demand policy can represent, one has therefore to specify the interactions with the objective of external competitiveness.

Globalisation: tracking worldwide externalities

As already mentioned, external trade is not so much associated with job losses for industrialised countries as it is with reductions in the share of poorly qualified jobs. Such distortion stems primarily from trade with low wage countries. Of course, when countries are running large trade deficits this can be accompanied by significant job losses (as exemplified by the US economy in the mid-80s when the dollar was at its peak). Papaconstantinou, who covers extensively the issue of globalisation and employment in the present volume, reviews the evidence on this point.

Still, globalisation refers not only to the extension of external trade in the last decades but also to the setting of truly international organisations and markets (of which financial markets are preeminent) which facilitates in a radically new way

the mobility of factors, and especially of various forms of capital in the late 1980s (see OECD, 1992*a*, Chapter 10).

The issue of the delocalisation of jobs is clearly concerned with this new mobility of factors. Effects are difficult to assess as indirect effects (on third markets for instance or on the competitiveness of home industries) are numerous. Examples of specific trade changes often show that a certain observation period is necessary to catch all positive and negative effects. For instance cheap transmission of data first facilitated the delocalisation of routine tasks of treatment of information. In a second phase, more skilled tasks, such as computer programming, tend also to be contracted abroad (India, East Asia, but also Eastern Europe) where ICT know-how has diffused, all of which threatens the home labour market of computer specialists. Such a move can become worrying when it affects the capacity of economies or regions to master the use and development of new technologies.

The direction and magnitude of foreign direct investments (FDI) also constitute a good indicator of the structure of the globalisation process. Between 1980 and 1988 the share of the triad (the United States, Japan and Europe) in the inward flow of FDI tripled from $142 billion to $410 billion, clearly showing how these flows of funds accompany the integration of markets and take advantage of specific technological advantages of developed economies (as opposed to low production cost advantages). These aspects are reinforced by the results of a recent study by The Transnational Corporations Center of the UN (UN, 1993) showing the rise of FDI in services (nearly one-half of total FDI in the early 1990s) and the importance of the market-seeking behaviour of transnational corporations investing abroad in services.

Conversely, in this appraisal of the dynamics of globalisation, the growth dynamic of any firm in a developed economy clearly relies on the development of new products. Along with organisational capabilities in accessing markets, product innovation is a key to competitiveness for firms in an industrialised country. Even small and medium-sized firms are almost permanently on the look-out for new products and services (Naes Gjerding *et al.*, 1992).

All these points stress that the imperative of technological competitiveness for any advanced economy has been reinforced with the process of globalisation. However, technological competitiveness is a multidimensional notion which requires greater precision.

Models of international trade and specialisation often assumed (in the Hecksher-Ohlin-Samuelson tradition) that technology is a factor which is freely mobile and accessible to all firms independent of their localisation. Systematic attempts to map the distribution of technological competence and specialisation between countries show that these assumptions are not very realistic. Not only

are national systems strongly specialised in their technological competence but the degree of specialisation (as drawn in the usual classifications) seems to have been further strengthened in recent years (Archibugi and Pianta, 1992; Guerrieri and Tylecote, 1993). Besides differences in specialisation, there is strong evidence to indicate that some national systems seem to be ahead of others in a broad range of technologies and that some countries tend to move ahead much more rapidly along such a broad range. This is the background for the interpretation of international economic dynamics, reflected in the catching up and forging ahead of whole economies.

One important aspect of the catching up process was that it was paired with the opening up of the OECD economies in terms of international trade and flows of foreign direct investments. It is the furthering of this trend, along with the diffusion of ICT, which recently led this internationalisation to a new phase, namely the process of globalisation, with the development of truly global markets and a truly worldwide division of labour. Financial markets are well-known examples of these global markets. Conversely inter-firm co-operation in costly projects aiming at developing large new systems or products, or mass production, constitute examples of this new international division of labour.

The growing frequency of international inter-firm co-operation in relation to product development efforts illustrates that certain areas of technology are characterised by large scale economies and by indivisibilities which tend to exclude not only small- and medium-sized firms but also big firms from small- and medium-sized countries from entering the field without joining international alliances (the fact that we seem to be moving towards a single worldwide consortium when it comes to developing new aircraft illustrates this phenomenon). These tendencies may explain why most of the earlier successful small OECD economies now seem to have special problems in terms of stagnation and unemployment. It may be of broader interest in the present situation to analyse the new situation of these small countries. If their problems reflect the combined effect of economies of scale in technology development and increasing globalisation, the problems may also be regarded as early signals of what might be expected for medium-sized countries in the near future.

When dynamic economies of scale are realised in such international co-operation (Ethier, 1979), the question is raised as to the distribution of the resulting value added at an international level; this is particularly important as more and more externalities tend to become external to the national economy. This seems to be the case when it comes to investment in basic research to which access to expertise from all over the world is simple. But it might also include a growing proportion of the efforts to develop certain new technologies. If this is the case the incentives for national governments and national firms to invest in R&D will be

weak and there will be an increasing need for international sharing of costs and responsibilities.

Moreover the process of globalisation is far from uniform and homogenous. First, and in spite of the development of telecommunication and other technologies simplifying world-wide communication, it remains difficult and costly for firm managements to co-ordinate a truly integrated worldwide system of production and trade. A closer look at trade flows shows a pattern which more closely ressembles regionalisation than globalisation. The biggest US MNEs have developed reasonably coherent sub-systems of production and trade at the level of the European, Asian and American regions while the interaction and flows of commodities are much more modest between the three regions.[20]

Second, and this was one of the most prominent results of the TEP-programme, innovation processes are interactive rather than linear (OECD, 1992*a*). Many studies have shown that the development of new technology involves firms in intensive communication and co-operation between many specialised parties (universities, technical institutes, bodies of standardisation, public authorities, users, sub-contractors and sometimes even competitors). At the same time, it has been shown that the process of innovation often has its roots in routine activities of production and marketing. This has important implications for the limits of globalisation.

On the one hand, long-distance communication is often expensive and delays the process of innovation. On the other hand, the ideal position of a firm is within a knowledge-intensive network specialised in the set of skills most crucial to furthering its innovations.

Consequently, globalisation could be combined with a trend towards localisation. Some authors have noticed this combined movement and coined the concept "glocalisation" (Storper, 1991). This points to the importance of the knowledge base for the localisation of production and for local employment developments. It becomes increasingly important to develop and reproduce such knowledge-intensive networks at local, regional or national level in order to support existing jobs and stimulate the creation of new jobs. Firms producing advanced business services could play a strategic role in such networks and may actually become more consequential for job creation than manufacturing firms. In this more volatile world, it has obviously become crucial for economies to develop a fabric of stabilising economic relations that can create positive externalities. Such a complex objective is not easy to define. However, it is clear that it does not conflict with, but is possibly complementary to, internal policies favouring the general growth of demand.

To return to the cumulative causal line of arguments (as shown in Figure 1), it is interesting to see how the above-mentioned issues are inter-related and to consider the policy prospects they suggest.

III. THE PROSPECTS FOR A COMPREHENSIVE EMPLOYMENT POLICY

We can now attempt to summarise the main issues raised in the last section and study their relations within the framework presented in Section I in order to explore the policy prospects they may generate.

The diffusion of the new information and telecommunication technologies could clearly have far-reaching repercussions, as they concern most aspects of economic activity on both the production and the demand side. Yet the leading developed economies are also finding this new age to be co-inciding with a period of slow economic growth and rising unemployment and/or increased inequality in the distribution of incomes. Such problems are sufficient for the diffusion of a new technological system to be perceived as threatening.

However it is also clear that these problems of unemployment and income distribution are not affecting all the leading industrialised economies in the same way. We have hitherto stressed the common features of the problems faced by these economies when they try to resume economic growth to ensure full employment and reduce poverty. We have assumed that these features were linked and that referring to a theoretical framework could help to assess these linkages. This scheme recalls that structural adjustment can be seen as composed of three interdependent processes. One process essentially concerns adjustments in the organisation of production: designing work and shaping flows on internal and external labour markets. The second relates to changes in the distribution of incomes; and the third to the transformation of demand, in particular involving social learning to adjust to changes in product features.

These processes are interlinked in the sense that a mismatch at any level tends to impinge upon the remaining room for manœuvre to adjust at other levels. When this interdependence is overlooked, policies of direct monitoring at any level (be it through action on the labour market or measures to redistribute incomes or promote new patterns of consumption) can be undertaken which finally prove to be costly and fairly ineffective in welfare and employment terms.

With the continuing stagnation of economies, the links between these issues are becoming clearer. Increasingly sharp inequalities in incomes and/or rising unemployment considerably limit the scope for the spread of new patterns of consumption and accompanying product innovations. Conversely, a stalemate in

consumer behaviour does not help transform work organisation, the functioning of labour markets or the distribution of incomes (by developing innovative collective goods). Therefore, to assess the room for manœuvre left to economic policy in times of structural change, special attention should be paid to identifying these links and designing policies with co-ordinated (if not cumulative) effects on the three issues mentioned.

To summarise, our study has endeavoured to show that changes on the demand side are still relatively modest and may not be in line with those that have already occurred on the production side. Some key uncertainties exist concerning the potential for change in an area central to economic recovery.

We have entered a period where knowledge in its broadest sense has become a strategic resource of the economy (see Lundvall and Johnson, 1992) and a large and increasing proportion of products and services should be deriving their value from the knowledge they "contain". New technologies have substantially transformed production conditions in many industries, both within firms and between firms. This change is common to most developed countries and has a strong impact on the nexus of international transactions in goods and services, not to mention the cross flows of all kinds of capital. In comparison, changes on the final demand side have been relatively limited. It should be borne in mind that IT is used in the logistical support of most markets and large organisations, in both distributive and administrative services, and that a great many consumers are accustomed to personal computers, new telecommunication apparatus and other electronic equipment. Yet there are signs that IT could transform life styles even more extensively once its potential has been fully put to use in urban and social life as well as in the increased interactive provision of education and health services.

This mismatch is to some extent responsible for stagnation and unemployment. 1980s-style demand-management policies have met with prohibitive limits at national level: indebtedness among agents, the effects of poverty in dividing mass markets, increased pressure by external competitors on internal and external markets, investors with shorter time horizons and increased sensitivity to financial pressures, and rising opposition to further public spending. IT cannot overcome all these shortcomings although it does have the potential to support an upturn in demand, at least for collective and personal services, which represent a large share of employment. The problem is therefore largely organisational and is made all the more complex by the fact that new institutions need to be equipped to channel this upturn.

The challenge for structural policies is therefore to develop mechanisms through which the dynamics of demand and supply structures can be mutually reinforcing. In the present case, this requires the accommodation of structural changes on the production side by instituting policies to organise demand (such

as subsidies for new intermediation activities, adequate training schemes and the provision of new collective services). The bulk of such measures should obviously take advantage of the scope for decentralised action provided by information technology networks to overcome barriers to the further expansion of a centralised welfare state.

Specific and resolute actions in this direction are all the more necessary in that large-scale modernisation of production has not yet reached its full momentum. The spread of new ICT user processes was boosted in the 1980s by a bandwagon effect on most activities. The impact of this modernisation on efficiency, whether in terms of productivity (see Solow's paradox) or profitability, is not yet manifest in most cases. Consequently, this "lag" has somehow postponed a productivity shock. There are signs that this period may be coming to an end. There have been recent cases of firms undertaking a full re-engineering of their production processes using the networking possibilities of ICT, for which technology has really seemed to pay off.[21] The possibility of productivity gains picking up again in the not-too-distant future remains open. Should this productivity shock, indispensable for economic growth, occur, it will increase pressure on labour markets. It should therefore be accompanied by substantial action on the demand side in the above-mentioned direction.

It could be argued that a sufficiently widespread rise in productivity could, by means of the usual price and quality incentives, reflate the level of demand and thus economic activity. In developed economies, a large part of the effect could lead to a redistribution of market shares, while developing economies (south and east) would require financial aid in order for the potential rise in demand to become effective. Action on the demand side would therefore seem to be unavoidable, even in setting up financial schemes to help developing countries.

In looking at the possibilities for action on the demand side, we have mentioned the value of stimulating restructuring in service activities. The large employment potential in these activities makes it worthwhile considering a major redesigning of work. New technologies can help in this respect through the highly flexible organisation of widespread part-time work, paid and unpaid leave, and training periods. Various schemes could also help develop an entire group of decentralised activities ranging from market to public activities. Urban crises and serious deficiencies in our education and health systems underline the need for such new collective services. The border between work and non-work can be blurred by such changes. Institutional arrangements of various kinds will be required to turn these possibilities into realities. Only such far-reaching transformations can help developed economies deal with job losses in the manufacturing industries. The vast majority of this sector's redundant workers are unskilled, and specific training schemes are needed, in part before redundancy occurs, if these workers are to be included in a new world of production, leisure and education.

Training is often seen as a key to alleviating the problem of unskilled employment. It could, for example, curb the threat of job relocation. Yet the rise in the proportion of unemployed skilled workers proves that it is no cure-all. Qualifications have to contain a collective dimension and thus present clear and specific advantages in terms of organisational capabilities and local opportunities for co-operation. Such competitive advantages go hand in hand with a renewal of the fabric of intercorporate relations.

The resulting substantial adjustment in industrial relations would help our societies to move towards further decommodification of labour.[22] In other words, citizenship would not be limited to a wage-labour relationship, but would enlarge its special status and rights within the sphere of economic activities.[23] Changes in attitudes towards the employment of young people over the past decade should help developments in this direction.

This outlook strengthens the need to focus policy efforts on the development and fair distribution of knowledge among citizens. Without public policies to support the education and training of the less-skilled groups of the workforce, we risk producing a highly polarised society in terms of income, knowledge and job opportunities. The only alternative to unemployment for the underprivileged who do not belong to the "knowledge elite" would be dependent and extremely low-paid, menial service jobs. There is a great risk of dualism, which would hamper the outcome of a new growth pattern with (redefined) full employment. Such a drift is all the more difficult to avoid in view of the growing inequality in the distribution of family incomes; we have therefore emphasized the significance of income distribution as a key adjustment factor in times of structural change. At this stage, it is worth mentioning that income distribution conditions the expected outlook for setting up new full-employment schemes and new life patterns. When sluggish economies cannot afford to maintain their commitment to social progress for all, they are better advised to redefine their commitment than to exclude large sections of the population. The rise in poverty in the developed economies is a major symptom of a sclerosis which drastically reduces the scope for the above-stated changes in the organisation of work and in life and consumption patterns.

This warning is too often forgotten when policies attempt to reduce unemployment in the short term by downgrading jobs and lowering wages. There is no trade-off between inequality in employment and inequality in incomes; rather this is a delicate problem that is especially difficult to address since it involves such fundamental issues for the cohesion of our modern societies as the work ethic and a feeling of citizenship.

NOTES AND REFERENCES

1. In some countries, dualism can also increase within firms, increasing the number of low- and high-grade jobs at the expense of middle-grade jobs.
2. The assumption of upward shifts in NAIRU (Non-Accelerating Inflation Rate of Unemployment) was just another way of saying the same thing: wide-ranging structural changes of uncertain origin placed long-term obstacles in the way of full employment (Cornwall, 1990).
3. Such as shifts in Phillips curves linking the unemployment rate with wage increases, and in Beveridge curves relating unemployment and vacancy rates.
4. Testing for a time trend in the unemployment time series produces a positive result in Japan (unit roots test) and in most OECD countries, with the clear exception of the United States.
5. Thus, one way to approach the productivity slowdown paradox of the 1980s is to consider whether overly fast changes in production processes are accompanied by greater upheavals in the formation of demand, which in turn severely hinder the learning processes and adjustments on the production side (Boyer and Petit, 1991).
6. Between 1981 and 1989 ICT industries in OECD countries have lost 69 000 jobs with large variations between sub-periods and countries as shown in the following table:

	1981-85	1985-89	1981-89
Japan	298 000	17 000	315 000
US	156 000	–537 000	–381 000
OECD	492 000	–562 000	–69 000

Source: Estimations OECD, data from Caracostas, Muldur (1993).

7. See the map of regional development in *Employment in Europe*, EEC DGV, Chapter 6 (1991), for EC countries, or Bluestone and Harrison (1982, 1986) for the new localisation of blue collars jobs in the United States.
8. See *Employment Outlook* (1990), chapter 2, OECD, July.
9. In a recent report to the French government, J. Arthuis (1993) stresses that delocalisation towards Asian or East European countries in a near future is a potential threat to most industrial activities (84 per cent of manufacturing employment).

10. This point shows up very clearly in the case of the United States where large deficits in manufactured goods in the 1980s corresponded to a 9 per cent decline in the demand for non-qualified workers [see OECD (1993), *Employment Outlook*, Chapter 5].
11. According to the classification used by Elfring (1992) that we use afterwards, with respectively the following items:
    a) personal services: hotels and restaurants, recreation and amusement, domestic services, other personal;
    b) distributive services: retail and wholesale trade, transportation, communications;
    c) producer services: business and professional services, financial services, insurance, real estate.
    d) social services: government proper, health, education, miscellaneous social services.
12. In Table 3 the share in employment of producer services in 1987 ranges from 7.7 per cent in Germany to 13.6 per cent in the United States.
13. With the exception, of Japan and France, where an increase in the share of employment in these trades was more noticeable.
14. Which is not the case of the United States, which presents across all services a higher than average share of employment, amounting in 1987 (according to the same source) to 73.5 per cent of total employment in services compared to an average of 64.5 per cent in the big OECD countries.
15. These observations are limited as no mention is made of the corresponding levels of ICT diffusion in each sector. Petit (1992) offers similar ideas, comparing adjustments in the job structure in services in France with the level of general investment, assuming that the ICT content of equipment goods is similar across all sectors.
16. Which can be well illustrated using a hedonic price approach to quality recognition problems. See Petit (1991).
17. Examples are given by the banking sector where firms may follow very different manpower policies, with different skill requirements and different uses of higher formal education. See Bertrand and Noyelle (1985).
18. According to Arthuis (1993), of 30 000 computer specialists in France in 1993, 20 000 were unemployed.
19. Where the number of part-timers jumped from 30 per cent in 1983 to 45 per cent in 1991, bringing down the average number of hours worked to 30 per week. See *Employment in Europe*, EEC DGV (1993).
20. Wells (1992).
21. This is shown in recent studies by Brynjolfsson and Hitt (1993), and Lichtenberger (1993) comparing the performances of large firms to the size of their investments in ICT technologies from 1987 to 1991. *Business Week*, 14 June 1993, under the heading "Technology Pay Off" also reports on the success stories of firms re-engineering their production processes around ICT networks.
22. As defined in Esping-Anderson (1990).
23. Bowles and Gintis (1986) made a point of this issue.

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INNOVATION IN A NEW CONTEXT

CONTENTS

This article was written by Chris Freeman, SPRU, University of Sussex, Falmer, Brighton, United Kingdom and MERIT, University of Limburg, Maastricht, The Netherlands.

SUMMARY

This paper first of all outlines a theory of technical innovation and of structural change based on Schumpeter's conception of long waves and "successive industrial revolutions" (Section II). It then applies this theory to the contemporary case of information and communication technology (ICT) and attempts to show that the successful diffusion of this technology depends on a wide variety of institutional changes. The present problems of structural unemployment and productivity slowdown are attributable to the mismatch between the new technology and obsolete organisational and social systems (Section III). Finally, the paper indicates some of the policies which might help to overcome this mismatch in the OECD countries and generate higher levels of employment.

I. INTRODUCTION

No-one can precisely predict the future, yet everyone has to take a view of likely events and of policies which may promote desirable outcomes and prevent or hinder less desirable outcomes. Such "scenarios" or "visions" are developed on the basis of generalisations, theories, extrapolations and models of real world behaviour. In the final paragraph of his *General Theory of Employment, Interest and Money,* Keynes (1936) pointed out that:

> "... the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist." (page 383)

It is therefore important, whilst being aware of the fragility and limitations of all forecasting, to try and improve general theories and models of the economic system. This means also attempting to take into account *new* features of its behaviour since human history is a unique process.

Section II of this paper argues that technical change should not be disregarded either in theories or in policy-making. It summarises the views of Schumpeter and other "structuralists" who have attempted to relate their analysis of business cycles and employment to technical innovations, organisational innovations and their diffusion. Section III applies this general theory to the specific case of information and communication technology (ICT) and its contemporary diffusion. Finally, Section IV suggests some policy implications which might improve employment prospects.

II. UNEMPLOYMENT AND TECHNICAL CHANGE

It was Ricardo (1821) who shocked his contemporaries and raised some problems which have troubled economists ever since with his famous statement that:

> "the opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests is not founded on prejudice and error, but is conformable to the correct principles of political economy." (page 392)

Although Ricardo himself was later at pains to modify and explain this rather stark statement, it led to a lasting recognition of the importance of time-lags and rigidities in the employment "compensation" mechanism. Whilst neo-classical theory insists that in the long run in well-functioning markets, the prices of labour and capital will ensure a balance of supply and demand for both, it does recognise that the new jobs which are generated somewhere in the economy will not necessarily match either the skill profile or the geographic distribution of the existing labour force. The compensation mechanism is neither instantaneous with respect to the time dimension, nor necessarily convenient to labour with respect to the nature and location of new employment. When these time lags and rigidities are severe and sometimes international in scope, they give rise to *structural* unemployment as opposed to the relatively painless and transitory *frictional* unemployment, which is a constant feature of the labour market.

Keynesian economists differ from mainstream neo-classical economists mainly in their belief that general equilibrium in the economy may not necessarily be a full employment equilibrium. They generally accept the reality and effectiveness of compensation mechanisms but emphasise that aggregate demand may be inadequate to realise and sustain full employment, unless monetary and fiscal policies are deployed systematically to attain this objective. While stressing the role of uncertainty, confidence and animal spirits in investment behaviour, they

nevertheless also tend to neglect the role of technical change in relation to unemployment.

The standpoint of this paper is that whilst classical, neo-classical and Keynesian economists have all contributed some important insights to the understanding of unemployment and economic cycles, they need to be complemented by a theory of technical change. In Schumpeter's theory, the ability and initiative of entrepreneurs, drawing upon the discoveries of scientists and inventors, create entirely new opportunities for investment, growth and employment. The profits made from these innovations are then the source of renewed confidence and a decisive impulse for new surges of growth, acting as a signal to swarms of imitators.

Whereas in neo-classical theory the emphasis is on factor price flexibility and in Keynesian theory on aggregate demand, with Schumpeter it is on autonomous investment, embodying new technical innovation which is the basis of economic development and new employment. In such a framework economic growth must be viewed primarily as a process of reallocation of resources between industries and firms. That process necessarily leads to structural changes and disequilibrium if only because of the uneven rate of technical change between different industries and countries. Economic growth is not merely *accompanied* by fast growing new industries and the expansion of such industries; it primarily *depends* on that expansion. The new firms and new industries are an essential source of the new employment which compensates for the loss of jobs in declining industries and firms. It is a process of "creative destruction" in which the process of job creation outstrips that of job destruction as a result of profound structural adjustment and not as a smooth incremental process.

However, as Kuznets (1940) pointed out, whether or not the very rapid growth of new leading sectors of the economy and new technologies offers a plausible explanation of long-term cycles in economic development and employment depends crucially on whether some of these innovations are so large in their impact as to cause major perturbations in the entire system – as, for example, could plausibly be argued in the case of railways – or on whether such innovations are bunched together systematically in such a way as to generate exceptional booms lasting about a quarter of a century and followed by deeper recessions and structural adjustment.

In addition to the points made by Kuznets, there are other reasons for the reluctance of many economists to accept Schumpeter's long wave ideas and some of them are good ones. Most of them relate to the confusion among long wave theorists about the statistical evidence, especially in the 19th century (Weinstock, 1964; Solomou, 1985).

Neo-Schumpeterians have, however, made considerable progress in dealing with the Kuznets argument about the clustering of innovations. They have reasonably pointed out that for a wave of technical change to have appreciable effects on worldwide investment and employment, it is *diffusion* and not first date of discovery or innovation which is the important phenomenon. The discovery by Faraday of the principles of electro-magnetism and the first electric motor in 1831 had absolutely negligible immediate effects on the economic system. It was not until half a century after the first successful demonstrations of the possible applications of electricity that it became economically significant, and this was possible only through a combination of technically and economically inter-related innovations and basic infrastructural investments. It is the *diffusion* of *new technology systems* through waves of new investment, not the date of individual innovations, which can reasonably be maintained to be the key phenomenon from the standpoint of economic growth. Furthermore the empirical evidence supports the view that the diffusion of such systems is a matter of decades rather than months or years.

The very rapid growth of the world economy in the 1950s and 1960s, followed by the slowdown in the 1970s and 1980s and the resurgence of structural unemployment, might reasonably be held to vindicate at least some of Kondratiev's and Schumpeter's ideas about long waves in the growth of capitalism. If the test of a theory in the social sciences is held to be predictive power, then long wave theories come out from this test rather better than most others in considering the development of the world economy in the 20th century. Nevertheless, Schumpeter's theory of long waves is still far from gaining general acceptance, whereas most economists would probably now accept many of his other ideas on the role of innovation in competition.

The debate as to whether the rather poor aggregate output statistics for the 19th century and the more clear-cut 20th century statistics justify long wave assumptions rumbles on [see *e.g.* Kleinknecht (ed.), 1992]. But it is not actually necessary to take any position in this debate to accept the notion that waves of pervasive technological change can periodically cause severe problems of structural adjustment. In fact, ever since Kondratiev's orthodox critics in the Bolshevik party attacked his statistical methods, these debates on long-run statistics have served to obscure rather than to clarify the main contribution of long cycle theorists to economics. This contribution relates to the role of infrastructural investment and of related waves of technical change in the *qualitative* transformation of the economy. The study of past waves of technical change may stimulate useful insights for the present but it is not even necessary to take any view about *past* waves of technical change (steam power, electric power, mass production of automobiles, etc.) to recognise some important implications of the *present* wave of technical change for investment and employment. It is however, necessary to

accept the point that ICT is: *i)* a truly pervasive technology deeply affecting most industries and services; *ii)* that its introduction and efficient diffusion depends on many managerial, organisational and other institutional innovations as well as on relative prices; and *iii)* that this diffusion involves some radical discontinuities compared with earlier patterns of production, distribution and consumption.

It is to these points that we turn in Sections III and IV. Section III charts the diffusion of ICT and discusses some of the social and organisational changes associated with this diffusion. Section IV draws policy conclusions.

III. THE DIFFUSION OF ICT AND INSTITUTIONAL CHANGE

In the early stages of a radically new technology, very few people know much about it. Attitudes vary between sheer disbelief and amazement because of simple lack of experience. This is a time of promotion by groups of scientists and engineers on the basis of their experiments, enthusiasms, theories, beliefs and interests, assisted by those few people outside the science-technology community who share their convictions and interests and see some advantage in the development and application of the technology. As soon as these applications show some promise of profit, commercial influences become stronger and the market selection environment begins to exert its influence. A trial-and-error process of learning by doing, using and inter-acting becomes more and more important and market demand stimulates further innovations. Although profitability tends to dominate diffusion in a capitalist society, a process of attempted humanisation is also important whether in the form of workforce resistance, consumer pressures, or more recently, some type of formal technology assessment (TA). At this stage, there are usually very few statistics of production, trade or employment. Even in the 1960s the official statistics for the computer industry were still very poor and those for software almost non-existent.

Although engineers and scientists such as Diebold (1952) and Wiener (1949) had clearly forecast universal computerisation, it was only with the development of microelectronics (LSI – large-scale integration – and VLSI), and above all with the advent of the microprocessor in the 1970s, that the costs of using the computer in every factory, office and home came down so low that their vision became everyday reality. The new developments in optical fibres and in telecommunication and computer technology meant that vast quantities of data could not only be recorded, processed and stored in fractions of a second but could also be transmitted worldwide extremely cheaply.

The recent statistics of trade, employment and R&D are quite sufficient to justify the view that ICT *products* have grown so rapidly in the last 20 years that ICT industries have become the leading edge of economic development. However, they greatly understate the role of ICT in world economic developments for three reasons:

i) The growth of ICT *service* industries has been even more dramatic than that of manufacturing. Software, other business services based on ICT, databanks, networking services and ICT based entertainment services have been the fastest growing service industries of the 1980s and are extremely important from the standpoint of new employment. Many of these are dependent on the telecommunication infrastructure which is being transformed by digitalisation and will be the foundation for even more revolutionary developments in the future associated with multimedia and education. The statistics for these services are, however, even weaker than those for manufacturing.

ii) Although this growth of new leading industries in manufacturing, services and infrastructure constitutes a "development block" (to use Dahmen's expression) whose dynamism is now the main engine of world economic growth, it would be a mistake to think of ICT simply as a set of new fast-growing industries. It is also a potent source of transformation in older "traditional" industries, such as construction, clothing, mining or mechanical engineering, and services, such as tourism, public administration, health, education and most of all, financial services. In fact, ICT is not only affecting *every* industry and *every* service, it is also affecting every *function* within these industries and services: design, R&D, production, marketing, management and administration.

iii) Finally, the diffusion of ICT is intimately connected to changes in organisation and management structures and to deeper changes in the institutional and social framework.

Their very pervasiveness makes it hard to define and measure the ICT industries and services, but they already account for over 10 per cent of OECD manufacturing employment and manufacturing exports and they are still the fastest growing major categories in world trade and world production. The painful process of adjustment which all the OECD countries have been experiencing in the 1980s and 1990s is not just a matter of inflationary problems or mistakes in macroeconomic policies or the emergence of new leading sectors, even more it is a vast learning process affecting *every* industry and service. Individuals, firms, governments and all kinds of other organisations are learning by trial and error, by innovation and by imitation, how to adapt themselves to the new characteristics and the new potential of this extraordinarily pervasive technology.

The scope and nature of these changes are so great that it is hardly surprising that the first results are often actually a *fall* in productivity; it takes a long time to realise the potential advantages in organisations which have been long accustomed to different ways of doing things and different management structures as well as different types of equipment. Rigid procedures, other forms of institutional inertia and entrenched attitudes can be very strong.

In part, this is a question of change in generations as Kuhn (1962) observed in relation to the acceptance of radically new paradigms in natural science. This can easily be observed today in almost any household where most parents have seen how much more quickly and confidently their children have learnt to use computers, play computer games and use all kinds of other electronic equipment. The learning process in offices and factories, in hospitals and hotels is far more complex, involving as it does the ways in which information is assembled and transmitted, work is organised and people relate to each other and communicate as well as the purely technical attributes of computers and other equipment.

There are many economic advantages based on the use of ICT but some of the most important can be grouped under four headings which all interact and all necessitate organisational change linked to technical change.

- speed,
- flexibility,
- networking,
- storage.

The first of these characteristics – speed – was there from the beginning of computers and of telephony and was indeed the main purpose in developing computers at all from Babbage and Zuse onwards. The other characteristics developed only during the diffusion process as a result of linking computer technology with telecommunication technology and numerous related and complementary innovations in software, in peripherals, in computer architecture, in components and integrated circuits, and in optical fibres. This whole constellation of innovations only emerged as a "new technology system" over several decades. It is still evolving and technical change continues at a high rate. However, the four characteristics which will be discussed in this section already give a coherent pattern for a new style of management, which is in conflict with the old style based on mass production and often described as "Fordism". An over-simplified and schematic contrast between these two styles is shown in Table 1.

This is not technological determinism. Technologies are developed and diffused by human institutions; the processes of development, selection and application are *social* processes. In the OECD (and most other) contemporary economies, the selection process is heavily influenced by perceived competitive advantage, expected profitability and (intimately related to these factors) time-

Table 1. **Change of techno-economic paradigm**

"Fordist" old	ICT new
Energy-intensive	Information intensive
Design and engineering in "drawing" offices	Computer-aided designs
Sequential design and production	Concurrent engineering
Standardised	Customised
Rather stable product mix	Rapid changes in product mix
Dedicated plant and equipment	Flexible production systems
Automation	Systemation
Single firm	Networks
Hierarchical structures	Flat horizontal structures
Departmental	Integrated
Product with service	Service with products
Centralisation	Distributed intelligence
Specialised skills	Multi-skilling
Government control and sometimes ownership	Government information, co-ordination and regulation
"Planning"	"Vision"

Source: Adapted from Perez (1990).

saving potential. However, it is also true that some technological trajectories, once launched, tend to have their own momentum and to attract additional resources by virtue of past performance. Finally, both the technological system and the economic system get "locked in" to dominant technologies once certain linkages in supply of materials, components, and sub-assemblies have been made, economies of scale realised, training systems and standards established and so forth. Consequently individuals, firms and societies are not quite so "free" in their choice of technology as might appear at first sight (Arthur, 1988; Dosi, 1984; Perez, 1983, 1985).

In fact, in the early days of computing it was in no way a dominant technology and had to struggle for survival in a world geared to very different technologies and systems. Even very well-informed industrialists, such as T.J. Watson, the head of IBM, did not believe that there would be any large commercial market for computers (Katz and Phillips, 1982) and thought that the only demand would be for a few very large computers in government, military and scientific applications. Early computer users had great difficulties in obtaining reliable peripherals and appropriate programmes and in recruiting people with the necessary skills. However, even in these early days, computers did already demonstrate those revolutionary *technical* advantages, which enabled such far-sighted pioneers as Norbert Wiener (1949) or John Diebold (1952) to forecast their ultimate universal diffu-

sion. In their early applications during and after the Second World War, computers already showed that their *speed* in calculation would drastically reduce by *several orders of magnitude* the time taken to perform complex calculations. It is very seldom in the history of technology that such a revolutionary change occurs. This was and remains their decisive technical and economic advantage (Table 2).

After a change in management in the early 1950s, T.J. Watson Junior took over at the helm of IBM and took the lead in exploiting the already considerable need of large firms for improvements in data processing. At this stage, the electronic industries generally were still "fitting in", albeit somewhat uncomfortably, to the old world paradigm. Computers became part of the departmental, hierarchical structures of the large firms which adopted them. Their main advantages at this stage were in the time-savings in *storing and processing* of enormous volumes of information in standardised applications such as payroll, tax, inventories, etc. They certainly did not yet revolutionise the *organisation* of firms, for example, by making available information at all levels in all departments. Radio and television fitted in well to the paradigm of cheap, standardised consumer durables supplied on hire-purchase to every household, like washing machines, cars or refrigerators.

Although their revolutionary *technical* potential was already clearly visible, computers were still rather expensive, cumbersome, user-unfriendly items of equipment. It was widely assumed that large mainframe computers in specialised data processing departments or groups assisted by the hardware suppliers would be the normal pattern of diffusion outside scientific and military applications. IBM became by far the most profitable firm in the world industry by operating on this basis. Its own management structure differed to a relatively small extent from those of other large firms even though it spent a great deal on training and R&D and had its own strong company traditions.

Von Tunzelmann (1993) and other historians have shown that it is realistic to regard the technical change sought by firms in *process* technology as primarily *time-saving*. He takes as an example the history of technical change in the British cotton industry during the Industrial Revolution. Probably, however, there has never been a technology where time-saving played a more important role than ICT. In later applications of computing some of the *indirect* time-saving advantages of computer technology have become equally or more important. The "just-in-time" system of the Japanese automobile industry was originally a purely organisational innovation and had nothing to do with computers. However, as consultants extolled its merits and it diffused in North America, Europe and Oceania, as well as Japan, its application was increasingly linked to the use of computers and to the integration of product schedules and inventory control with purchasing and sub-contracting through a network of computers. Similarly with the "electronification" of design. This not only meant the application of CAD and

Table 2. **Change of techno-economic paradigm in OECD countries**

Area of change	1. Late 1940s-early 1970s	2. Early 1970s-mid-1990s	3. Mid-1990s onwards "Optimistic" scenario
I. Information and communication technology			
A. Electronic computers	Early valve-based machines mainly in military applications. Future potential often under-estimated. Big improvements in architecture, memory, peripherals lead to take-off in commercial market in 1950s. Huge improvements in reliability and performance from use of transistors and integrated circuits. Main-frame computers in large firm data-processing dominant but mini-computers take off in 1960s.	From 1971 the micro-processor leads to small, cheap, powerful personal computers diffusing to households as well as huge numbers of business users and changes the nature of the computer industry. Large main-frames and centralised data-processing departments play diminishing role as work-stations and PCs gain greater share of market.	Universal availability of PCs and of portable and "wallet" type computers linked to networks. Computers so unobtrusive in so many applications that they pass unnoticed (like electric motors in the household today). Super-computers and parallel processing for RD and other applications such as data banks where truly vast memory capacity and speed of processing is needed.
B. Computer software	First programming languages in 1950s. Hardware companies developing and supplying software to own standards. As applications multiply scientific users in R&D do their own software programming. Big DP departments develop software teams working with hardware suppliers. Emergence of independent software companies giving advice and support to users and designing systems.	Very rapid growth of software industry and consultancy especially in the United States. Packaged user-friendly software facilitates extraordinarily rapid diffusion of computer hardware, especially to SMEs, but customised software and modified packages business also grow very rapidly. Movement to Open Systems in the late 1980s facilitates inter-connections and networking. Shortages of software personnel acute in 1970s and 1980s but abating in 1990s.	Reductions in requirement for software labour from 1) standard packages, 2) automation of coding and testing, 3) reduced mainframe support, 4) improved skills of users. But these trends offset by new software demand from 1) parallel processing, 2) multi-media and virtual reality and expert systems, 3) changing configurations because of continuing organisational and technical change. Renewed surge of demand for more skilled software design and maintenance.
C. Semi-conducteurs and integrated circuits	From valves to transistors in 1950s and integrated circuits in 1960s to large-scale integration (LSI) in 1970s. Orders of magnitude improvement in reliability, speed, performance almost doubling the number of components per chip annually and drastically reducing cost.	From LSI to VLSI and wafer-scale integration. With the micro-processor from 1970s onwards, many small firms enter computer design and manufacture. Huge capacity of VLSI circuits leads to vastly increased capacity of all computers and huge reductions in cost.	Chips have become a cheap commodity. Both technical and economic limits to present stage of miniaturisation reached in early 21st century leading ultimately to "Bio-chips" or other radically new nano-technology.

Table 2. **Change of techno-economic paradigm in OECD countries** *(cont'd)*

Area of change	1. Late 1940s-early 1970s	2. Early 1970s-mid-1990s	3. Mid-1990s onwards "Optimistic" scenario
D. Tele-communications infrastructure	Electro-mechanical systems predominate in 1950s and 1960s. Traffic mainly voice traffic and telex limited by coaxial cables (plus microwave and satellite links from 1960s). Large centralised public utilities dominate the system with oligopolistic supply of telephone equipment by small ring of firms.	Massive R&D investment leads to fully electronic stored programme-controlled switching systems, requiring less maintenance and permitting continuous adaptation to new traffic, including a wide variety of voice, data, text, and images. Many new networking services develop. Optical fibres permit orders of magnitude increase in capacity and cost reduction. Break-up of old monopolies.	Widespread availability of bandwidths up to a million times that of the old "twisted pair" in coaxial cables. "Information Highways" using access to data banks and universal ISDN providing cheap networked services for business and households and permitting tele-commuting on an increasing scale for a wide variety of activities. Mobile phones and videophones diffusing very rapidly.
Estimates of increase in ICT capacity			
OECD installed computer base (number of machines)	30 000 (1965)	Millions (1985)	Hundred millions (2005)
OECD full-time software personnel	> 200 000 (1965)	> 2 000 000 (1985)	>10 000 000 (2005)
Components per micro-electronic circuit	32 (1965)	1 Mega-bit (1987)	256 Mega-bits (late 1990s)
Leading representative computer: instructions per second	10^3 (1955)	10^7 (1989)	10^9 (2000)
PCs: instructions per second	–	10^6 (1989)	10^8 (2000)
Cost: computer thousand operations per US$	10^5 (1960s)	10^8 (1980s)	10^{10} (2005)

Table 2. **Change of techno-economic paradigm in OECD countries** *(cont'd)*

Area of change	1. Late 1940s-early 1970s	2. Early 1970s-mid-1990s	3. Mid-1990s onwards "Optimistic" scenario
II. Industries and services			
A. Manufacturing	Mass production industries based on cheap oil, bulk materials and petro-chemicals predominate in 1950s and 1960s boom. Electronic capital goods industries still small though very fast growing. Consumer goods (radio and TV) fit into general pattern of household consumer durables. Early CAD and CNC introduced as "islands" of automation mainly in aero-space and promoted by government.	Electronic industries become leading edge in 1980s. Rapid diffusion of CAD, CNC and robotics in metal-working and later other industries. Productivity increases and diffusion slowed by learning problems, site-specific variety, skill mis-matches and lack of management experience. Integration of Design, Production and Marketing slow to take off. FMS and CIM have big teething troubles.	Generalisation of electronic-based equipment and control in all industries. "Systemation" of various functions within firms through CAD-CAM, etc. Flexible manufacturing systems in most industries. Larger labour and capital productivity increases in OECD countries. Layered incorporation of Third World countries in expanding world manufacturing output and trade.
B. Services	Mass production style spreads to many service industries, especially tourism (packaged holidays, cheap air and bus travel, etc.) distribution and fast food. Rapid growth of (public) social services and of central and local government employment. Hierarchical centralised management systems in large organisations, whether government or private.	Many services become capital-intensive through introduction of computer systems, especially financial services. Service industries also begin to do R&D and more product innovation. "Diagonalisation" of services based on capability in ICT (tourism companies into financial services and vice-versa; banks into property services, etc.). Big learning problems and software failures. Word processors become universal.	Vast proliferation of networking services, producer services, consultancy and information systems. Tele-shopping, tele-banking, tele-learning, tele-consultancy, tele-commuting, based on cheap universal computing and very cheap telecommunications (fax, E-mail, video-phones, mobile phones, etc.). Growth of labour-intensive craft services, "caring" services and creative services on personal customised basis and local networks.
C. Scale economies, firm size and industrial structure	Increasing size of plant in many industries in 1950s, and 1960s (steel, oil, tankers, petro-chemicals). Big scale economies facilitate growth of large firms and concentration of industry. MNCs spread investment worldwide especially in oil, automobiles and chemicals. In late 60s and early 70s increasing evidence of "limits to growth" of energy-intensive mass production style.	Production scale economies sometimes reversed but scale economies in R&D, marketing, finance, etc., still important. In 1980s and 1990s intense competition, computer systems and cultural revolution lead to "down-sizing" of some large firms – with reduction of both white and blue collar employment. Many new SMEs side by side with high mortality in recessions.	Continued high rate of small firm formation especially in new technology and new service areas. Some re-concentration in capital-intensive and R&D-intensive sectors, leading to worldwide oligopolies in symbiosis with myriads of small networking firms at local level. Conglomerates with complex and shifting alliances in various regions.

Table 2. **Change of techno-economic paradigm in OECD countries** *(cont'd)*

Area of change	1. Late 1940s-early 1970s	2. Early 1970s-mid-1990s	3. Mid-1990s onwards "Optimistic" scenario
D. Organisation of firms	Hierarchical departmental structures with many management layers and vertical flow of information typical of large firms. Computers fit into existing structures and often into existing data-processing departments based on tabulating machines. In manufacturing computers introduced as process control instruments of existing processes or as "islands" in existing production systems.	Cheap widespread computer terminals lead to "cultural revolution" in firms based on de-centralisation of some functions, horizontal information flows, lean production systems and networking within and between firms. Acute stress and conflict attends clash of cultures, reorganisation of production and systemation, and out-sourcing of many functions.	New flexible management style predominates. More stable employment for core personnel with networks of smaller firms and part-time workers. Greater participation of workforce at all levels of decision-making.
III. The macroeconomy and employment			
A. Economic growth and business cycles	"Golden Age of Growth" in mass production industries, services and systems. Rather stable Keynesian regulation of "vertebrate" economy providing stability and confidence for investment and consumer spending. Inflationary pressures and social tensions of late 60s and early 70s herald structural crisis of this paradigm as it reaches limits. Bretton Woods system provides fairly stable international framework until it breaks down in early 1970s.	First structural downswing crisis of mid-70s leads to desire to "get back on course" (*e.g.* McCracken Report). Second crisis of early 80s leads to recognition of structural problems but only in the third crisis of early 90s is their depth and difficulty appreciated. Huge productivity potential of ICT offset by rigidities in social system. The conflict of alternative paradigms is increasingly fought out in the political sphere as governments search for solutions and as public opinion tires of the invertebrate economy with its excessive turmoil.	Combination of technical and social change together with political reforms leads to new pattern of sustainable growth, renewed confidence for investment and new pattern of consumer spending. Changes in UN and Bretton Woods family of international economic institutions lead to stable global framework of expansion. "Forgotten" elements of Keynes' 1940s vision restored and provide greater resources for Third World "catching up". A new "vertebrate" world economy emerges.
B. Employment and unemployment	"Full employment" policies rather successful based mainly on full-time adult male employment 16-65. Relatively low but rising female participation rates. Very low structural unemployment. Recessions of relatively short duration. Low levels of youth unemployment. Expanding secondary and tertiary education systems.	Structural unemployment becomes more severe with each recession. Big increase in part-time employment and in female participation. Big increase in training and re-training to change skill profile of workforce but problems remain especially for less skilled and less educated. Long-term and youth unemployment become major problems.	Economy reverts to shallow recessions with much lower levels of structural unemployment. More self-employment and more flexible part-time work and life-time education and training for both men and women. "Active Society" providing work for all who seek it. Labour-intensive craft, caring and creative occupations and services proliferate. Shorter working hours for all and greater male participation in child care and house-work.

big time-saving advances in what used to be the "drawing office": it also made possible the linkage of design offices in many different locations. Large chemical engineering firms could switch the design of a chemical plant from Frankfurt to London to Singapore or Milan at will and MNCs could link their design and engineering functions in real time in several different locations through their own telecommunication networks. Computers thus contributed to the reduction of lead-times for new products and processes, as well as to greater flexibility in product mix, sub-contracting schedules and deliveries to the distribution chain.

A major characteristic of the semi-conductor and computer industry from the 1960s onwards was the very rapid change in the successive generations of integrated circuits. The number of components which could be placed on one tiny chip doubled every few years until it has now reached many millions and still continues to expand. This meant that all those firms making the numerous products which used these chips were also obliged to make frequent design changes. Rapid changes in design and product mix thus became a characteristic feature of the electronic industry and they increasingly used their own technologies to meet this requirement (CAD, networks of computer terminals, integration of design, production and marketing, etc.). Speed, flexibility and networking thus emerged in the 1980s as strongly inter-related characteristics of the new techno-economic paradigm (Table 2). Organisational and technical change became inextricably connected.

Now it was no longer a question of "stand-alone" computers or numerically-controlled machine tools or other items of equipment, or of separate data-processing departments or separate machine shops with a few CNC tools. Increasingly, it was a question not of "islands" within an alien and quite different manufacturing system or service delivery, but of the whole organisation being tuned in to what was previously stand-alone equipment or experimental plant. Flexible manufacturing systems (FMS and "systemation") or computer-integrated manufacturing (CIM) became the name of the game rather than the diffusion of individual items of equipment.

Numerous case studies of diffusion of robots, CNC, lasers, CAD and so forth in manufacturing or of computers and ATM in banks or of EDI (electronic data interchange) in retail firms (*e.g.* Fleck, 1988, 1993; Havas, 1993) testify to the systems integration problems and the site-specific problems which arose and still arise in a widening range of firms and industries. Operating and maintenance skills do not match the new equipment; management cannot cope with the inter-departmental problems, changes in structure and industrial relations; sub-contractors cannot meet the new demands; the software does not run properly, interface standards do not exist, etc. Nevertheless, the small minority of firms that succeed in coping with all this turbulence can reap great advantages in economies of

scope, in quality and image of products, in customisation of design and in rapid response to market changes.

The worldwide intensification of competition based on rapid technical and organisational change is leading to some dramatic changes in industrial structure as well as in management structure within firms. Large firms with rather top-heavy departmental and hierarchical structures faced particular difficulties. Because of rapid, easy access to information at all levels, both vertically and horizontally, intermediate layers of management were often no longer necessary. The need for rapid response and greater decentralisation of responsibility within the new production and management systems also intensified this pressure towards "down-sizing" by reducing the number of middle managers.

There is a problem of flexibility of large firms confronted with a period of enormous technological and organisational turbulence. Eliasson (1992) and other economists have argued that large Swedish and other European firms are often unable to cope with the speed of change. However, other Schumpeterian economists, such as Pavitt (1986) have argued that even very large firms *are* capable of learning and changing and that they still have great advantages and scale economies. It is also true that whilst large firms are often down-sizing and small new enterprises (SMEs) have been flourishing in some sectors of industry, there is evidence of reconcentration in other sectors and a new wave of mergers. These somewhat contradictory trends are characteristic of a period of structural adjustment but in any case it is clear that SMEs have become increasingly important in all OECD countries in generating new employment and in imparting greater flexibility and structural competitiveness to the economy. IBM has also entered into numerous technological collaborative arrangements with smaller firms. Even in such countries as Japan and South Korea, where large conglomerates have shown great innovative initiative, and have tended to predominate in transfer of technology, the growing importance of SMEs is apparent, although often in a symbiotic networking relationship with the larger groups. For example, in its new Electronic Technology Training Centre, established in 1990, the Samsung Electronic Company in Korea has allocated 20 per cent of the training places to the 2 000 SMEs with which it co-operates.

In considering the importance of small firms for employment growth and public policy it is important not to oversimplify the issues. Although many large firms have been shedding labour, this is certainly not true of all. There are firms generating new employment in every size category and many of these are to be found in the ICT industries, despite the fact that others have been sharply reducing their labour force. There is a great deal of restructuring *within* the ICT industries based on the success of personal computers, automation of many processes, microprocessors, customised chips and rapidly evolving product and service mix. A spectacular example of rapid growth is the success of the com-

puter games companies, Nintendo and Sega. No fewer than 38 of the 100 fastest growing publicly traded companies in the United States were ICT companies producing software, networking systems, telecom services, components and peripherals (Juliussen and Juliussen, 1993).

Networks of large and small firms have become steadily more important in the 1980s and some economists (Imai and Baba, 1991; Aoki, 1990) attribute Japanese success in world competition primarily to this feature of their organisation. Striking differences in sub-contracting relationships within Japanese and European networks have been analysed (Sako, 1992; Dodgson and Sako, 1993) and shown to affect, in particular, quality of products, technological upgrading, training and speed of response to market changes.

Although these advantages in flexibility and networking both within the firm and with other firms emerged already in the 1960s it was only in the 1970s and 1980s that computers became so cheap and so widely diffused and digital telecommunication networks so widely available (Table 2). The much-heralded "systemic" gains in productivity have taken a long time to achieve since they depend on changes throughout the system. The main effects so far are in the intensification of competition rather than productivity gains.

More clear-cut gains in labour productivity and still more in capital productivity may come through in the 1990s. They are already very substantial in the electronic industry itself. The US Department of Commerce announced the arrival of important "systemic gains" in the American economy in the fourth quarter of 1992 but the evidence in 1993 was still rather inconclusive. However, it is certainly to be hoped that these gains will increasingly come through both in the United States and in all other OECD countries in the 1990s. Whether they do so will depend on:

i) the strength of aggregate demand in the world economy and especially the strength of investment in new technology systems;

ii) the flexibility of labour and capital markets in responding to technical and structural change. It is usually the labour market which is singled out as "inflexible" but there is also evidence that the capital market is insensitive to the needs of SMEs especially because of high information and transaction costs;

iii) the policies pursued with respect to infrastructures, education, training and technology. It is to these questions that we turn in Section IV.

IV. POLICY ISSUES

It has been argued in Section III that ICT is an extremely pervasive technology and that despite its technical and economic advantages its successful diffusion has been possible only as a result of far-reaching organisational and managerial changes in firms and structural changes in industry. This has been a painful and prolonged process involving many conflicts and redundancies. However, this does not exhaust the extent of the institutional and social changes which are needed to create a hospitable environment for the new techno-economic paradigm. Some of these require public policies at various levels of government and these are the subject of this final section.

Whilst market forces are playing the main role in the contemporary situation, in promoting diffusion of new products, processes and services, public institutions and "quangos" (quasi and non-governmental organisations) continue to play an essential role too. A whole new system of standards, of regulation, of co-ordination, sponsorship and incentives is being slowly developed. This can happen only as a result of many different initiatives at all levels of government, which have been aptly described as "reinventing government". Institutions have both negative and positive effects. The "institutional drag" which holds back and frustrates new development has often been described and criticised, for example in the critique of "Euro-sclerosis" and in numerous attacks on large, inefficient bureaucracies, whether public or private. However, institutional reforms and new institutions can also have very positive effects in facilitating changes in the economy and in technology. New technologies and new management styles in industry exert their influence on government bureaucracies too. Just as the professionalisation of managerial bureaucracies in railways, in electricity companies and other large firms in the latter half of the 19th century led also to parallel change in government hierarchies, so today the management revolution in business sends ripples through government structures, attitudes and behaviour. In other cases, however, it is government practice which leads business, as for example, in more flexible working hours.

Not surprisingly, institutions vary enormously between countries, reflecting historical experiences, social and political conflicts, wars, the international division of labour, cultural traditions and much more. Again, unsurprisingly, this means that the institutional capability for change varies enormously. In some countries, the weight of institutional inertia and rigidity appears to lie heavy both on public and private institutions. In others, rapid changes in institutions almost keep pace with the changes in technology. This has led some economists, such as Eliasson (1992) and Olsen (1982), to argue that the mature industrial economies in Europe and North America are especially vulnerable to institutional drag, whilst others, mainly in Asia, show greater capacity for change.

Be this as it may, almost all economists would agree that there are some important functions for "reinvented" governments to perform. These often involve an entrepreneurial approach to government functions and a type of coordination and networking with industry and citizen organisations which is already evident in many OECD countries, but is a departure from much older traditional practice.

Among these functions are:

i) ensuring an adequate infrastructure for the new technologies;
ii) creating an environment favourable to the establishment and growth of numerous small and medium-sized enterprises (SMEs), and self-employment, especially in the new industries and services;
iii) development of new and reformed financial institutions to promote information systems and intangible investment;
iv) promotion of education and training policies to transform the skill profile of the workforce to match the new techno-economic paradigm;
v) dissemination of technical and managerial information and advice through a combination of public and private agencies;
vi) support of R&D programmes and projects to promote new applications of ICT as well as advances in basic technology;
vii) promotion of "structural competitiveness", especially in ICT;
viii) environmental protection and safety regulation, using ICT;
ix) promotion of good industrial relations and worker participation.

Policies of this kind already emerged in the 1970s and 1980s as a result of a trial and error process and the spread of best practice through observation, imitation and international competition. However, the process still has a long way to go and it is the main argument of this paper that the reinforcement of all these policies, together with other social innovations and experiments, is necessary for the OECD area to emerge from the structural crises of adjustment of the 1980s and 1990s onto a path of sustainable long-term growth.

This does not mean of course that these are the *only* policies which are needed. Indeed, they can succeed only in combination with other policies which emerge from standard Keynesian and neo-classical analysis of our present problems. It is not possible in a short paper to deal with each of these points in depth. Nor is it possible to deal with all the institutional variety in each Member country and the specific circumstances of social behaviour in each one. What follows therefore should be regarded as simply illustrative of the kinds of policies which are needed, together with some comments on those which are already being deployed in some countries.

The importance of the telecommunication infrastructure is obvious from all the discussion in Sections II and III above. An efficient network is absolutely essential to the conduct of modern competitive business anywhere in the world,

as became quite obvious in the last few years in Eastern Europe. However, the best example which illustrates the change in priorities for infrastructural investment is actually China. It is a relatively late change but all the more significant in view of the extremely rapid growth in the Chinese economy over the past decade. By the year 2000 China plans to quadruple the present (1993) capacity of the telecommunication network by adding 75 million lines. The arrangements and contracts with Alcatel, Siemens, NEC, Fujitsei, Ericsson, AT&T, Phillips, Northern Telecom and other suppliers provide for the local manufacture of switches and circuits as well as research centres for advanced technology. China is now the second largest market for Phillips and the fifth largest market for Ericsson. The Governor of Hebei province made clear the Chinese priorities in a speech in which he rejected the "old wisdom" that China would get rich by first building roads and then installing telephones and claimed that the opposite was now true. Other Asian countries such as Singapore and Hong Kong, with their heavy dependence on services industries and relatively high per capita incomes, are of course well ahead of China and ahead of many European countries in their advanced telecommunication networks. Singapore and South Korea in particular have followed extremely proactive policies in stimulating investment in their networks and advanced networking services. Japanese *regional* policy recognised already many years ago that the first essential condition to attract inward investment to depressed regions was infra-structural investment in telecommunications and airports. More recently, the great importance of "intelligent buildings" has also been recognised which may have an electronic content of 25 per cent of the total cost. Large office buildings are, in the Japanese way of thinking, "teleports", handling many different types of inward and outward information flows.

For all kinds of reasons the old mass production and use of automobiles with internal combustion engines is reaching limits of traffic congestion, air pollution, environmental degradation, acceptable accident rates and car ownership. The new ICT offers enormous possibilities for reducing (not eliminating) journeys to work, journeys to shop and other types of travel. In combination with public transport systems it also offers great possibilities for reducing traffic congestion and pollution in urban areas, as well as providing transport facilities for those who are at present deprived. It is into these areas that imaginative forward-looking schemes of public investment should be directed. Whilst ICT cannot yet be regarded as a "green" techno-economic paradigm, it does offer considerable possibilities for energy-saving and for reductions in the level of greenhouse gas emissions, preparing the way for more extensive changes towards sustainable development in the 21st century (Freeman, 1992). It is information highways rather than motor highways which are the great need today. It is doubtful whether a simple fiscal stimulus to the automobile industry and road-building programme is what is needed in any major industrial country. Indeed it is probably the

opposite of what is needed. It is all the more disappointing that some European public investment programmes are still putting the main emphasis on roads.

For example, the British recovery programme announced in the autumn of 1992, although providing for measures to stimulate the construction, road-building and automobile industries, made no mention of ICT. It could as well have been promulgated in 1932. This is all the more surprising as Britain has become one of the leading European countries in the digitalisation of networks, in the provision of new services and in mobile telephones. European countries have been very uneven in the speed with which they have moved but all have taken some steps towards new structures with greater competition in the supply of new equipment as well as new services. Nevertheless, the movement has generally been rather slow and hesitant by comparison with North America, where the extension of digital networks to households (making possible the growth of a wide range of new consumer services) has gone further than in the EC or Japan, despite the fact that an EC memorandum proposed major information highway investment already in 1988.

The United States, the EU and Japan have all announced policies in the 1990s involving Keynesian-type public investment programmes to stimulate economic recovery but there is still rather little emphasis in these programmes on the use of public contracts and procurement to promote the rapid advance and application of ICT. Perhaps the most imaginative emphasis on using public investment and procurement to advance new technology is in the United States pronouncements on *technology policy* (Clinton and Gore, 1993). The Clinton-Gore policy statement (February 1993) on "Technology and Economic Growth" states boldly:

> "American technology must move in a new direction to build economic strength and spur economic growth. The traditional federal role in technology development has been limited to support of basic science and mission-oriented research in the Defense Department, NASA, and other agencies. This strategy was appropriate for a previous generation but not for today's profound challenges. We cannot rely on the serendipitous application of defense technology to the private sector. We must aim directly at these new challenges and focus our efforts on the new opportunities before use, recognizing that government can play a key role helping private firms develop and profit from innovations."

The statement then goes on to specify in more detail how these bold objectives may be achieved for example by:

> "Redirecting the focus of our national efforts toward technologies crucial to today's businesses and a growing economy, such as information and communication, flexible manufacturing, and environmental technologies."

and

"Support for a national telecommunications infrastructure and other information infrastructures critical for economic expansion."

These new policies will be implemented through major changes in the Federal Government structure itself, in which:

"The new National Economic Council will monitor the implementation of new policies and provide a forum for coordinating technology policy with the policies of the tax, trade, regulatory, economic development, and other economic sectors."

Throughout, the statement places very great emphasis on the ICT infrastructure under the heading entitled "Information Superhighways". It also emphasises the creation of a national network of manufacturing extension centres which will give all businesses access to the technologies, testing facilities, and training programs they need. Federal funds (to be matched by state and local governments) will support and build on existing state, local, and university programmes, with the goal of creating a nation-wide network of extension centres.

It remains to be seen how far these ambitious policy proposals will actually be carried into effect with all the various constraints in the US budgetary and political system. Nevertheless, the proposed policy package is in itself a very significant event, marking as it does the recognition, at the highest level in the most powerful OECD country, of the importance of information technology policy issues and indicating constructive and imaginative thinking about these problems.

Although not so ambitious as the Clinton-Gore proposals, the EU and various EU member governments have put some stress on telecommunication investment and proposals for promotion of new technology generation and diffusion. These are very varied in different member States as might be expected in view of the variety of circumstances. Almost all, however, and even the new (1994) Japanese package, have been severely constrained on the one hand by the high interest rates, and on the other hand by the desire to reduce public sector deficits. This serves to illustrate the interdependence of fiscal, monetary and technology policies and the difficulty of escaping from some of the constraints imposed by the depth of the recession itself. It remains to be seen also whether the new Federal Government structures in the United States will prove successful in the co-ordination of fiscal, trade, regulatory and economic policies with technology policy.

Many economists of neo-classical or Keynesian persuasion might well agree with most or all of the proposals in the Clinton-Gore package. They are after all mostly concerned with areas of market failure which have traditionally been accepted as the legitimate concern of public policies and initiatives. Nevertheless, although economists might agree on many complementary aspects of policies for recovery and renewal of high economic growth, there is a real difference of

emphasis in the relative importance assigned to different aspects of these policy prescriptions. In every major cyclical downturn in the world economy (1830s, 1880s, 1930s, 1980s), these differences in emphasis have come to the fore.

In the early decades of the 19th century it was the British industrialist Robert Owen, who in his factory at New Lanark, in his writings and his political activity, most clearly provided an alternative to the prevalent pessimistic Malthusian trend in classical economics at that time. Most industrialists and economists in the early days of the Industrial Revolution tended to assume that population pressures and the necessity to sustain profitability would persistently drive wages down to or below subsistence level. Particularly in times of recession most industrialists and their political spokesmen insisted that social reforms, such as shorter working hours or restrictions on the employment of children would lead to the ruin of industry because they would reduce profitability and competitiveness.

Owen maintained that better work organisation, better education and training (he had his own school at New Lanark), social reforms, and superior technology would together make it possible to offset such downward pressures and indeed to raise profitability. There have thus been two main co-existing approaches to the restoration of profitability and the generation of new employment during cyclical downturns. The response of many firms and policy-makers is to try and cut labour costs by reducing the labour force and ultimately by reducing wages. It is often argued that minimum wage legislation and high social benefits are a cost which prevents job creation especially for low paid unskilled workers. This was one justification put forward in Britain for the abolition of the "Wages Councils" – organisations set up by Churchill in 1909 specifically to protect the lowest paid workers. This argument was also frequently used as the justification for the British Government's refusal to accept the "Social Chapter" of the European Union.

This illustrates two very different approaches to the concept of "flexibility". For neo-classical economics, flexibility relates mainly to the freedom of employers to change levels of wages and fringe benefits and to hire and fire labour. Only in this way, it is argued, can sufficient new jobs be created. The experience of employment generation in the United States in the past 20 years is often cited in support of this proposition, whilst the failure of the EU and EFTA countries to generate much new employment in the private sector is often attributed to greater rigidity in wages and social benefit systems. However, much new employment in the United States is also being generated in high wage ICT industries and services.

A somewhat different concept of "flexibility" emerges from the analysis in Section III of this paper: the flexibility of firms who have learnt to use ICT effectively to improve their products, processes and services and respond to new market needs more rapidly. This second type of flexibility may often be based on new forms of networking and involve co-operation between firms in improving

their technology and quality. Carlsson (1989) is one of many economists to point out that the firm's "flexibility" is much more than responding to price signals and demand fluctuations. It is the entire capability to cope with a turbulent environment. Increasingly, it requires flexible working *hours*, for the day, the week, the year and lifetimes (Hewitt, 1993).

It may be maintained in defence of the first approach to "flexibility" that it can generate large numbers of jobs quickly with rather little capital and little or no training, for example, in personal services, catering and distribution. In criticism of this approach, however, it may be argued that it may lead employers to neglect technical change and training and simply rely on low wages and unpleasant conditions of employment. Furthermore, the atmosphere of fear and anxiety engendered by confirming stable terms of employment and social benefits to a very small and diminishing core of key workers may have very adverse effects on corporate morale and social cohesion. A short-term approach to "human capital" may be just as damaging or even more damaging than a similar approach to fixed investment.

However, the alternative policy of mainly relying on technical and institutional change to improve industrial relations, revive investment, generate new employment and restore profitability cannot be effective if it is confined only to a few firms. These will have little or no effect at the macroeconomic level. Widespread diffusion, and multiplier effects are necessary. Steam engines were used on a small scale in the 18th century, but it was not until they were used for an entirely new transport system and for the mechanisation of most other industrial sectors that steam power could provide the impetus for the great Victorian railway boom of the 1840s, 1850s and 1860s which induced growth in many other sectors (the upswing of the second Kondratiev cycle). Long wave booms are necessarily based on very pervasive technologies with numerous applications and new opportunities throughout the entire economic system. This paper has argued at some length that ICT is such a technology today. Both the scale and the variety of these opportunities can revive confidence and stimulate animal spirits, but they can only do so when investment is on a large scale.

Herein lies the exceptional importance of public investment, infrastructural investment and institutional change during long wave downturns. New pervasive technologies require a very wide range of new skills; they require new management techniques and new organisational structures; very often they also require new forms of market regulation, national and international standards. This paper has argued that strong pro-active policies of the type proposed in the Clinton-Gore technology policy statement could contribute substantially to the alleviation of unemployment in the OECD area more generally and reduce substantially both the duration and the need for other approaches such as the reduction of wages and social benefits.

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LONG CYCLES, TECHNOLOGY AND EMPLOYMENT: CURRENT OBSTACLES AND OUTLOOK

CONTENTS

This article was written by P. Caracostas, an economist and adviser to the Directorate-General XII for Science, Research and Development of the European Commission (Brussels, Belgium), and by U. Muldur, an economist and member of the FAST-Prospective research team, DG XII-A-3, European Commission (Brussels, Belgium). The opinions expressed herein are the authors' alone and not those of the European Commission.

SUMMARY

The Schumpeterian dynamic has broken down. The scientific discoveries and technological innovations of 1945-75 have yet to generate the growth and new jobs which might be expected from sustained technological advance. The reasons for this predicament can be found in the slow pace of the socio-economic change needed to exploit technological opportunities, as well as in the at least partial failure of these advances to meet the needs of society and the world economy. Two areas for consideration and implementation are proposed for science and technology policies: the expansion of demand through the geographical growth of markets (technological adaptation through co-development with the countries of the South and the East, as well as with less developed portions of the industrialised world) and the development of products, systems and services that are better suited to society's needs, needs which are inadequately met by the market ("eco-technologies", health care, education/training, urban housing, and so on). Socio-economic research must also be stimulated to gain a clearer understanding of the non-technological, non-market factors that shape employment, with the role of government viewed from an overall perspective as that of a catalyst and a fine tuner, increasingly "subsidiary" to the grass roots initiatives of associations, businesses, unions, local and regional authorities, etc.

I. INTRODUCTION: BREAKDOWN OF THE SCHUMPETERIAN DYNAMIC

Technical progress plays an important role in modern growth theories, particularly since it is widely accepted that traditional factors account for only a fraction of economic expansion. On the other hand, the part it may play in downswings is often neglected, or its importance minimised. While technological innovations are generally acknowledged to be a growth factor, they are rarely seen as one that

could deepen a recession (see Freeman, 1980) – not in and of themselves, but through their interactions with private and social responses to innovation.

According to Schumpeter (1939, 1943), the development of capitalism is propelled by major innovations. The dynamic of innovation has two basic features: first, major innovations tend to be concentrated in a small number of sectors and, second, they do not spring up in isolation, but rather in intermittent clusters. These waves of innovation cause widespread economic disruption and induce a complex adjustment process which gives long-term movements a cyclical nature. For example, each Kondratiev cycle corresponds to a set of fundamental innovations. Schumpeter identified three such periods, with the first corresponding to the so-called "first industrial revolution" (1789-1812), the second driven by railroads and metallurgy (1842-94) and the third prompted by electricity, chemistry and the internal combustion engine (1898-1939).[1]

Schumpeter's disciples consider the post-war expansion – the "thirty glorious years" – as the ascending phase of the fourth Kondratiev cycle and believe that its downturn began in the early 1970s. This would make today's phase one of structural transition between two long waves.

At the end of the 1970s, which had seen renewed interest in the analysis of long-term movements, a number of economists in both the United States and Europe prompted widespread acceptance of the idea that recent technological innovations would enable Western economies to emerge from the depressive phase and to embark upon the ascending phase of a new cycle.

To summarise very briefly, these economists held that technologies (and particularly those in the areas of information and communications) would help to rationalise the productive system, solve chronic productivity problems and lower the relative prices of products, while at the same time stimulating demand by creating new products and services. The production and distribution of such innovations would theoretically create new jobs to offset those lost in automation of the productive system – provided that employment opportunities and skills could be successfully geared to the new demand generated by industrial and technological change. Along with rechannelling efforts into industrial and technological modernisation, a number of measures were supposed to be taken to facilitate swift and judicious industrial restructuring, whence deregulation and privatisation, as well as programmes to check currency fluctuations, lest monetary effects disrupt these structural transformations.

This appealing blueprint for recovery swayed many a political leader and provided the popular justification and theoretical foundation for the new industrial and technology policies that were implemented in the 1980s.

Today, in the early 1990s, one cannot but observe that despite a clear-cut victory over inflation, moderately successful liberalisation and significant industrial

and technological modernisation, Western economies have yet to cast off the shackles of weak, non-continuous economic growth, mounting unemployment and high real interest rates. When the promised growth failed to materialise after the Gulf War, policy doubts intensified: a willingness to put up with inflation, a certain resurgence of protectionism and a wariness of the industrial and technological modernisation policies said to foster unemployment are being voiced by an increasing number of politicians and business leaders.

Here we shall try to concentrate on this final point and determine whether science and technology policies can help lift us out of recession or, on the contrary, whether they make matters worse by helping to swell joblessness, the social cost of which exerts perverse effects on continued growth. First we shall look briefly at whether clusters of technological innovations coincide with growth phases and examine the type of innovation that generally takes place during downswings; the link between the changing content of innovations and mounting unemployment will be analysed. Secondly, we shall try to list all the attempted explanations as to why the most recent wave of innovations has failed to restore growth and full employment. Section III, finally, will look briefly at some possible new horizons.

II. TIME LAGS BETWEEN INNOVATION CLUSTERS AND PHASES OF EXPANSION AND RECESSION

The first Schumpeterian truth borne out by historians is the absence of continuity in the occurrence of innovations. Yet the link between waves of major innovations and faster economic growth is not immediate, since there is a time lag – which varies from one cycle to the next – between the design and development of new products and processes and the subsequent economic benefits in terms of expansion and job creation.

The time lag between innovation clusters and expansion phases

While the inventions relating to railroads and metallurgy preceded the 1842-94 cycle, it was not until the ascending phase of that swing that their applications were developed and spread rapidly, laying the foundations for the major innovations of cycles to come. The cluster of fundamental technological innovations between 1842 and 1880 already bore the seeds of all the great industries of the 20th century (electricity, consumer electronics, chemicals, auto-

mobiles, aeronautics and household appliances).[2] These essential innovations had no immediate impact on the industrial expansion of the day, with the obvious exception of those that had applications for textiles, the iron and steel industry or railroads.

A second cluster of technological innovations occurred during the descending phase of that same cycle, *i.e.* between 1880 and 1894, but this time it was more a matter of *product innovations* or improved applications of prior scientific or technological discoveries.[3] Practically all the innovations that were the pride and joy of the "thirty glorious years" following World War II had already been developed during this cycle, although they had been neither produced nor used extensively in the economy or in society.

The impressive research carried out by Landes (1975) clearly highlights this phenomenon. He states, for example, that "nothing significant really took off in the decades between the wars, which instead constituted a period of technical and commercial development for the discoveries of the pre-World War I generation" (p. 575 of the French text), and he proffers his pivotal hypothesis regarding the 1945-74 expansion, contending that the new science-based techniques did speed the pace of growth – but not in the 1940s or 50s. "Not surprisingly, the break came more around the time the initial innovation made its impact – that is, around the turn of the century. Viewed with hindsight, the expansion that preceded World War I was actually the beginning of an entirely new trend rather than a cyclical upswing from the lengthy depression of 1873-96, and it was only the intrusive influence of the war and its uneasy peace, with all its subsequent disorganisation and mismanagement, that kept the new techniques from bearing fruit..." (p. 706).

During the ascending phase of the following cycle, however, other major innovations were incorporated into these nascent industries.[4]

Aeroplanes, motor vehicles, chemical processes and techniques for transmitting, receiving, amplifying and tuning were perfected during World War I. Thereafter came another wave of innovations that could be classified as minor in that they triggered no notable technological advance but were designed rather to enhance product quality, reduce size or trim production costs.[5]

As a result, regular broadcasts of public radio and television programmes could get under way in the early 1920s and mid-30s respectively. For ten years after their introduction, both products experienced spectacular growth in production and sales, albeit at levels that would pale in comparison to the output and diffusion of decades to come. Despite the successful start, statistics for 1945-50 show that less than 20 and 3 per cent of post-war households in the major Western countries were equipped with radios and television sets respectively. The real global explosion in the production and consumption of these two mass-market electronics products would not come until the following decades.

Virtually the same analysis can be made for everything turned out by the most dynamic post-war industries. For example, the scientific discoveries that paved the way for those two spectacular modes of transport – aircraft and automobiles – also date back to the second Kondratiev cycle, since it was in the cycle's final years, *i.e.* between 1880 and 1894, that the first prototype aeroplanes and motor vehicles were developed. Improving upon them in the ascending phase of the following cycle was a series of countless innovations that enhanced speed, comfort and safety and cut production costs. Since both means of locomotion were initially considered to be instruments of war or luxury goods, their widespread manufacture and distribution did not begin, as with broadcasting, until the depressive phase of the same cycle, although even then there was no rapid market saturation.[6]

Nevertheless, given the complexity involved in manufacturing automobiles and aircraft (entailing the assembly of a spectacular number of semi-finished and finished products), advancing to the mass production stage required further innovations that were more techno-organisational than technological.

In this respect, one can only stress the crucial impact of Henry Ford's new methods of organising labour and compensation (Boyer, 1986). These techno-organisational innovations in the division of labour laid the groundwork for production lines, product standardisation and semi-automation of mass production processes. Such changes boosted efficiency and substantially improved production costs and consumer access to new products. Even so, by 1938 the number of cars on the roads totalled no more than 28 million in the United States and 8 million in all of Europe.

In this sense, the new markets created by the products and processes invented towards the end of the 19th century, and perfected through innovation clusters in the first two decades of the 20th, were far from saturated on the eve of World War II. It was not until the post-war years that all these great "structuring" innovations, *i.e.* those that revolutionised production methods and consumer habits, would spawn what F. Perroux called "growth industries".

Turning to the truly major innovations of the present-day cycle (1940-?), it can be seen that they too came about in technological clusters at the beginning and the end of the ascending phase, *i.e.* between 1935 and 1950 and between 1960 and 1975.[7]

Nevertheless, none of these innovations developed between 1935 and 1974 had any real immediate impact on the period's spectacular growth rate. None turned quickly into new growth industries, nor did any make a direct or immediate contribution to the job creation and productivity gains that followed World War II.

An example of this is computers – the major innovation of the first wave, spanning 1935-50. By 1955, some ten years after ENIAC was developed and two years after the renowned IBM 701 came onto the market, only ten or fifteen computers had actually been installed. By 1965, there were only about 31 000 computers in the entire world market of some $7.8 billion.[8] Such figures, even when placed in their initial economic context, show how futile it is to seek any theoretical or practical connection between the major innovations developed between 1940 and 1975 and the period's spectacular growth rate.

In line with the lag that historians and economists have detected between the emergence of great scientific or technological discoveries and their transformation into new sectors of economic activity, these major innovations would not begin to have any significant economic impact until much later, *i.e.* until the 1980s.

We therefore observe that there is no correlation possible between the major innovations devised during a given period and the concomitant rates of expansion of national economies. Because the inventions and innovations developed during a long cycle generally lay the groundwork for the economic recovery and expansion phases of the subsequent cycle, the benefits of recent innovations cannot be counted on to rekindle economic growth and create jobs in recessionary times. The existence of this time lag – whether or not it is tending to get shorter in the long term – requires that a number of other economic and social factors coincide to allow the beginning of a new cycle during which the major innovations of the previous cycle will make their full impact by sustaining expansion and creating jobs. It is therefore impossible to climb out of recession merely by pressing full steam ahead with technological innovation.

Moreover, it is clear that research and technological development policies – particularly in the public sector – are not subject to frequent shifts in strategy and direction. "Priority" fields of scientific and industrial research, as well as the terms of and prerequisites for public and private funding, change very little over the short and medium term. Shifts in this area from one decade to another often amount to little more than minor adjustments corresponding to gradual reappropriations within each R&D budget as new "priority" fields emerge and prior technico-industrial options become less important. For public sector R&D policy, the long term frequently spans more than 20 years, whereas in other areas of government policy it covers less than 10 (as with industrial and trade policy, whereas for financial and monetary policy, the long term means two years).

This apparent continuity in technology policy directions contrasts with the cyclical aspect of economic movements and the diversity of technological innovations. So while it is generally deemed natural to tailor trade, industrial and financial policies to the prevailing economic phase – depression, recession, recovery or expansion – research and technology managers have yet to start gearing R&D policies to hard times or prosperity.

The predominance of process innovations in depressive phases

And yet, innovations arising during depressive economic phases have neither the same intensity, the same characteristics nor the same effects as those that occur in times of prosperity. Over the past twenty years, scholars have kept up a significant debate over the dissimilarity of invention clusters in economic periods that are structurally different.

While specialists generally agree that innovation flows are not constant over time, there is no consensus as to their grouping or correlation with phases of prosperity or recession. Mensch (1975, 1979) appears to have been the first to formulate the "depression trigger" hypothesis, which holds that economic downswings favour the emergence of major innovations. The theory has sparked much debate, but to date there has been no empirical evidence to back it up.[9]

Close analysis of the time series presented in this literature, from two different perspectives – one assessing each innovation's techno-industrial importance (major or minor) and the other focusing on its scope of application (product or process) – prompts a slightly different conclusion. During the ascending phases of each cycle, two distinct phenomena may be observed: first, the practical implementation and widespread distribution of the major innovations developed during the previous cycle; and second, the discovery of product innovations which will not become widely used until subsequent cycles. As van Duijn (1983) has noted, product innovations, and particularly those that give rise to new industries and help create jobs, appear at the beginning of ascending phases, *i.e.* during economic recoveries.

An improved economic climate, and especially prospects for rising demand and renewed corporate margins and cash flow, increase the propensity to innovate (Schmookler, 1968) and make it easier for public and private-sector investors to lend substantial support to R&D projects that entail greater risk, yet at the same time are radically new and offer great economic prospects.

During descending or depressive phases, innovations do abound, but they are either minor (*i.e.* tending to improve or differentiate existing products or processes) or have to do with processes (enhancing productivity or trimming production costs by saving on raw materials, energy or labour).

Freeman (1979) was one of the first to emphasize these changes in the contents of innovations and in the directions of R&D policies which characterise the transition from the ascending to the descending phases of a Kondratiev cycle. He does not really explain the reversal in trend, but his analysis does make a connection between rising unemployment and changes in the technological dynamic. During a cyclical upswing, the most important innovations and new products turn into profitable new industries. The subsequent spillover benefits for

the entire productive system lead to sharply higher output and employment. The shift downwards, which begins with the end of the new industries' exceptional expansion, is marked by two basic trends. The first is an increasingly pronounced swing in R&D and technological change towards the objective of cutting production costs, chiefly through savings on labour and materials. In addition to this trend, and closely related to it, is a move towards greater capital intensity. Both play a decisive role in the mounting joblessness characteristic of long-swing depressive phases.

Whenever the creation of new processes becomes intense and outpaces that of new products, it results in an intersectoral imbalance well known to economists: consumer goods industries cannot keep up with the capital goods sector's strong and accelerating expansion. Ultimately this leads to a conflict between margins and markets which causes a profitability gap between sectors, along with surplus output of production factors, with negative repercussions for employment.

As a result, in the depressive phases of long cycles, which are marked by a slowdown in major innovations and a proliferation of innovations that offer improvements, the price of technology-intensive equipment tends to decline. And if labour market or payroll rigidities preclude a parallel drop in labour costs, the widening gap between those costs and the cost of technology will prompt firms exposed to international competition to substitute more capital for labour.

Heightened competition in depressive phases shortens private investors' time frames and encourages them to select only those projects that can turn a quick profit. In addition, it hardly prompts public R&D investors – also facing financial constraints – to adopt selection and financing policies that would be any different, and that could break the vicious circle gradually taking shape. Then, as process innovations and product improvements pour faster and faster into the world market, new product price tags continue to fall, and a form of automation that evicts human labour from the production circuit becomes "profitable" – and the only way for businesses to survive the competition.

III. WHY RECENT WAVES OF INNOVATION HAVE FAILED TO RESTORE GROWTH AND CREATE JOBS

Why is it that the scientific and technological discoveries made between 1945 and 1975, which had no immediate impact on economic growth at the time, did not subsequently trigger a new growth cycle? Particularly as 1975 saw the emergence a new wave of innovations – the third in the cycle which began in 1945.[10]

The possible answers to this fundamental question fall into two categories: the first emphasizes mainly socio-economic and non-technological phenomena, while the second looks at how different waves of technological innovation have varied in nature.

First group of explanations: the technological innovations were not accompanied by other economic and social innovations

The first major argument put forward in the various pieces of research on relations between technology, employment and growth is that there is no shortage of technological innovation, but that the economic and socio-institutional changes needed for technological progress to be turned to better account and disseminated failed to materialise. In other words, contemporary society was unable to adapt to the new technological paradigm and take advantage of the potential benefits that it offered.

In seeking to establish whether waves of technological innovation corresponded to phases of economic growth, we earlier (involuntarily) confined the scope of the concept of Schumpeterian innovation to technological progress alone. The concept is, however, very broad and extends to the structural changes that have taken place in a great many areas such as the organisation of production, consumption, distribution and financing channels and domestic as well as international institutions. Taken in conjunction, these factors have indubitably played a decisive role in the reversal of previous cycles.

There are, by definition, two ambivalent characteristics peculiar to all major innovations, namely that they both destabilise and downgrade. They challenge the distribution of responsibilities and powers within business and in society, require wholesale changes in the way the latter are organised and downgrade all structures and knowledge which do not alter and adapt to the changes under way. The result is that resistance and rigidities build up in the various segments of economic and social life, impeding the in-depth changes required in order that major innovations can be effectively incorporated in institutional, economic and social structures.

It is therefore up to the authorities to contend with this natural collective resistance to change by showing the social strata and industries hardest hit by the "technological turning point" reached by the productive system[11] that there are prospects for advancement or compensation.

Many comments can be made on the basis of this theoretical approach.

First, wage relativities moved into crisis in the 1970s, and none of the attempts to do better than mass production along Henry Ford lines has so far resulted in the introduction of a new method of work organisation. Yet during the

previous Schumpeterian transition crisis, mass production made it possible to surpass 19th century wage relativities and adapt wage-earners to the new technical/organisational constraints of the time.

Many experts believe that the introduction of the latest technologies in both factories and offices has been a failure in that advanced process controls have quite simply been grafted onto the old Taylorist/Ford-type structures with the sole aim of increasing labour productivity.[12] The only real changes in business organisation (quality circles, Kanban system, Lean Production, Toyotism, etc.) are those borrowed from the Japanese. According to Coriat (1991),[13] Japan, which seems to have been more successful than the Western countries in adapting to the most recent technologies, began back in the years 1950-60 to think about how to devise the organisational and industrial structures best suited to the new technologies and also to its own socio-cultural traditions.

It can therefore be argued that the changes in the organisation of work and in labour management needed to take full advantage of the new technologies have not really taken place in the West.

Second, it is true too that the inter-war years also saw a great many economic, commercial and institutional innovations: new distribution channels (supermarkets, hypermarkets), new bank instruments of payment, consumer credit, hire purchase, leasing, the professionalisation of marketing and advertising, the introduction of rules governing competition, new banking regulations. Major changes were also made in the management of the world economy.

Thanks especially to the undisputed leadership of the United States at the end of the war, practically all the major international institutions to come into being during the "thirty glorious years" were set up in record time. The years 1945 to 1947 saw the establishment of the IMF, GATT, the World Bank and the OEEC, while countries' positions on foreign trade moved closer together and the Bretton Woods agreements brought a new international monetary system into being.

Comparing the above changes with the innovations of the 1980s is an interesting exercise. At domestic level, today too there are an impressive number of innovations: home shopping, teledistribution, home banking, telepayment, work at home, etc., though these are not as yet very widespread, except in a few countries. In almost all countries, on the other hand, banking systems have been updated as a result of financial, (de)regulatory and technological innovations.

Where international organisations are concerned, however, there has been no real reform, with both the policies they have implemented and their methods of organisation remaining fundamentally unchanged for almost fifty years. The basic principles of the GATT, for example, have not been updated even though multilateralism has retreated where trade is concerned and regionalism has progressed during a period which has seen the creation and development of many regional integration or free-trade areas (EU, EFTA, NAFTA, LAIA,

MERCOSUR, ASEAN, BSECA, SARCA, etc.). It is difficult, though, to say to what extent the present world leadership crisis is impeding the institutional and economic changes needed at world level.

Increasingly, however, it is being recognised that at neither the national nor the international level has it been possible to carry out all the socio-economic and institutional adjustments that are necessary if all the positive effects of technological change are to be felt by our economic systems.

Second group of explanations: the recent wave of technological innovations and the accompanying R&D policies are not adapted to the needs of society or the world economy

This second approach, unlike the first, is based on analysis of the ways in which the characteristics of recent waves of technological innovations differ from earlier waves. A comparative analysis of technology clusters during the last two cycles points to four major changes:

The output of present-day advanced technology industries involves little job creation

There can hardly be any need to repeat the fact that a great many jobs were created in the post-war growth industries. By comparison, the new information and communication industries are not generating as many jobs as, say, the automobile industry during the post-war period.

Another important feature of the new technologies of the 1980s is that they are also used in the automation of their own sectors of production, robots for example being used in the production of other robots or electronic components, expert systems in that of software packages or advanced process controls, biotechnologies in that of new materials or new molecules, etc. In this sense, industries based on advanced technologies are also their own customers, and this is something that substantially reduces the sector's capacity to create jobs.

An attempt has been made here to calculated the total number of jobs created in these industries worldwide. For reasons which have mainly to do with job classification by industry, it was only possible to include in the estimate jobs created in data processing, consumer electronics and telecommunication equipment.

Table 1 shows that, despite substantial public and private investment in the 1980s, total employment in these sectors in 19 industrialised OECD countries declined by 69 000 between 1981 and 1989, the 492 000 jobs created during the first half of the decade being more than offset by the massive losses recorded during the second half.

Table 1. **Employment trends in the sectors producing new information and communication technologies**[1]

	Jobs			Changes		
	1981	1985	1989	1985-81	1989-85	1989-81
Japan	986 000	1 284 000	1 301 000	298 000	17 000	315 000
United States	1 585 000	1 741 000	1 204 000	156 000	–537 000	–381 000
EC[2]	1 373 000	1 396 000	1 365 000	23 000	–31 000	–8 000
Other industrialised countries[3]	157 000	172 000	162 000	15 000	–10 000	5 000
OECD (19 countries)	4 101 000	4 593 000	4 032 000	492 000	–562 000	–69 000

1. Corresponding to the two sectors: "Office and Computer Machinery" and "Radio, TV and Communications Equipment" in the OECD nomenclature.
2. Excluding Belgium and Luxembourg.
3. Excluding Australia, Iceland and Turkey.

Source: Based on OECD *Industrial Structure Statistics, 1989-90,* and INSEE (1991), *Enquêtes sur l'emploi.*

It is true that differences in countries' competitiveness play a part in the international breakdown of total employment in these two sectors. Job losses were, for example, much more extensive in the United States than in the EC, while Japan succeeded in creating a total of 315 000 jobs in the new information and communication technologies, even though there too there was a slowdown in job creation in the second half of the 1980s. It is also true that the number of jobs created in the developing countries, especially in South and South-East Asia, is not indicated in the preceding table.

At world level there are not many figures available on employment trends in the information and communication technologies sector. A 1992 EC study on 73 of the biggest companies in the data processing, consumer electronics, electronic components and telecommunication equipment industries does nevertheless provide some interesting information on trends in employment worldwide. The first point of note is that the total number of jobs in these four industries rose rapidly between 1980-86, from 3 to over 3.4 million worldwide. The rate of job creation slowed appreciably in the second half of the last decade, and the total number of jobs in these four industries throughout the world was put at 3.6 million in 1991. The slower pace of job creation stemmed in reality from a substantial fall in the number of jobs in European and American industries, the South-East Asian countries (including Japan) succeeding in creating more than 600 000 jobs, while in the rest of the world employment in the four industries virtually stagnated. One explanatory factor was job transfers resulting from industrial relocation to other countries, but when the jobs created by western multinationals in the countries of South-East Asia are balanced against those created by Japan or the Dragons in

Europe and the United States, it is apparent that the phenomenon is not as significant as might initially be thought.

According to the same study, there were in 1991 almost 95 000 employees of European firms resident in the countries of the Far East, while the latter countries' firms had almost as many employees in Europe (92 400). The same balance for the United States shows a deficit of some 152 000 employees.

These figures do not confirm the theory that there have been massive job transfers from the West to South-East Asia – not at least in the four industries in question. Also, a growing proportion of the output of information and communication technologies industries in the Far East is consumed in the region itself. So further explanations for the continuing creation of new technology-related jobs in this part of the world are Asia's spectacular economic development in recent years, plus buoyant demand for high-tech products and services on these markets which are still by no means saturated. It follows that, over and above questions of differences in competitiveness and job transfers, there are explanatory factors which have to do with the relative saturation of Western markets and the general depletion of the growth dynamic in the West, and in Europe in particular. Also of importance is that massive layoffs in the information and communication industries only began between 1990 and 1993 in the Western countries, at a time when direct investment by European and American firms in the countries of South-East Asia was showing a distinct downturn.[14]

It therefore seems highly likely that the worldwide slowdown in job creation observed during the second half of the previous decade will be followed, in the 1990s, by the stagnation of the total number of new-technology-related jobs throughout the world.

With the volume of employment stable worldwide, national technological competitiveness strategies can but result (where employment is concerned) in job transfers from one country to another, but without this having the effect of reducing actual unemployment levels in these countries.

The strategy of investing in new technologies in order to solve the unemployment problem[15] therefore needs to be completely revised, if only concerning the way in which public and private funds are invested in these sectors.

As for the argument that technological competitiveness strategies can result in the creation of a great many jobs in user sectors, this still has to be proved by means of in-depth sectoral and quantitative studies. In particular, it has to be shown that, at both domestic and world levels, using new technologies in these sectors creates more jobs than it takes away. To the best of our belief, no scientific study has as yet provided indisputable empirical evidence of this.

The new products deriving from information technologies are very varied in their applications

This is particularly true in that one of the most important characteristics of the new products and systems stemming from the recent wave of innovations is that they can easily be substituted for both manual and intellectual work. Moreover, whereas technological innovations tended in earlier cycles to be applied in just one sector, information and communication technologies and biotechnologies tend to be multisectoral in their applications. As a result, no sector of the economy is really safe from job-reducing automatisation, though this applies especially to the tertiary sector which, up until the 1970s, had had to contend with just the telephone, typewriter and punched card, but has now been invaded by a whole series of advanced process controls (mini and microcomputers, fax machines, photocopiers, telematics networks, DAB/GAB, TPV, Minitel, etc.).[16]

There are, in addition, three other major differences between the products which were new in the 1980s and those that appeared between the two wars. First, today's technologies consume far fewer raw materials, intermediate goods and energy than do cars, telephones, radios and televisions which, at the time, increased intersectoral demand for goods produced by such traditional sectors as steel, electricity, plastics, wood, etc. Few traditional sectors are today benefiting from the increased production of the electronics and data processing industries.

The second difference concerns the jobs created in the tertiary sector. As a result of the massive increase in automobile sales, many jobs were created in such areas as garages, dealers, driving schools, motorway construction, public utilities, motor car insurance. The jobs that data processing nowadays creates indirectly in service activities (software, agents, maintenance, consultants, training) are in the first place far fewer in number (the average life expectancy of a car in the 1950s was 15 years, while today's new products are rendered obsolete after some 3 to 4 years' use by the next generation of the same products), and secondly they correspond to skills that are less affected by unemployment.[17] As for other recent technological innovations (Robot, MOCN, microprocessors, biotechnologies, etc.), they create almost no new jobs outside their own sectors of production.

The third major difference has to do with the fall in the price of present-day innovative products, which is much more rapid than in the case of innovations dating from earlier cycles. Over and above its sectoral and microeconomic effects, this phenomenon also has a macroeconomic impact. Whereas cars, televisions and household appliances prompted households to save in order to be able to purchase them, it is very difficult in the present context of a structural fall in the savings ratio to say that the present generation of new products provides the same sort of incentive. Since their purchase prices are low, they can often be bought by means of consumer credit.

There are too many process innovations and few genuine product and consumer innovations

With post-war R&D policies focusing on the defence, aeronautics, nuclear and chemical industries, what product innovations there were in these sectors tended to have defence applications (rockets, helicopters, etc.) and had little impact on the pattern of household consumption.

A close look at the innovation clusters of the last few years reveals that there have been an impressive number of process innovations aimed solely at the corporate market. It is also noticeable that there have been very few really new products. The vast majority of product innovations are designed to update old products such as the telephone, the television, the automobile and traditional household appliances. Usually they serve to accelerate the pace at which old markets are renewed, but do not widen the range of existing products and create new markets. Yet one of the major challenges of our time is the tendency for markets to become saturated.

All the post-war growth industries became modernisation industries during the 1980s. According to various estimates, between 80 and 95 per cent of households in the Triad countries now own a car, main residence, television, hi-fi, dishwasher and other domestic appliances.

The only new product innovations which have become part of the standard pattern of household consumption, such as video-tape recorders, camcorders, personal computers and electronic charge cards, have also spread rapidly and the growth of their present markets depends more than anything on the emergence of new applications which will make them more useful (consumption innovation).[18]

It is difficult not to see the scarcity of genuine structuring product and consumption innovations as a consequence of the mistakes made in the thrust of R&D policies.

Until the end of the cold war, R&D policies in both the United States and also France and the United Kingdom were mainly geared to the concerns of the military-industrial complexes. The excessively defence-oriented stance of R&D policies has been criticised in many studies, leading as it did to process and product innovations which had no real uses for the economy or in civil life. It has been stressed on countless occasions that Japan was able to take advantage of this situation in the years between 1960 and 1970, focusing its R&D policy on consumer product innovations which of course proved extremely successful. In the late 1970s, another criticism was that there was also too much emphasis in the West on basic research, whereas Japanese firms were concentrating on applied research which was likely to prove commercially successful much more quickly.

As a result of this criticism, R&D policies were redirected in the 1980s towards industrial competitiveness. This meant mobilising a country's R&D capacity in order to respond to its industries' immediate needs. Because of the general rise in interest rates in the 1980s, the tendency was to select and finance those R&D projects which were likely to yield concrete and profitable results in the short term, sometimes at the expense of R&D projects which did not at first sight appear to have industrial applications, or which were only going to show a profit in the long term.

With the United States and the European countries having begun to focus more on applied and industrial research, various studies now show that Japan is in the process of changing the thrust of its R&D policy, insisting more on the major role that basic R&D plays in long-term economic growth. This seems all the more appropriate in that applied research which targets existing products and processes in order to improve their quality and adaptability, or reduce *their production costs*, is not of much assistance in getting out of the present crisis. For a new, long economic growth cycle to commence, there must be another scientific and technological "break" of the sort which will result in new products suited to society's new requirements.

Any genuine crisis-oriented public R&D policy ought therefore to be designed to protect against or moderate markets' natural tendencies during depressive phases, *i.e.* it should counter any accentuation of their preference for minor product improvement and differentiation innovations, and also for process innovations and the selection of projects which are profitable in the short term, all three being dictated by the competitiveness constraints accentuated by periods of recession. To prevent the ascendancy of these private preferences, the authorities should on the contrary seek to restore the balance between financial, industrial and political considerations in the thrust and financing of technological R&D (see Muldur, 1991).

In practical terms, this comes down to proposing that, during crisis periods, they should support and finance more projects targeting product innovations and/or requirements that are ignored by the market because they are not profitable in the short term. They should also include job creation as an objective in their technological priorities, at least by not giving financial support to process innovation projects which save on labour (except in the case of unpleasant or dangerous jobs).

This sort of radically new concept of public R&D policies, adapted to the characteristics of innovations in depressive phases of business cycles, was neither tried nor taken seriously until the early 1990s.

The main objective of public R&D policies in the 1980s was to back the market in its preference for competitiveness, productivity and financial logic. This

the authorities did instead of attempting to regulate or counter market defects – accentuated during depressive phases – by putting forward government preferences other than those motivated by short-term competitiveness and financial logic.

The returns on R&D investment diminish

The thrust of this relatively little known argument is that today's industrialised economies are having to contend not with the depletion of the effects of a wave of innovations, but with a much more widespread and radical crisis in "modern" technology as such, deriving from the characteristics it has acquired over the last two decades.[19]

First, the rise in R&D costs is the inevitable result of technology being science-based and needing time to become established. The whole process, from basic research to the final product, is becoming much longer and more complex. New technologies involve combining more and more numerous activities, as a result of which research costs increase and the design time for major innovations lengthens. To this must be added the fact that research can no longer be carried out with the help of relatively simple instruments, as in the past; instead it requires laboratories that have to be increasingly well equipped by ever more costly systems.

In 1970-71, the world spent $64.3 billion on R&D, *i.e.* some ten times more than total spending between 1950 and 1960. In 1990, R&D spending totalled $430 billion, meaning that as much was spent in the space of one year as during the "thirty glorious years" following World War II. The ratio of the industrialised countries' R&D expenditure to their total GDP rose steadily between 1960 and 1990; however, a country analysis does show that growth rates differed, being higher in countries like Japan, South Korea and China.

Second, R&D projects are costing more and more to finance. Post-war methods of R&D financing, which were not very selective and were based mainly on raising relatively inexpensive financial resources in compliance with the regulations, began to be inadequate as of the early 1970s. Financial logic, which prompts R&D investors to select projects according to the level of risk and short-term profitability in order to ensure the highest possible return on capital while keeping the level of risk within reasonable bounds, finally gained the upper hand on the other two criteria, industrial and political, which gauge project usefulness in terms of long-term competitiveness or social progress and collective welfare.

The share of public funds diminished and R&D financing became increasingly subject to the constraints of the market. The authorities also sought to put public funds more into the financing of industrial R&D projects which would be

profitable in the short term than into long-term projects which were free of the constraints of competitiveness.

These changes in the manner of choosing what R&D projects to finance took place against the background of a general increase in the cost of capital,[20] a factor which has further increased the cost of financing technological investment projects. Also, the major characteristics of R&D activity (high risks, incomplete appropriability of profits, indivisibility, etc.) make it practically impossible for all R&D projects – and especially those involving basic research – to be financed and implemented in a competitive market economy.

The outcome is that the method of financing now predominant, in which public financing is tending to decline and to follow in the footsteps of private investors, enforces a method of selection that gives an advantage only to minor innovations or improvements.

Third, there is a tendency for the private and social return on technological investment to diminish. The decline in the overall efficiency of technology may be attributed to several series of factors. The development of innovations offering improvements quickens the pace at which productive and financial assets decline in value. Product life cycles shorten and technologies soon become obsolete – after two or three years' use and in any event as soon as the next generation of the same product is announced. Coupled with the rapid obsolescence of technologies is the accelerating depreciation of the productive assets and know-how that gave rise to previous generations of technologies.[21]

What, for example, is the value nowadays of the scientific and industrial know-how which served to produce the 1 kilobyte DRAM memories introduced in 1970, one unit of output of which cost $20 million, and what will be the value tomorrow of the 4 megabyte memories introduced in 1989, one unit of output of which today costs $600 million?

Because technological competition is now so fierce, all the firms involved have to have a survival strategy, the economic and social consequences of which are considerable. Firms are now having to invest more and more in R&D in order to bring out new products which have to be manufactured and marketed at an increasing tempo on the world market in order to amortize the investment rapidly and show a profit, a growing share of which will go back into financing new innovations making improvements which will render obsolete some of the technologies developed a few years previously. This vicious circle is to be found nowadays in almost all industries exposed to international competition (data processing, electronics, automobiles, machine tools, etc.).[22] It favours "incremental integration innovation", *i.e.* the constant improvement of elements/components of the product and of the way these elements/components fit together, and hence

economies providing variety and the "modular" management of products and systems.

The private return on these investments, which are increasingly costly, are less and less easy to amortize over a short period of time and serve only to rekindle demand in markets approaching saturation, can only continue downwards.

As for the gradual decline in the social return on technology, this can be attributed to two phenomena. First, the gains in terms of the value derived from use, which are perceived by consumers when there is a change in technological generation, diminish (from subsonic jets to supersonic aircraft, from an old series of integrated circuits to a new series, from one microcomputer to another which has more capacity and is faster, from the traditional to the cordless telephone). Second, new negative externalities for society are added at each stage. A great many experts have emphasized the increase in external costs attributable to technological development (overexploitation and depletion of natural resources, pollution, interference with the ecological balance, negative effects on health, loss in value of traditional know-how, problems relating to technological complexity and safety, unemployment, etc.).

Combined, these factors have the effect of lowering the return on technological investment both for companies and for society as a whole. The structural deadlock with which "modern" science and technology are now confronted therefore means completely revising our R&D policies and introducing new international rules for the utilisation of technological R&D as a means of world economic competition.

The common theme underlying these four groups of factors is that new technological innovations, which are the outcome of corporate strategies and scientific and technological policies, are not very well adapted to the major economic and social problems of our time.

IV. NEW HORIZONS FOR DEMAND: GEOGRAPHIC GROWTH OF MARKETS AND THE DEVELOPMENT OF "SOCIO-INDUSTRIAL COMPLEXES"

The two (hypo)theses analysed above are obviously not really separable. The Western countries' options with regard to scientific and technological policy must undoubtedly shoulder some of the responsibility for the emergence of the recent wave of technological innovations which have contributed to the rise in unemployment but have failed to rejuvenate markets, broaden existing product

ranges and increase the rate of economic growth and development. At the same time, it cannot be denied that the rigidities of our productive structures and the reactions to socio-institutional change have made it impossible to take full advantage of existing technological innovations.

These two phenomena mean that, in order to meet social aspirations, radical changes are now needed in the production and utilisation of technologies.

With the level of structural unemployment in the Western countries rising (recent studies stress that, even if there is an economic upturn, unemployment will fall only slightly), against a background of globalisation of national economies, all "national solutions" which do not take account of the growing interdependence of economic and technological policies are unworkable. Obviously, therefore, all the solutions now being looked at as a means of stemming unemployment and boosting economic growth depend on more extensive international co-operation. There can be no "national salvation" in the context of a globalised world economy.[23]

The world productive system, the capacity and quality of which have been improved appreciably by new technologies, is now efficient. The problem is no longer one of increasing the system's productivity and overall effectiveness, although it could perhaps be argued that there are still some domestic industries which are not very competitive, but which survive thanks to government subsidies whose cost is borne first and foremost by the countries concerned.

The real problem, therefore, lies rather in the fact that this efficient productive system is under-performing because it is only producing for a market of 750 million effective consumers. Optimum use of the productive capacities of the Western countries, *i.e.* of their advanced technologies and skilled labour, is only possible if *new development areas* or *new spheres of consumption* can be found. Economic history tells us, however, that there are only two ways of achieving this.

The first involves *expanding the effective market at world level.* This means new countries joining the rich, industrialised countries' club which, in the early 1990s, no longer seems improbable. Some twenty countries are at present on the sort of growth path which should bring them into the industrialised countries' club (Korea, Singapore, China, Taiwan, India, Mexico, Turkey, Israel, Brazil and certain central and eastern European countries). Increasingly, these countries' development and solvency depend on the continuation of their exports to one another (regionalisation) and to the industrialised countries. With their participation, the world productive system could function in such a way as to meet the requirements of a market of more than 3 billion people. This sort of expansion of effective demand would be such as to help ensure that productive capacity in the Western countries was fully utilised. However, this prospect means implementing a series

of economic and institutional reforms aimed at introducing a new international division of labour.

In particular, the sacrifices that the Triad countries would have to make in the short term, because of exports from countries with low incomes and low levels of environmental protection, would only be politically acceptable if new world regulations could gradually ensure a minimum level of social and ecological protection everywhere. This somewhat optimistic postulate concerning a new North/South compromise at world level seems at present to be coming up against neo-protectionist tendencies which, in the United States and Europe in particular, are gaining momentum at the same time as unemployment is dividing society and accentuating social exclusion. All of which means that thought must be given to public and private strategies for the short, medium and long term. Where business is concerned, the challenge is to locate massively and lastingly in Asia which, increasingly, is coming to be seen as a vast growth area to be taken advantage of not just from a Triad point of view (relocating in order better to compete with other Triad firms), but also from a regional standpoint (setting up in an area which is becoming integrated). For the authorities it is a question of encouraging, wherever the need is felt (in Asia, but also in Latin America, the former Soviet Union and Eastern Europe, around the Black Sea), the consolidation of large "regional" markets while at the same time paving the way for a new world multilateralist framework (commercial and competitive) designed, in the long term, to achieve economic, social and environmental convergence between regions of the world that are at present so different. As far as technological R&D is concerned, therefore, private strategies and public policies need to take account of these world factors by seeking, through co-operation based on mutual interests, to shift the focus of research in such a way as to satisfy more fully the requirements of restructuring or developing societies. Another objective of the developing globalism of "scientific mega-projects" (in such areas as the global change in the environment, oceanography or space)[24] could be to find solutions to the problems specific to the lives of billions of men and women living outside the Triad (*e.g.* major flood prevention, tropical diseases, specific details to do with the fight against AIDS, hybridisation of new technologies and traditional know-how, local energy systems, management of large towns, conversion of Eastern Europe's command economies and military-industrial complexes, etc.).

The same way of "geographically" expanding the world market can be applied within the areas of the Triad by *harnessing the regions' growth potential* at sub-national level.

Within the European Union, for example, the new political concept of "economic and social cohesion" introduced by the Single European Act (1987) relates specifically to this dimension: in addition to the political overtones reflecting solidarity between unequally developed areas, co-operation between industrialised

European regions and regions where development is lagging behind also has its economic significance. By encouraging the endogenous growth of "peripheral" regions (in particular Greece, Ireland, Portugal, the Italian Mezzogiorno and a large part of Spain), demand can be generated which will benefit all the countries of the Union. Matching this is technological R&D policy, the object of which must also be to channel European research towards satisfying these regions' specific requirements (*e.g.* research into population drain, local energy systems, rational management of primary resources and the diversification of ways of using agricultural raw materials, etc.). Research of this sort will also help to develop a programme of scientific and technological co-operation with the developing countries, some of which at least are experiencing similar problems. Such research will be based more especially on the emergence of increasingly numerous instances of co-operation which occur spontaneously between European regions, bypassing national frontiers.[25]

The second alternative would be to seek to *expand the scope of the Triad's productive system by generating "new spheres of consumption".* This depends entirely on the emergence of new product innovations capable of transforming present production and consumption standards – an example being the automobile between the two wars. But this again presupposes international co-operation aimed at freeing scientific and technological development from the constraints of short-term competitiveness and channelling the industrialised countries' R&D capacities into designing and realising new fundamental innovations which will bring about a change in the technological paradigm and the start of a new long cycle.

The Scandinavian countries have for some years been discussing the possibility of establishing "socio-industrial complexes" (borrowing from the "military-industrial complex" notion) geared towards responding to social requirements as regards energy, housing, the environment, transport and health care.[26] The authorities and society (in the sense of the various socio-economic players) would have a specific role to play in this context, namely that of "precursory consumer", *i.e.* a demanding user who, through a "consumer learning" process, would promote the realisation and constant improvement of new products, systems and services in response to a potential demand from society.

There are, in our societies, growth "deposits" which could be exploited inasmuch as latent requirements can be turned into effective demand. The economist L. Pasinetti argues, too, that when productivity grows and demand for existing consumer goods is satisfied, consumers have to learn new requirements in order to prevent "technological unemployment".[27] Public technological R&D policies can further this process at two levels: first, by setting research targets designed to encourage the emergence in the medium term of these radical socio-technical innovations and, second, by transforming the way they interact with society,

i.e. with the final users of the expertise and technologies whose development they are backing. In this respect, if the stated industrial competitiveness objective of many public technological R&D policies is not, first, looked at in the long term (product and consumption innovation) and, second, seen as involving the use of these technologies being learned by the final users (workers where production technologies are concerned, consumers where new systems of personal use are involved), it is liable to result at best in a fruitful discussion between engineers acting as spokesmen for producers on one hand and users on the other. Public policies could thus contribute to the growth of employment by backing research in areas of public interest (the environment, health, education) or mixed public/ private interest (transport, telecommunications, leisure, energy, urban housing). Whether it be the new environmental technologies (for monitoring, prevention and rehabilitation),[28] technologies designed to meet the needs of the elderly (who are increasing in number in the Triad), know-how and systems for managing technological and social complexity (*e.g.* major technological risk management, air safety, health and safety in the workplace, etc), the development of knowledge-related occupational and leisure activities (multimedia systems, virtual reality, hypertext, etc.),[29] there is an immense field to be explored and harnessed in an effort to prompt industrialised societies to produce new activities which are rich in skill-generating jobs.

There can be no denying that there will be major problems involved in implementing these two "world solutions" to the common problems of economic recession and mounting unemployment. If, on the other hand, countries refuse *en bloc* to move in either direction, all that will be left will be short-term solutions of a political rather than an economic nature, such as reduced working hours or protectionism, which are not really geared towards increasing the overall volume of employment at world level, but which seek either to adapt to the scarcity of work by sharing it more astutely, or to win market shares from competitors so as to increase the volume of jobs in one's own country at the expense of those lost in neighbouring countries.

Lastly, these long-term objectives of public technological R&D policies must not be allowed to mask a third avenue for government action which urgently needs to be given increased prominence: encouraging research and exchanges of information on the *non-technological and non-market determinants of employment*[30] (creating job "deposits" by mobilising the authorities and the social economy at local level) within the framework of support for basic socio-economic research on the interaction between technologies (process/consumption innovations), growth (inter- and intra-sectoral comparisons) and employment (economic, socio-cultural and institutional factors). Also in need of encouragement is research into the management and organisation of technological and work resources as they relate to corporate strategy and organisation, and also research

into analysis of industrial structures (exposed/sheltered sectors) and socio-economic structures (market/non-market production/public property; costs/benefits of Triad competitiveness versus costs/benefits of world co-operation).

In the short and medium term, this sort of research can have a not inconsiderable impact, disseminating worldwide the knowledge and experience of those who, sometimes under extreme conditions, test new rehabilitation and job creation measures at local and regional level, often outside the context of or at the margin of world competition.

V. CONCLUSION

World co-operation between the industrialised and industrialising countries, mobilisation of the growth potential of depressed regions in the Triad areas, the development of technologies corresponding to new requirements and shared and disseminated social experimentation: these are avenues which, each in their own way, represent a move away from protectionism, from the "all technological" and social *laisser-faire* which have not proved their worth in terms of economic growth and job creation over the past twenty years.

These avenues involve profound changes in the thrust of public policy at national and international level, the need being to redefine the role of government. The latter has to re-establish its legitimacy, moving away from both short-termist fascination with the theoretical efficiency of the market and from protection of corporatism in the guise of solidarity (centralised and handed down from above). The openings which are taking shape are only meaningful from the standpoint of "subsidiarity",[31] not seen as a legal division between various levels of government (as has often been the case in the recent European debate), but as the pre-eminence of action "from below" involving the people, associations, enterprises, local and regional authorities, etc., which are provided by the state with a dynamic framework for expressing their needs and a long-term perception of the general interest.

NOTES AND REFERENCES

1. Needless to say, the beginning, end and length of each cycle are not the same in all countries.
2. Theoretical discoveries of *wireless transmission* by Maxwell (1860-64) and initial experiments by Hertz (1870-80), *machine tools* by Decoster (1843-61), *turbine* by Boyden (1844), *electromagnetic machine* by Clark (1849), *sewing machine* by Howe (1846), Wheatsone's work on the *typewriter* (1851-60), *typewriter* by Remington (1873), *astronomical photography* (1850), *magneto-electric generation* by Gramme (1869), *self-excited electric dynamo* by Siemens (1866), *gas motor* by Lenoir (1860), *four-cylinder engine* by Otto (1862), *ammonia-cooled refrigerator* by Carre (1860), *refrigerators* (1865), *air brake* by Westinghouse (1867), *bicycle* (1867), *industrial dynamo* by Gramme (1875), invention of the *telephone* by Bell (1876), *theoretical process of television* by Senlecq (1877), *cylinder phonograph* by Edison, *arc light* by Brush (1877), *filament lamp* by Edison (1879), *nitroglycerine* (1847), *phosphates* by Wisant (1878), the first *synthetic dyes* (1856), *the Solvay process* (1866), *dynamite* by Nobel (1867), *the first artificial substance* (celluloid) by Hyatt (1868), *eosin* by Caro (1874), etc.
3. The first *automobiles, electric-powered boat* (1885), *tractor* (1892), *electric lift* by Siemens (1880), *cash register* by NCR, *adding machine-printer* by Burroughs (1886), *tabulator* by Hollerith (1884), *electric thermostat* by Butz (1885), *automatic regulator* by Thomson-Houston (1888), *filament lamp* by Stanley (1884), *electric machine* by Voss (1890), *engine ignition by magneto* by Forest (1885), *camera* by Kodak (1888), *phonograph* by Edison (1885), the first *wireless communications* by Marconi across the English Channel (1885), *special steels* (1885), *metal-frame skyscraper* (1884), birth of *the cinema* (1893-95).
4. *Aeroplanes* (1902-08), *electronic television* by Zworykin (1911-23), *electronic detector* by Fessenden (1903), *diode detector* by Fleming (1904), *crystal receivers* (1906) by Dunwoody (carborundum) and Picard (silicon and iron pyrites), *grid-glow triode* by Forest (1906-07) and Von Lieben (1911), *repeater* by Cooper-Hewitt (1907), *vacuum tube* discovered simultaneously by Arnold (ATT), Langmuir (General Electric) and Meissner (Germany) between 1912 and 1913, *cellophane* (1900-05), *gas turbine* (1906), *photoelectric cell* (1905), *tungsten lamp* (1907), etc.
5. *Neutrodyne circuit* by Hazeltine (1919), *screen grid tube* by Marconi (1926), *pentode* by Philips *with aural null grid* (1927), *multi-element vacuum tubes* (beginning in 1926), *heterodyne and superheterodyne tubes* (1924-35), *synthetic rubber* (1927), *polyethyl-*

ene (1930), *front-wheel drive* by Citroën (1934), and the arrival of *batteries*, which brought in the first portable electrical and electronic devices.

6. The same can be said for air transport. The first civil aviation route was opened in 1919 between Paris and London, yet twenty years later the number of passengers remained extremely small. The vast majority of the household appliances (refrigerators, cookers, electric heaters) that had been developed were still not commonplace in the years between World Wars I and II.
7. The first stage saw the advent of *rockets* (1935), *helicopters* (1936), *diesel locomotives* (1937), *jet aircraft* (1942), *radar* (1935), *tape recorders* (1935), *point contact transistors* (1948), *computers* (1946), *colour film* (1935), *flexible discs, nylon* (1938), *DDT* (1942), *silicone* (1943), *streptomycin* (1944), *continuous casting of steel* (1948), *xerography* (1950), etc. Later, in the 1960s, *i.e.* at the height of the current cycle, there appeared *software packages, integrated circuits, microprocessors, lasers, colour television, magnetic charge cards, breeder reactors,* etc., and the automation of production processes (especially for repetitive and continuous sequences) made a spectacular leap.
8. Figures obtained by State of the Information Processing Industry, prepared for AFIPS and EIR and presented to the Spring Joint Computer Conference in Boston in 1966.
9. See in particular Clark, Freeman and Soete (1983); Mansfield (1983); Kleinknecht (1981); van Duijn (1983); Solomon (1986); Kleinknecht (1990).
10. New generations of microprocessors, robots, flexible manufacturing units, N/C machines, computer assisted design and manufacture, microcomputers, videotext, fibre optics, electronic charge cards, new materials, biotechnologies, etc.
11. This approach is developed in the writings of the founders of the theory of regulation (see, in particular, Aglietta and Orléan, 1982, Aglietta and Brender, 1984, Boyer, 1986). That said, the notion of social cohesion breaking down under the pressure of economic and technological change goes back a very long way and can be found in the works of such sociologists as Durkheim (1902), Simmel (1955) and Hirsch (1976).
12. Some specialists point out that computer scientists, in charge of the automatisation of their companies, have preferred to make a place for themselves in the firm's hierarchy rather than try to alter the breakdown of responsibilities as implied by the new technologies.
13. See also, Lipietz (1991), the special issue of the review *Panoramiques* (1993) and the special issue of the review *Sociologie du travail* (1991).
14. According to newspaper information, the total number of "announced" layoffs in the information and communications industries over the last three years may be put at over 450 000 in the Triad countries as a whole.
15. See Breton (1992).
16. See, in particular, the work by Petit (CEPREMAP, Paris) and Réati (Commission of the European Communities, Brussels).
17. Garages and motorway construction provided jobs for unskilled workers. Nowadays, maintenance, sales and consultancy relating to advanced process controls generate

demand for labour with very much the same skills as those required for production, *i.e.* engineers and technicians who are much less affected by unemployment.

18. See the pioneering work by Réal (1990) on the "dual nature of technical progress" (process innovation/radical consumption innovation) and his analysis of growth in the United States, Japan and France between 1979 and 1985.
19. For more information on this argument, see Mensch (1979), Giarini and Loubergé (1979) and Muldur (1991).
20. The cost of capital is defined as the minimum real pre-tax rate of return on a project required to cover financial costs.
21. It will be observed that the recent steps taken by the Japanese to slow the rapid renewal of product ranges in the automobile industry have the same objective as a proposal contained in the report by Muldur (1991), which recommends increased international co-operation in order to slow the rapid obsolescence of products and technologies.
22. It is interesting to note that in sectors such as chemicals and pharmaceuticals, where patents ensure that the amortisation period for innovations is longer, European firms do show good industrial and business results.
23. See the proposals contained in the Commission of the European Communities' White Paper for the Member States of the European Union (CEC, 1993).
24. See the work undertaken in the context of the OECD's Megascience Forum and the futuristic "programmes" proposed by Gaudin (1993).
25. See Camagni and Quévit (eds.) (1992).
26. See Lundvall (1988).
27. Quoted by Lundvall (1988).
28. See the estimates concerning the world market for the environmental industries (*e.g.* $300 billion in the year 2000, according to Environment Watch Western Europe, 4.12.1992) which give an order of magnitude of the possibilities – which is of course all they should be seen as. See also, in the *Panorama of EC Industry*, 1990, CEC, Brussels, the chapter on the environmental services industry, and the work done by the BIPE-ERECO.
29. See Lévy (1990 and 1991).
30. See D'Iribane (1990) and the special issue of *Panoramiques* (1993).
31. See, in particular, the recent work by Millon Delsol (1993).

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TRAINING AND EMPLOYMENT IN THE NEW PRODUCTION MODELS

CONTENTS

This article was written by Robert Boyer, Head of Research at the CNRS, economist for CEPREMAP.

SUMMARY

Human resource development policies need to be rethought in the light of the changes that have taken place in the production paradigm. Provided that they are, it is reasonable to believe that they will help to promote employment in the medium- and long-term. A good general education and continuing learning in the workplace have become two essential components of management for firms faced with uncertain markets, competition on quality, and the growth of information technology. Post-war education and training institutions are no longer adequate, but it is difficult to break the vicious circle of under-skilling, because it is also necessary to reform industrial relations, wage formation and modes of corporate organisation and management.

I. THE EROSION OF FORDISM MEANS THAT FIRMS MUST ADOPT NEW STRATEGIES

Throughout the 1970s and 1980s, analysts tended to focus on short-term trends and paid little attention either to the factors promoting growth or to the scale of technological and organisational change in progress throughout the OECD area. The first to accurately diagnose the situation were the specialists of technical change (Freeman, 1977). They observed that, by as early as the late 1960s, the initial wave of post-war innovations had started to lose momentum. The new information technologies, however, were not mature enough to replace the latter immediately and spur renewed growth. At the same time, the international environment, wage relations and the role of the welfare state were undergoing changes that were ultimately to jeopardise continued growth in the industrialised countries (Aglietta, 1982; Boyer, 1988).

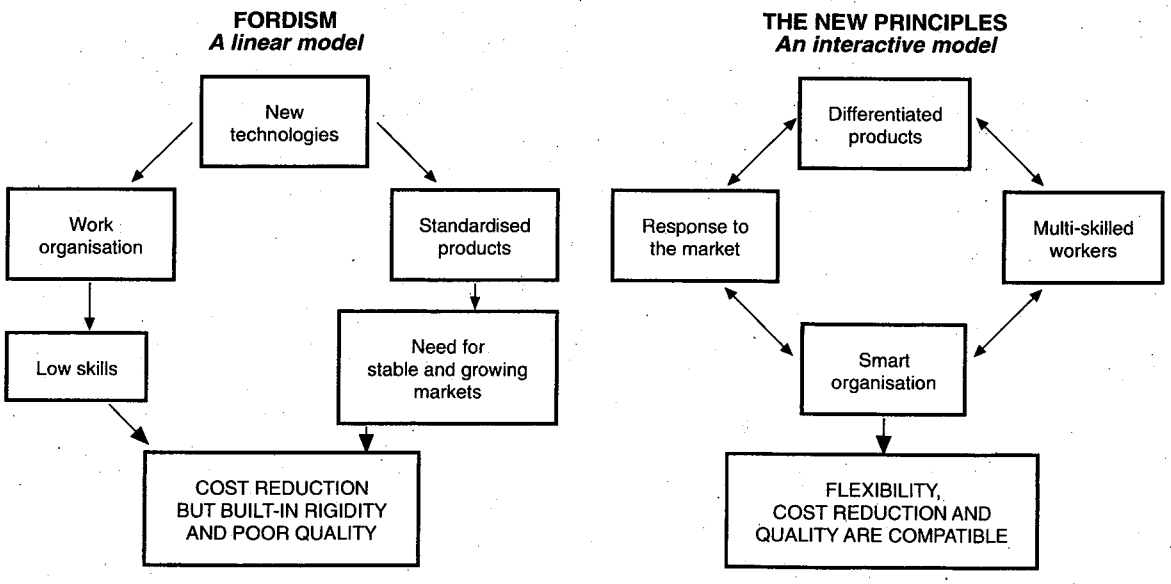
Work carried out by the OECD has gradually uncovered the basic features of the emerging new socio-technical system (OECD, 1988*a*), and has drawn various conclusions regarding innovation policy, education systems, the management of

firms (OECD, 1992), and the factors underpinning competitiveness and growth (Foray and Freeman, 1993). An earlier comparative analysis attempted to identify the bases, modes of organisation and implications of these new productive principles (Boyer, 1991), and to demonstrate that they offered a way of overcoming many of the imbalances and limitations inherent in the earlier organisational model based on mass consumption of relatively standardised products (Figure 1). In particular, greater production flexibility makes it possible to overcome the inertia of Fordist-type production processes (Fleissner and Polt, 1990). The reasoning behind this is three-fold.

After World War II, a linear conception of the relationship between science, technology and growth prevailed. New technologies were used to produce standardised goods and thereby to generate large increasing returns. Regarding work organisation, production workers saw their skills downgraded, because a high degree of specialisation was perceived to be the prerequisite for continuous cost reduction, and thus market growth. As long as growth remained strong and steady, this production model was viable and efficient.

But from the late 1960s, numerous developments such as the slowing down of productivity in the United States, the rise of problems with quality, growing labour unrest – calling into question the organisation of industrial work – and

Figure 1. **The two production models**



Source: Boyer.

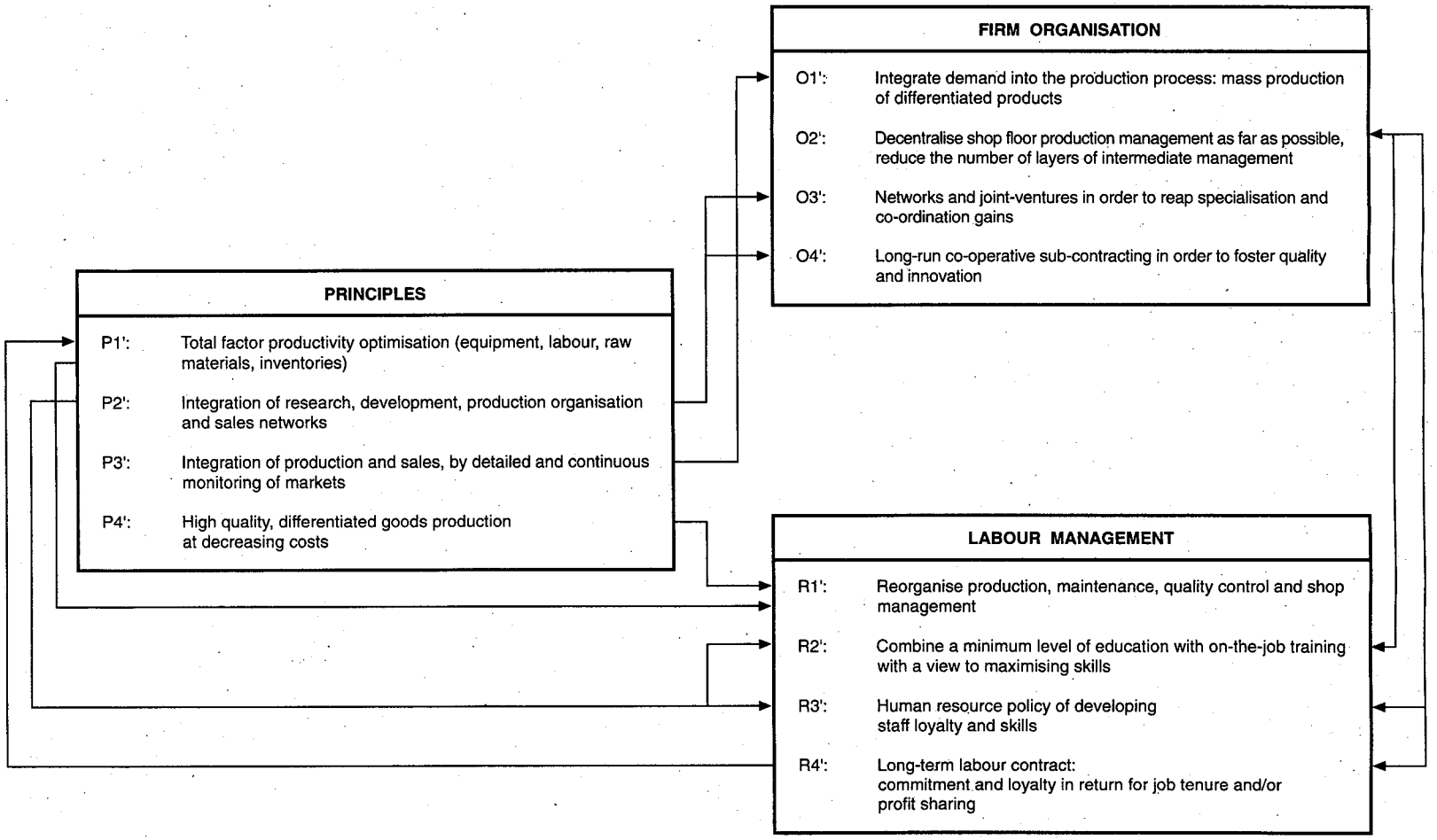
capital deepening, revealed the limitations of this model. Also, the continuing internalisation of trade accentuated competition and encouraged firms to adopt strategies of product differentiation with a view to restoring traditional economies of scale. Further, national economies became increasingly dependent on developments taking place in the world economy, so that the increased uncertainty regarding the volume and pattern of demand highlighted the production rigidities inherent in the linear model, which had gone unnoticed while growth was strong, steady and more or less foreseeable (Boyer, 1993).

In a sense, the principles of the interactive model (Figure 1) make it possible to respond more effectively to these new features of the economic environment. Demand-driven production, the introduction of technological and organisational innovations with a view to creating differentiated products and to competing on quality in conditions of oligopolistic competition, the shortening of lead times between design, production and delivery to market, are all factors that enable firms to respond more effectively to unforeseen developments and sharp fluctuations in the macroeconomic situation, and thus to improve their performance (Milgrom and Roberts, 1990). In this model, information processing and decentralised production management introduce a new configuration in the firm's internal organisation, and its relations with suppliers. Moreover, greater production flexibility is not incompatible with cost reduction and improved quality.

Implementation of this model of flexible, differentiated production thus calls for new principles, an internal organisation and a system of labour relations that break sharply with previous practices (Figure 2). In terms of objectives, better quality goods and greater product differentiation help to reduce costs by optimising overall productivity and through the integration of research and development, the organisation of production and marketing functions. The new system of organisation aims to integrate demand into the production process either by keeping stocks to a minimum or by responding to consumer demand for differentiated products and quality. The learning ability and versatility of workers are thus essential components of this production model, with the result that a satisfactory general education must now be combined with vocational training that is both broad-based and periodically updated. But this presupposes wage arrangements that give an incentive to continuously improve skills, and a long-term trade-off to ensure that employees will not be penalised in the medium-term by their efforts to improve productivity and quality. In this respect, frequent temporary lay-offs and external mobility are liable to break the virtuous circle inherent in the new principles of production.

It is thus not easy to switch from the linear to the interactive model, since training has to be synchronised with the decentralisation of decision-making, the maintenance or improvement of the general level of education, and the redesign of jobs and pay systems. The transformation is all the more difficult in that

Figure 2. **A new management model: principles, firm organisation and wage relations**



Source: Boyer.

organisations have approximated closely to the linear model. This is the gist of the present article, which describes a number of indications that would support the thesis of a shift in the production model.

II. ECONOMISTS AND MANAGERS ARE STARTING TO SHOW INTEREST IN THIS SHIFT IN THE PRODUCTION MODEL

This diagnosis of a shift in the industrial model, and thus in the factors promoting growth, is borne out by a series of converging indications.

First, the very theorists who were interested in cyclical fluctuations and short-run economic policy have shifted the focus of their investigations towards growth and development, considered as the outcome of endogenous technical change (Romer,1986; Lucas, 1988; Grosmann and Helpman, 1991). The starting point for their analysis is quite simple: ideas are as important as goods in that they can be used simultaneously by many agents: furthermore, the advances made today pave the way for the innovations of tomorrow, since ideas and knowledge are not necessarily subject to the law of diminishing returns. However, they can only be produced and used by humans, not by machines, which means that human resources are central to the process of growth, as formalised by numerous models based on theories of endogenous growth. Of course, these advances need to be synchronised with capital formation and especially the acquisition of producer goods, the availability of public infrastructure, and incentives to promote dynamism and innovation.

Second, the development of such lines of research has cast the growth model put forward by Solow (1956) in another light: in the long run, the growth rate of an economy is determined only by exogenous trends of technical change and the labour force. Furthermore, as it was assumed that no cost was involved in mastering science and technology, all countries should eventually converge to the same growth rate. On the one hand, technical change is not exogenous given that is imposed on firms but the outcome of the innovation strategies they adopt in order to acquire or maintain oligopolistic profits (Foray and Freeman, 1993). As new products and/or processes are disseminated through imitation by other firms, the process of growth is fuelled and strengthened by the external effects that result from increased knowledge. On the other hand, an inability to invest sufficiently in education, research or productive capital may keep some economies in an underdevelopment trap, while the most advanced countries have both a larger stock of know-how and the ability to increase it more rapidly. Thus, the equivalent of the level of technological development determines growth trajectories that may diverge on a long-term basis. Further, the institutions responsible for promoting

innovation and the diffusion of new technologies may vary widely from one country to another, so national systems of innovation will differ widely too (Lundvall, 1992, Nelson and Rosenberg, 1993).

These ideas are particularly useful for understanding the present period, and especially the emergence of the newly-industrialising countries. If ideas have indeed played a major role in development, then their impact is even greater today than it has been in the past (Landes, 1992). If standardisation paved the way in the past for mass production, production lines and extraordinary gains in productivity, then the knowledge which each producer now controls and creates is capable of producing major changes in the genesis and diffusion of technical change: "It is replication and discovery, not computers and machine tools, that are fundamental" (Romer, 1993). In the author's view, it is even possible to perceive the equivalent of what historians of the economy and technology call "industrial revolutions": in the past these were associated with textiles, steam engines and the motor car; today, information technology, telecommunications and applications of scientific advances (biological engineering, etc.) are having equally powerful effects.

In some respects, the ideas of the theoreticians of endogenous growth tie in, unexpectedly, with Schumpeterian-type theories. For example, the concept of technological paradigm (Dosi, 1982) emphasises the specific features of the innovation clusters that shape productive systems during each major phase of growth and industrialisation. There is also the idea that the development process is logistical in nature rather than a constant-rate process, due to the fact that the oligopolistic profits that launched the growth phase are gradually whittled away.

By the same token, theories of the firm have attracted renewed interest from analysts. Economists have opened the black box that the firm represented in neo-classical theory: in parallel with explanations in terms of transaction costs or principal/agent relations (Aoki *et al.*, 1990), neo-Schumpeterian economists see the firm as a place of innovation, imitation and learning, in a context of competitive markets in factors and products (Nelson and Winter, 1982). But economists are now attempting to determine the reasons for the succession of contrasting forms of organisation. Thus, the organisation of a large firm cannot be separated from the nature of economies of scale and scope, and the cost of market access (Chandler, 1990). Similarly, the distinction drawn in earlier analyses between U-form and M-form enterprises has been replaced by the contrast drawn in the 1990s between American and Japanese firms (Aoki, 1988).

Thus, the traditional divide between economic analysis of the firm and management research has narrowed somewhat in that a number of theorists have developed tools capable of analysing the discontinuity of organisational choices, and have proposed formal models for the management modes of contemporary firms (Milgrom and Roberts, 1990). It was thus possible to show that a reduction

in the number of defects, rapid communication with the customer, and the ease with which the programmes that control equipment can be modified, induce a process of cumulative improvements in the firm's overall competitiveness. These findings are all the more interesting in that they explain why three of the components of the new model are complementary (see Figure 2).

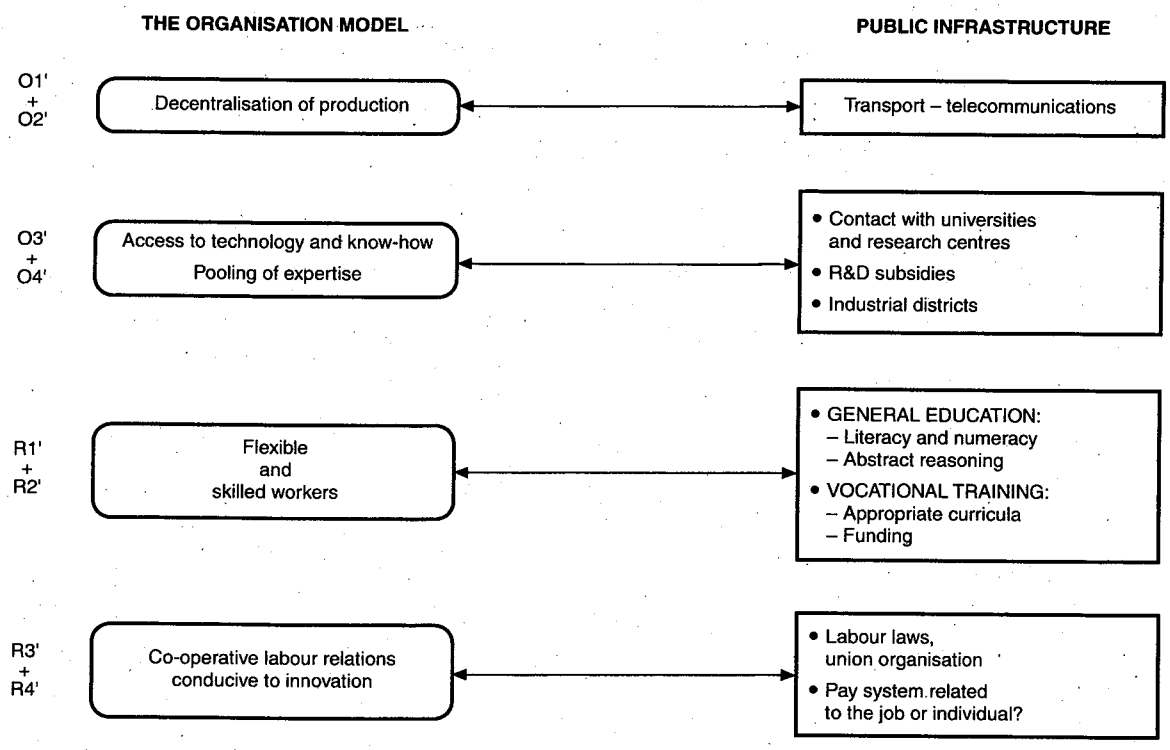
Lastly, it has not escaped the notice of practitioners that the internal organisation of firms, and the relations of firms with sub-contractors and customers, have often played a determining role in the ability of firms to respond to unexpected circumstances, to seize market opportunities and to develop and deploy new technologies. Thus, firms operating within the same sector (automobile manufacturing, consumer electronics, etc.) have followed markedly different development paths; in general, firms with more centralised forms of management, based on a chain-linked linear model of technological innovation, production and sales, have lost market share to competitors with less centralised managerial structures and with internal organisations based on the principle of interrelated activities. This hypothesis would need to be checked more rigorously by systematic studies, but it seems borne out in the case of the automobile industry for example (OECD, 1988*b* ; Womack *et al.*, 1991). In addition, new sectors have emerged and grown rapidly, whether they were at the core of the emerging paradigm (software engineering, services to enterprises, etc.) or were simply an enabling condition of the latter (telecommunications, etc.) (Freeman and Soete, 1991).

III. INADEQUATE TRAINING CAN BE AN IMPEDIMENT TO THE STRATEGIC DECISIONS AND GROWTH OF FIRMS

To be effective, corporate strategies require public infrastructure and rules of the game that are consistent with the prevailing productive system. Analysis of the viability of the new principles shows the need for government policies, some of which are a continuation of Fordism (*e.g.* the role of transport) while others are newer (Figure 3).

- Thus, while low cost and reliable transport are still a determinant of the competitiveness of firms, exchanges of information between customers and firms, principals and sub-contractors are now very important, making it necessary to develop telecommunications; these are one of the components of the virtuous circle between market monitoring, production and research and development.
- Similarly, in order to convert inventions and technological advances into profitable processes or products, it is necessary to keep constant track of

Figure 3. **The new production model calls for adequate public policies and infrastructure**



Source: Boyer.

research developments in areas related to the firm's activity. This is greatly facilitated if research and development centres are close to universities and basic research institutions; indeed, a firm can innovate only if it is able to keep abreast of the advances of its competitors. Furthermore, part of a firm's efficiency will stem from possessing certain types of implicit knowledge, which is transmitted more easily in an industrial district *via* the nexus of trust that exists within it (Lorenz, 1993).

– At the same time, the need to broaden workers' skills renews the aims and content of learning. On the one hand, computers demand greater mental abilities, which very probably can be acquired only with a good basic education (Bartel and Lichtenberg, 1987). On the other, vocational education can no longer be limited to training young people to do a specific job throughout their entire career, since now they have to be able to adjust to

new responsibilities, modes of organisation, and technology at various stages of their working lives.

- Lastly, a firm can devise ways of involving its employees (participation in decision-making, profit-sharing, creation and strengthening of an enterprise culture, etc.), as shown by the transplants of large Japanese companies (Kenney and Florida, 1993). However, labour laws, trade union organisation, labour relations and pay systems must permit such arrangements, or even better, encourage them and secure their long-term viability.

The quality and motivation of the workforce are essential, a development that breaks somewhat with the labour institutions inherited from the *"les Trente Glorieuses"* (*i.e.* thirty years of uninterrupted growth). The operation of modern industrial plant and computer systems places demands on the mental abilities of employees, who in addition must be capable of responding flexibly to unforeseen developments and of acquiring new skills in response to changes in the working environment. While with Fordism, an observer sometimes had the impression that the machines were designed to control the work of humans, with the new model it is the initiative of individual workers that is essential to the continuity of productive flows and quality (Shimada, 1991).

However, it is quite possible that the legacy of poor skills and the inadequacy of education systems designed at a much earlier time to meet the requirements of a wholly different productive paradigm, may well prove to be an impediment to firms wishing to implement new industrial strategies (Hollingsworth, 1993). In countries such as the United Kingdom or the United States, such impediments may arise, in part, from the introduction of human resource policies which are both inadequate and obsolete given the new demands of competitiveness (Marsden, 1993; Dertouzos *et al.*, 1989).

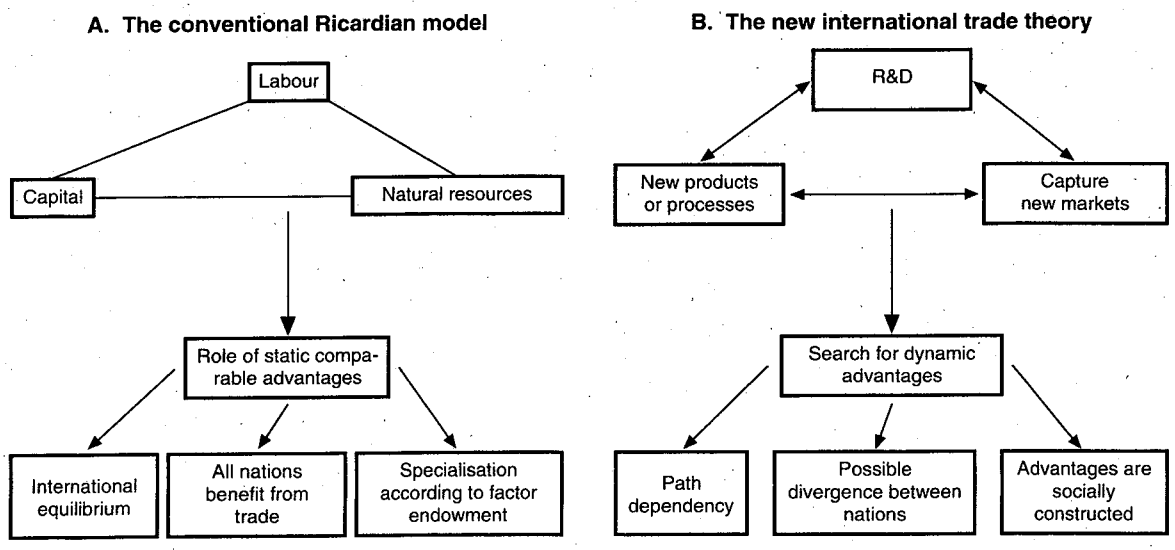
It is nonetheless important to stress that education policy alone, while necessary, is not sufficient to produce successful firms and to encourage firms to subscribe to the new model. In economies with high rates of unemployment, as in Europe for example, firms may be prompted to select new employees on the basis of qualifications and training, even if this means assigning over-qualified workers to jobs which are ultimately unrewarding, compared with earlier periods. Analyses in terms of creaming-off (Spence, 1973) can help to explain why, the lower the level of qualifications, the higher the unemployment rate (OECD, 1993*a*): this inequality may derive from human capital formation, but it stems also from the signals sent by qualifications and level of training. In short, while the availability of well-trained labour is an enabling factor, it will not necessarily induce changes in modes of personnel management.

Moreover, firms may well be incapable of setting up a vocational training system of benefit to them all, since the very fact that education is a public good

encourages the well-known phenomenon of the "free-rider": all parties would like to benefit from education, but nobody wants to have to pay for it. Both theoretical analyses and comparative studies suggest that economies which lack strong professional associations may well suffer from under-investment in training (Streeck, 1992). Furthermore, extreme decentralisation of bargaining and training procedures would prevent a shift from an equilibrium based on a low level of skills to one based on a continual upgrading of skills (Soskice, 1990). Lastly, should monetary turmoil and economic uncertainty lead to high rates of interest and tight budgetary policy, firms might be blocked in their efforts to teach workers new skills (Amendola and Gaffard, 1988). Finance and taxation can therefore also be factors that inhibit the embracing of new productive principles.

Indeed, the relationship between training and the factors promoting growth in a market economy needs to be reconsidered. It may be recalled that in the Ricardian model, natural factor endowments were the determining factor in specialisation, leading to an international equilibrium that was basically static in that technical progress played no part in determining comparative advantage (Figure 4). In consequence, training does not play a leading role, at the most it forms part of a nation's resources and is treated as a given factor. In contrast, the new theories of international trade and analyses of endogenous technical change

Figure 4. **The new production model changes the factors that promote growth in an open economy**

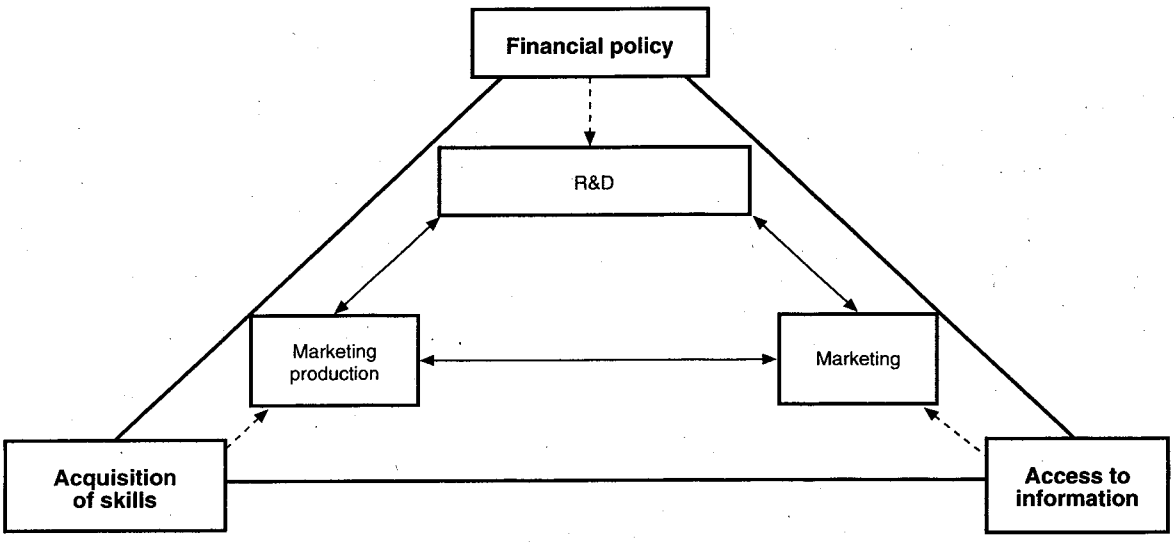


Source: Boyer.

repeatedly stress that competitive advantage is acquired through the ability to invent, and then to produce at a competitive price, new products or more efficient processes. In this view, there is a learning process that can potentially cause specialisations to diverge; nations which prove incapable of learning are liable to find themselves blocked on a slow growth path, or even to stagnate, *i.e.* find themselves in the equivalent of an underdevelopment trap. Skilled labour is the scarcest resource in such a model, and growth is largely the outcome of the cumulative extension of skills through education or on-the-job training (Lucas, 1988). The impact of the transition to an economy based on continual advances in knowledge and know-how should not be underestimated (Eliasson, 1988).

In view of the above, dynamic growth calls for the simultaneous co-ordination of two processes (Figure 5). On the one hand, firms must continually seek to establish a dynamic balance between the process of innovation, the simplification of production methods, and the monitoring and creation of new markets, in accordance with the "snowball" model developed under the TEP (OECD, 1992). A firm's expansion may be impeded by a failure to innovate rapidly enough or to master production processes, or marketing errors. But on the other hand, governments must pursue policies which are capable of perpetuating such growth, from one period to the next, in the skill levels of both individuals and firms. Clearly, the

Figure 5. **Economic policies may enhance or inhibit the emergence of the new growth model**



Source: Boyer.

quality and dissemination of both general training and scientific research are necessary conditions for the perpetuation of this snowball effect. The mastery of modern production processes presupposes that workers have a minimum of general skills. However, the ability to convert technical advances into innovations depends to a large degree on the quality of the training of researchers and engineers, as well as on the density of the network of relations between research and industry. In both cases, the volume, quality and adequacy of human resources are crucial. But this strategy must be underpinned by a firmer vision of the future provided by a funding structure willing to lend support to product and process innovation (Amendola and Gaffard, 1988; and Edquist, 1993).

Given the importance of new ideas (Romer, 1986 and 1993) which in part exhibit the attributes of public goods, it is the duty of governments to promote the creation of new knowledge, and to allow such knowledge to be disseminated, without discouraging innovators from continuing to innovate (Nelson, 1993). Policies to ensure the recognition of intellectual property rights and the dissemination of scientific and technical information can thus play a crucial role in the competitiveness of a region or nation. According to this conception of growth, governments constantly aim to ensure that the three components of their medium- and long-term strategy – financial policy, education and training policy, and scientific and technical policy – are consistent with one another. Also, these policies must be compatible with corporate management and industrial specialisation.

If, on the other hand, a gap is allowed to open up between economic policy and the strategies deployed by firms, the dynamics of growth will suffer accordingly. This may well be what happened in many European countries in the 1970s and 1980s (Amable and Boyer, 1992). For example, the maintenance of high real interest rates and the climate of uncertainty may have inhibited in part the rate of diffusion of new technologies. Consequently, whereas human resources were probably insufficient to sustain strong growth around the level of full employment, the scale of the 1992-93 recession resulted in cuts in the number of medium- and highly-qualified jobs, including in sectors that were supposed to be growth sectors (electronics, information technology, etc.). In 1994, the shortage of skilled labour will thus not be the determining factor in the revival of growth. The newly-industrialised countries of South-East Asia, however, offer striking examples of the successful co-ordination of public policy and markets (Wade, 1990; OECD, 1992). This co-ordination has made possible strong growth that is due not merely to the fact that these countries are catching up but also to their successful integration into the new production paradigm that is emerging.

IV. DELAYS IN ADOPTING THE PRINCIPLES OF THE NEW MODEL, AND UNDER-SKILLED LABOUR, AGGRAVATE UNEMPLOYMENT

Until recently, economists were content simply to contrast the classical unemployment of the 1980s, caused by insufficient profitability, with the Keynesian unemployment of the 1930s resulting from insufficient demand. More recently, a shortage of production capacity combined with persistent stagnation has created a third type of unemployment described as "Marxist" (Malinvaud, 1991). By analogy, therefore, if on-the-job training is considered to depend upon the volume of cumulative investment (Kaldor, 1957; Arrow, 1962), then the slowdown in productivity gains may also be a result of the slowdown in capital formation.

Analyses in terms of the production paradigm, the theory of regulation and the new labour economics provide three avenues of research to complement this interpretation:

i) Theories of the efficiency wage have the merits of showing that there are situations in which it is not advantageous for a firm to seek the lowest possible wage: there is an optimal wage level which minimises production costs because pay can increase the motivation, and thus the productivity, of employees. The same reasoning can be extended to skills: for some types of production organisation, for example the production of differentiated high-quality goods, it is not advantageous for firms to have low-skilled workers, since production costs are likely to be higher than for workers with adequate skills. If it is also assumed that the wage structure is relatively inert with regard to market imbalances and that firms are unable to organise the training that they need, it is possible to design models in which the shortage of skilled labour restricts recruitment and production by firms (Rouilleault, 1992). This unemployment stems from a number of market imperfections or institutional rigidities: invariable wage ladders resulting from collective bargaining for fixed pay scales; delays in implementing public policy on education (which might also have been inadequate); and/or the inability of firms to set up vocational training programmes (Soskice, 1990). This possibility is frequently pointed out by researchers who study the United Kingdom and the United States. In contrast, the low level of youth unemployment in Germany is often ascribed to the quality of its training, and the fact that it is tailored to the needs of firms. Large Japanese firms also underline the link between stable employment, continuous learning and competitiveness (Aoki, 1988).

ii) From a theoretical point of view, unemployment may appear to be the consequence of a gap between the skills required for modern forms of competition and the skills delivered by the education and training system. The more widespread the new principles of production, the more likely such a gap. The resulting unemployment may be large-scale and persistent because the time it takes to train people is determined more by the cycle of replacement of generations than by the business cycle. In view of the negotiating costs, the scale of investments required to reform the education system, and the potential conflict of interest between wage-earners, firms and public authorities, an economy might well be incapable of tailoring its vocational training system to the needs of the new production paradigm, despite any efforts it might be making to move towards competitiveness based on the quality of products and labour. A comparison of France and Germany in this respect reveals the longevity of specifically national attributes in education system relations and trajectories over a period of more than half a century (Boyer and Caroli, 1993). Comparative studies tend to show that the differences between the unemployment rates of these two countries are ascribable in part to differences in the quality of relations between the training system and the management of firms (Maurice *et al.*, 1982; Mobus and Sevestre, 1991).

iii) An earlier study (Boyer, 1991) tried to show the degree to which economies match the new production paradigms by constructing an indicator for Germany, the United States, France, Japan and Sweden. The exercise is undoubtedly hazardous since it is not easy to construct a entirely satisfactory composite indicator of qualitative, organisational features. Given this caveat, the indicator shows that over half of the difference between the unemployment rates of individual OECD countries is attributable to two factors working in tandem: first, the maintenance of sufficient rates of investments to ensure the cumulativeness of experience effects (Figure 6); second, the most rapid dissemination possible of the organisational forms associated with the emerging production paradigms (Figure 7). While allowing that such an exercise is extremely hazardous, it can be illustrated by two examples: if US firms had a production organisation similar to that of Japanese firms, unemployment in the United States would be more than 5 per cent lower, all other things being equal; similarly, if French firms had German types of production organisation, unemployment in France would be more than 3 per cent lower (see Box).

These are all still fairly fragile, although invaluable, indications of a link that has been neglected for far too long between the organisation of firms and types of unemployment. This article merely maps out the broad lines of the major research

Figure 6. **Modernise according to the new productive principles**

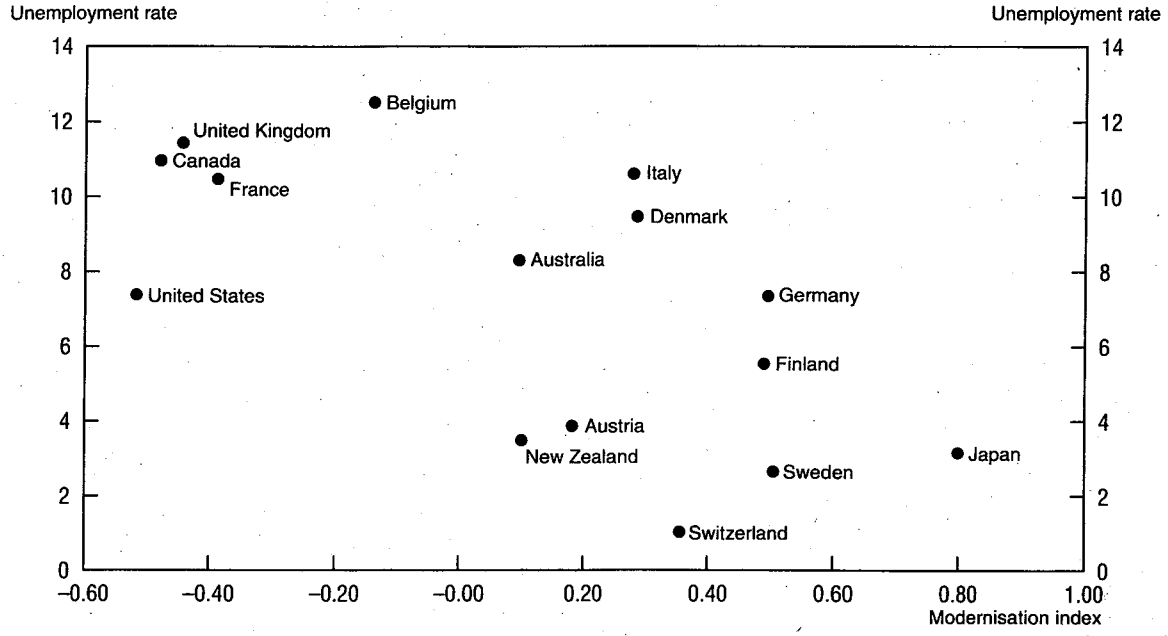
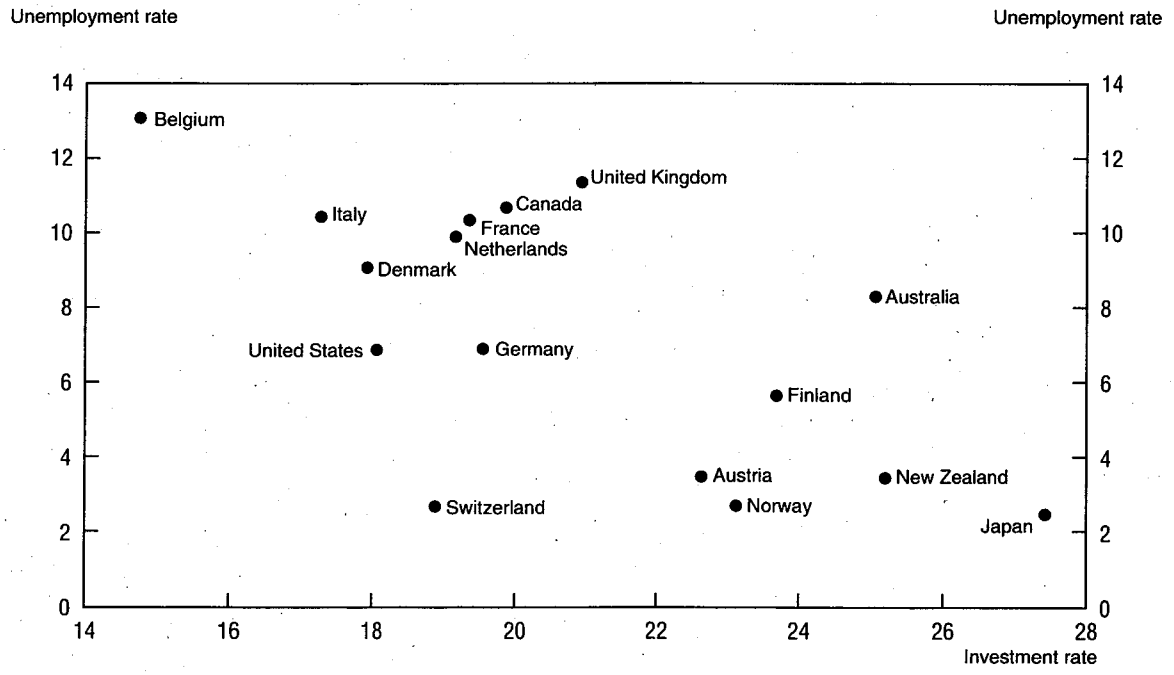


Figure 7. **Invest**



Source: Based on Boyer (1991), p. 52 (modernisation rate) ; and OECD, *National Accounts* (investment rate).

Two structural determinants of the unemployment rate

$$TCHO = 17.6 - \underset{(4.0)}{4.3} \times MOD - \underset{(2.3)}{0.49} \times TINV \quad R^2 = 0.53 \quad F = 10.1$$
$$\qquad\qquad\quad (2.4)$$

TCHO: Unemployment rate in 1990

MOD: Modernisation index, *i.e.* degree to which the economy matches the new production principles

TINV: Share of productive investment in GNP at constant prices

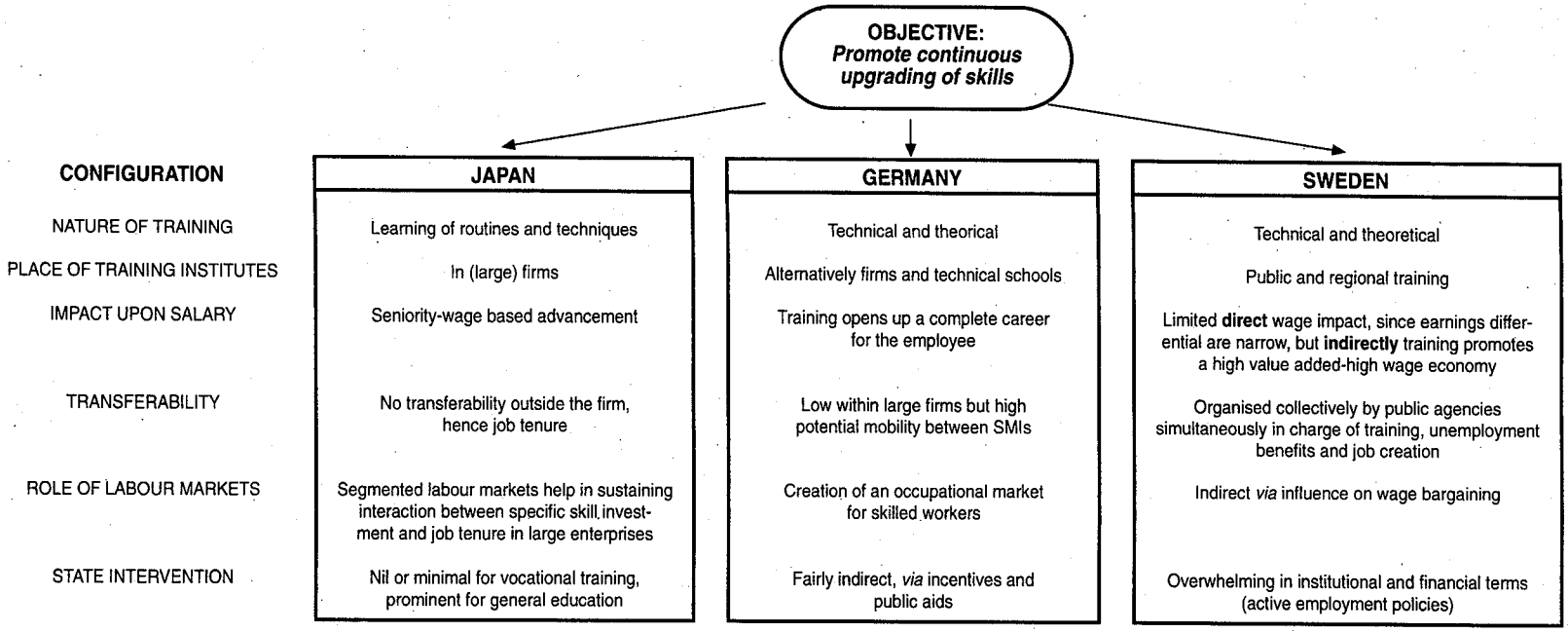
programme that would be needed to analyse more thoroughly the unemployment that results from the inability to adapt to the new production principles.

V. MANY DIFFERENT TYPES OF EDUCATION SYSTEM FOR THE SAME STRUCTURAL COMPETITIVENESS

Governments are often tempted to import the best of the institutions developed by neighbouring countries or by countries competing with them in world markets. In one sense, the spread of Fordism after World War II is symptomatic of such thinking based on the premise that there is "one best way". It is now the German model which, in terms of training, is attracting strong interest from virtually all quarters, given the contribution it has made to the competitiveness of the German economy (Guerrieri, 1992) – primarily as a result of the quality of German products, itself a reflection of the skills of its workforce (Gehin and Mehaut, 1993; Jacobi *et al.*, 1992). In terms of the organisation of production, most firms are interested in Japanese methods, from which they are tempted to copy those features assumed to be responsible for the success of the Japanese economy (just-in-time logistics, quality circles, profit-sharing, etc.).

The present analysis, however, stresses the fact that any imported institutional instrument must be both compatible and consistent with the style of social relations and economic management prevailing in individual countries. It can be shown, for example, that Japan, Germany and Sweden offer three very contrasting practical approaches to the perceived need for vocational training (Figure 8):

Figure 8. **Three modes of organisation for building structural competitiveness contrasted**



CONFIGURATION	JAPAN	GERMANY	SWEDEN
NATURE OF TRAINING	Learning of routines and techniques	Technical and theorical	Technical and theoretical
PLACE OF TRAINING INSTITUTES	In (large) firms	Alternatively firms and technical schools	Public and regional training
IMPACT UPON SALARY	Seniority-wage based advancement	Training opens up a complete career for the employee	Limited **direct** wage impact, since earnings differential are narrow, but **indirectly** training promotes a high value added-high wage economy
TRANSFERABILITY	No transferability outside the firm, hence job tenure	Low within large firms but high potential mobility between SMIs	Organised collectively by public agencies simultaneously in charge of training, unemployment benefits and job creation
ROLE OF LABOUR MARKETS	Segmented labour markets help in sustaining interaction between specific skill investment and job tenure in large enterprises	Creation of an occupational market for skilled workers	Indirect *via* influence on wage bargaining
STATE INTERVENTION	Nil or minimal for vocational training, prominent for general education	Fairly indirect, *via* incentives and public aids	Overwhelming in institutional and financial terms (active employment policies)
STRENGTHS	Fast learning and good response to technical change	Skill ensure the quality of products	Defensive labour flexibilities (low wages, low skills) ruled out
AND	Incentive to product innovation and diversification	Possibility of adjusting wage scales	Incentive to innovation
WEAKNESSES	Mobility difficult in the event of a downturn	Erosion by the rise of enrolment in universities	The reduction of wage differentials may be detrimental to industry
	Possible conflict with young generations' expectations	Sluggish response to radical and product innovations	Quasi-full employment disrupts industrial relations

Source: Boyer.

- in Japan the upgrading of human resources is based on a combination of high-quality general education for all young people and continuous and intensive training throughout the employee's career, at least in large firms. This system is particularly effective when production is diversified and growth is rapid. On the other hand, it would be difficult to apply if mobility between small and medium-sized enterprises was predominant, and during an economic downturn and/or a period of instability;
- in contrast, the German dual system is based on the transferability from one firm to another of sufficiently broad skills which allow workers to adapt to changing technological and macroeconomic contexts. But this requires a high degree of co-ordination between both sides of industry and the various ministries concerned, something which cannot be taken for granted in those countries with a high degree of decentralisation of industrial relations and of responsibilities for education and training;
- lastly, Sweden offers the example of the third type of system in which the public, most often regional, authorities play a key role in retraining labour once a sector's decline or loss of competitiveness has made the need for redeployment obvious. Its advantage is that it combines labour management and training policy, but its drawback is that it functions only *ex post* and not *ex ante*, like the Japanese and German systems.

Each system has its own strengths and weaknesses, and its ultimate effectiveness will depend upon the nature of technical change, the situation in the world economy and the choice of economic strategy. These comparisons of educational institutions would seem to belie the idea that there is "one best way".

In contrast, the need to adopt compatible managerial methods, organisation of firms, the nature of the labour contract, and the sharing of responsibility for training and education between firms and the state, may help to explain why reforms conducted in isolation have often proved unsuccessful. Examples of such failures include British and French attempts to copy the dual German system of vocational training, or the initial enthusiasm for, and subsequent reassessment of, quality circles in France. There are many other such examples.

VI. HOW CAN THE VICIOUS CIRCLE OF UNDER-SKILLED LABOUR BE BROKEN?

Before comparing some of the major economies within the OECD area, we must first contrast the vicious circle of prolonged Fordism with the virtuous spiral initiated by a model based on labour skills, once such a model is in place. For

example, internal markets (France) might be thought to be less efficient than skilled labour markets (Germany) based on the transferability of broad, although clearly defined, skills (Marsden, 1990 and 1993).

The organisation of large Japanese firms, however, provides the necessary coherence between the careers of employees and on-the-job training, which encourages versatility and adaptability. This structure would seem to be just as effective as the German skilled-labour markets – provided, that is, that the economic climate remains both steady and predictable. Which of the two approaches will eventually gain the advantage will depend on whether or not adaptability based on labour markets and industrial district effects (the German approach) will prove to be more effective than internal mobility and product diversification or the geographical dispersion of different establishments within the same group (the Japanese approach).

The United Kingdom and Germany both have skilled-labour markets which closely resemble each other in terms of: the degree to which skills are defined by trade, the proportion of apprentices in the same sectors, the relatively low wages of apprentices, low tenure effects, low wage differentials between sectors, etc. Yet the narrowness of UK skills contrasts sharply with the broad skills of German workers, which are periodically extended and restructured to take account of anticipated technical change. In addition, the range of subjects taught, as well as the mix of theory and practice, are far from identical (Bierhoff and Prais, 1993). Frequent dismissals and confrontational labour relations in the United Kingdom contrast strongly with the forward planning and co-management schemes, offering a modicum of co-operation, common in German firms.

Therefore the virtuous circle of rising qualification demands a combination of interdependent arrangements (Figure 9):

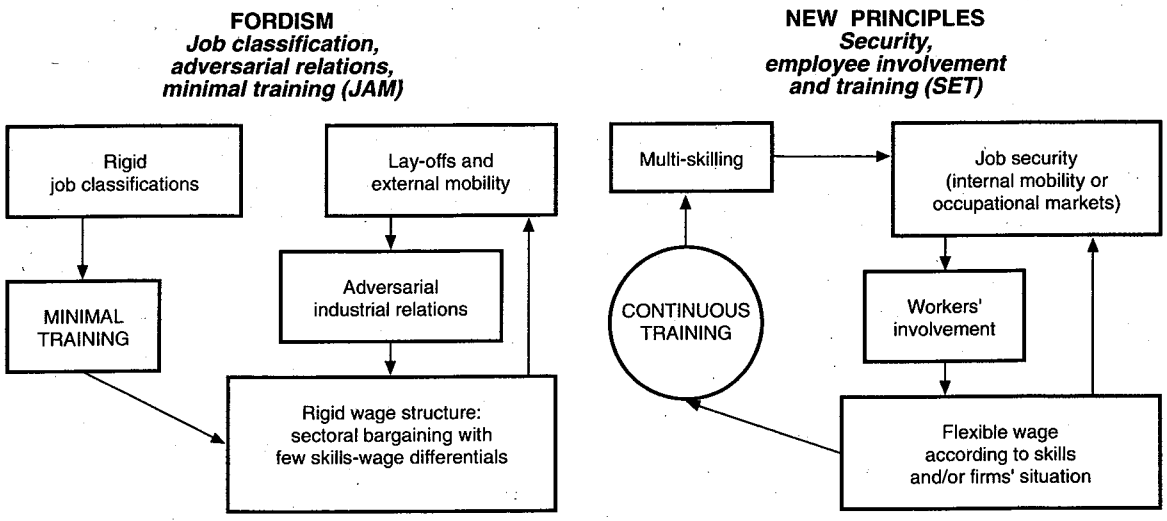
i) a sufficiently wide definition of skills to respond to foreseeable technical changes and unexpected sectoral or macroeconomic events;

ii) negotiations, preferably involving four parties – firms, unions, teaching staff and public authorities – for routine up-dating of curricula and skills;

iii) institutional systems guaranteeing workforce mobility either when the labour market is bordering on full employment, or according to a salaried, internal market type career. In effect it is important that technical change should not be seen as a threat to employment as, for instance, is the case in Great Britain;

iv) incentives for firms to train their workforce, either within the company through systematic rotation of jobs and the training centres themselves (although this would imply almost total job security), or through participation in an inter-firm training system (financed by compulsory contributions from firms belonging to the same sector). It is also important that training should not target the most highly qualified staff, but should cover all educational levels. This is certainly

Figure 9. **Training is effective only if it is suited to the management model**



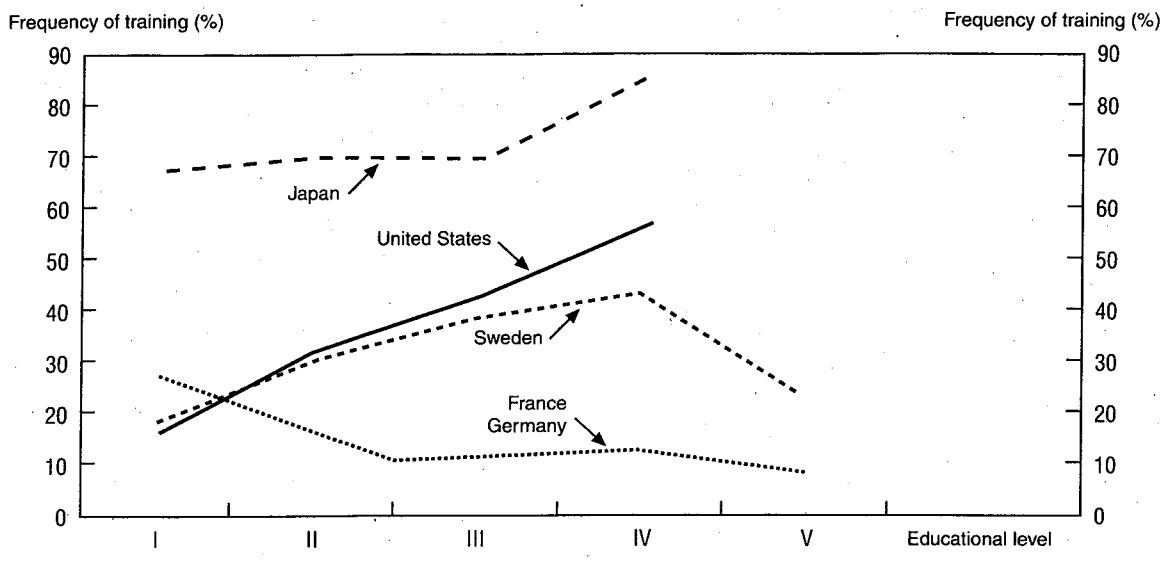
Source: Based on Brown, Reich, Stern (1990).

one of the best indicators for insertion in the new productive paradigm (Figure 10).

v) a training system for salaried workers which makes training attractive both for the firms providing on-the-job training facilities and for employees who can expect a salary ranked in line with the qualification obtained. However, if the collective agreements stipulate a very small salary differential between qualified and unqualified workers, the companies and labour force will not invest in training, and even less if these are specific to the company and both the companies and the labour force are poorly organised, due to intensive decentralisation of local employment markets (the case of the United States).

If any one of these conditions is lacking, it would appear that adhesion to the new productive(?) model would be made more difficult, or even impossible. This is a fair illustration of a strategy taking training as sole vector for organisational change.

Figure 10. **Frequency of training and education level**[1]



1. In the new model, training is more intensive and more evenly distributed across initial education levels.
Source: Diagram constructed from data in the OECD *Employment Outlook* (1991), p. 159.

VII. TWO PARADOXES OF HUMAN RESOURCE MANAGEMENT

The present paper thus draws two major conclusions, which both suggest that it is difficult, in the present climate, to reduce unemployment with a proactive training policy, although this is essential for employment in the long term:

i) although the importance of the role played by human resources in structural competitiveness has been clearly recognised by analysts and decision-makers, it is a far more difficult task to ensure the transition from a Fordist configuration based on under-skilled workers to a virtuous circle based on the continued upgrading of skills through education and on-the-job training. The case of France offers a good example of this paradox: despite efforts over more than a decade, French firms are far from possessing the competitive advantages of their German competitors (Boyer and Caroli, 1993);

ii) it requires a truly exceptional set of circumstances for major reforms of a national education system to be decided upon and implemented. It is worth recalling, for example, the ambitious policy adopted by the US Government

after World War II to help reintegrate returning GIs, or the introduction of an education system based on democratic principles imposed on Japan after the end of the war. This presents us with a second paradox which contrasts the short-term rationale behind decisions on economic, and particularly financial, policy, with the long-term thinking underpinning decisions on educational policy and the projected development of industrial specialisations. When the need for competitiveness, rising inequality and social exclusion force firms and governments to acknowledge the inadequacies of their education and training systems, it is generally too late to make adjustments which should have been made 10 or 20 years earlier.

Yet it would be wrong to accept policy drift on the assumption that the market and private initiative will eventually resolve this two-fold dilemma. In view of the discrepancies between the social and private returns on training, and the difference between short-term interest rates and the discount rate desirable for society, it is essential that governments launch initiatives aimed at breaking the vicious circle of under-skilled labour. This task is by no means easy, however, and far-reaching reform of education systems will only produce results in the long term. It would therefore be wholly unrealistic to expect such reform to have a rapid and dramatic impact on unemployment, which would require a combination of different and original remedies given the degree to which the institutional mechanisms introduced since the 1980s have proved, in 1994, to be ineffective in stemming the rise in unemployment from which Europe, in particular, has been suffering. Nonetheless, it would seem reasonable to argue that adoption of the new production principles will help to improve employment in the medium to long term.

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STRUCTURAL CHANGE AND EMPLOYMENT: EMPIRICAL EVIDENCE FOR 8 OECD COUNTRIES

CONTENTS

This article was by Norihisa Sakurai of the Economic Analysis and Statistics Division of the OECD's Directorate for Science, Technology and Industry.

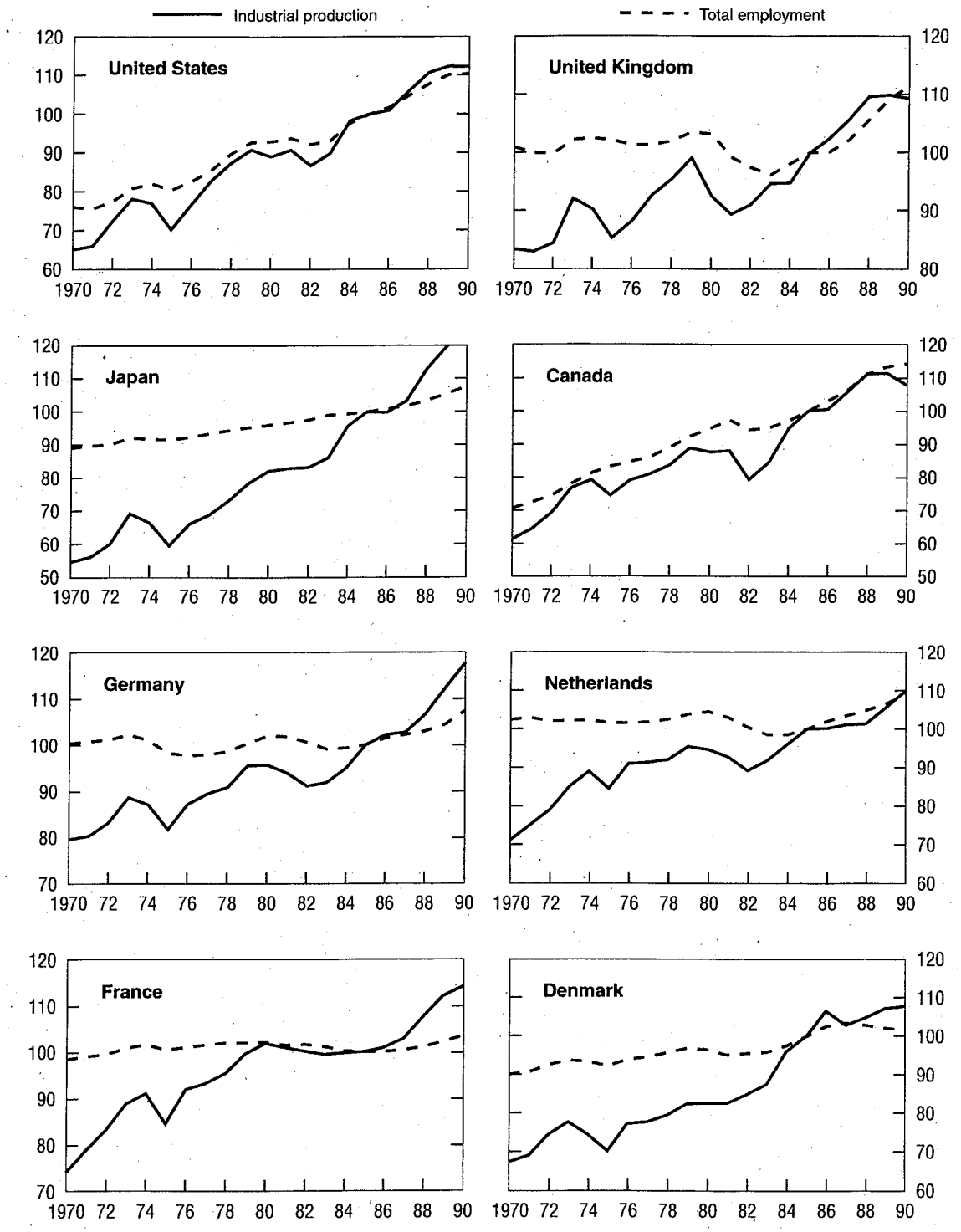
SUMMARY

Changing comparative advantages, technical change and shifting patterns of demand are the major factors affecting the structural composition of an economy. The prompt adjustment of economic structures to a changing environment enables the potential gains from change to be exploited. However, resisting change as a means of maintaining current employment tends to be unsuccessful in the long term. By using input-output techniques, this paper empirically analyses how and to what extent these structural forces have affected employment, and compares the relationships between employment performance and structural response across eight major OECD countries during the 1970s and 1980s. The major findings are: *i)* structural change had a labour-augmenting effect in the economies of the United States and the United Kingdom, but this was not evident in other countries where macroeconomic performance was much more important; *ii)* labour productivity growth had a large labour-saving impact in every country; and *iii)* especially for European countries, various factors behind excessive productivity increases (technical change, factor substitution, managerial rationalisation, labour market institutions and wage flexibility, etc.) might be a focus on policies.

I. INTRODUCTION

The unprecedented level of unemployment in the OECD area is attracting considerable interest among policy-makers. A doubt currently exists about the link between growth and employment because high and persistent unemployment did not subside significantly even during the last economic boom in the late-1980s. In the long term, employment has grown very slowly in contrast with rapid output growth (Figure 1). Such a situation leads the discussion of employment and unemployment to issues of a more structural nature: trade, technological change,

Figure 1. **Industrial production and employment (1985 = 100)**



Source: OECD, *National Accounts* and *Indicators of Industrial Activity.*

inflexible labour markets and organisational change, whose effects on employment have not been fully clarified.

Indeed, the increasing globalisation of national economies is likely to have internationalised unemployment and, to some extent, the problem can be attributed to trade. Various regional agreements and the rapid export-oriented industrialisation in the Pacific-rim area underscore the acute competition which exists between trading partners, and which has forced a number of traditionally protected industries to restructure. The activities of globalised firms have acted as a catalyst in accelerating this change, as their activities invariably entail a global reallocation of production towards low-cost producing countries, causing the destruction of old, low-productivity factories and jobs in high-cost countries.

Meanwhile, a number of product and process innovations, such as new energy conservation techniques or new information technologies, have occurred since the first oil shock, affecting the structure of employment. In particular, computer-based technological change has generated broad applications in use and its wide diffusion has contributed to enhanced economic performance.[1] On the other hand, automation in factories and offices has fundamentally changed the organisation of work, with demand for blue-collar, unskilled workers decreasing and that for more specialised, qualified workers increasing.[2]

The changing pattern of consumer demand is another significant factor affecting the structure of employment. Driven by growing income levels, the services sectors have rapidly increased both output and employment. Changing demand has also led to the restructuring of the manufacturing sector, with labour-intensive sectors declining and capital- and technology-intensive sectors increasing. Moreover, the increasing sophistication of consumer tastes has influenced the production system itself, demanding prompt adaptation to meet the demand for a variety of differentiated products. Traditional mass production systems have eroded and been replaced by computer-controlled production systems (FMS or CIM) used to produce small-batches of specialised products.

Have these factors been associated with employment performance? A number of questions can be raised with regard to this point. Has the expansion of international trade and investment led to an outflow of employment to trading partners? Can the services sector continue to absorb labour released from other sectors? Through higher levels of production, can high-technology sectors play a leading role in job creation? These questions remain open and the available evidence is not sufficient to provide clear policy recommendations.

The aim of this paper is to analyse the major factors responsible in determining the use of labour. Input-output techniques are employed which, by virtue of their inherent design, integrate the various industrial production systems, factor use, trade, technology and patterns of demand. In particular, this framework

makes it possible to address the relationship between sectoral performance and employment which is usually neglected in macroeconomic analysis. The input-output approach which is used here makes it possible to decompose changes in overall employment into various components: specifically, it is possible to isolate employment impacts flowing from changes in final demand, exports, productivity growth or changes in technology (as captured by changes in input-output coefficients). The countries covered in this study are Canada, Denmark, France, Germany, Japan, the Netherlands, the United Kingdom and the United States. Because the focus is on long term structural change in economies, as opposed to cyclical movements, the analysis is conducted over a relatively longer period, covering the decade and a half after the first oil shock.

Section II of the article gives an overview of the direction of change in employment structure across the eight countries. Section III investigates the factors associated with employment growth in the manufacturing and private services sectors. Section IV identifies the changes in employment in growing and declining sectors. Section V analyses the impact of changes in the industrial composition of structural change on employment. Section VI investigates the role of international trade in employment, and Section VII provides some policy implications derived from the analysis. The multiple OECD databases and decomposition methodology used in this study are explained in the annex.

II. DIRECTION OF CHANGE

Reflecting various cross-country differences, the eight OECD countries in the sample have experienced varying patterns of production and employment. In a broad sense, the development process has entailed a massive reallocation of labour across sectors, from primary to secondary and secondary to tertiary (Table 1).[3]

The employment share in the primary sector successively decreased. Natural resource discovery in Denmark, the Netherlands and the United Kingdom did not prevent this downward trend. Manufacturing employment also declined in every country, and in five European countries it also shrank in absolute terms. As a result, the manufacturing sector accounts for less than one-fifth of total employment in every country except Germany. The decline in medium- and low-wage sectors was drastic, while the high-wage sector rose in Denmark, Germany and Japan. A mass of new employment was thus created by the private services sector, in particular by the finance, insurance, real estate and business services (FIRB) sector, and the social and personal services sector. In Denmark, France

Table 1. **Change in sectoral shares of employment**

Percentage point

	Canada 1971-86	Denmark 1972-86	France 1972-85	Germany 1978-86	Japan 1970-85	Netherlands 1972-86	UK 1968-84	US 1972-85
Primary	–2.6	–4.1	–4.7	–1.4	–9.2	–1.1	–1.3	–0.9
Manufacturing	–4.6	–3.9	–4.4	–2.1	–2.5	–5.6	–10.4	–5.0
High-wage	–0.2	0.0	–0.2	0.6	0.2	–0.2	–1.4	–0.4
Medium-wage	–1.9	–1.0	–2.0	–1.1	–0.8	–1.7	–5.5	–1.8
Low-wage	–2.5	–3.0	–2.2	–1.6	–1.9	–3.7	–3.6	–2.8
Service	7.3	1.2	5.9	2.3	9.3	6.6	8.6	7.8
Trade	2.9	–3.1	1.1	0.1	2.0	–0.3	3.3	2.0
Tran. and comm.[1]	–1.0	0.5	0.7	–0.1	0.0	0.6	–0.5	–0.5
FIRB[2]	2.4	4.0	2.5	0.2	1.3	2.2	3.8	4.4
CSPS[3]	3.0	–0.1	1.6	2.1	6.0	4.1	2.0	2.0
Government	0.7	8.7	5.3	2.0	1.4	2.7	4.5	–1.8

1. "Tran. and comm." refers to transportation and communication sector.
2. "FIRB" refers to finance, insurance, real estate and business services sector.
3. "CSPS" refers to community, social and personal services sector.

Source: Secretariat estimates from STAN database and ISDB.

and the United Kingdom, the government service sector played a remarkable role in absorbing labour, although this was not the case in the United States.

The change in sectoral employment can be separated into two components: change in the composition of output by sector; and labour productivity growth of the sector relative to aggregate productivity growth. Compositional change in employment would be the same as change in output composition if sectoral labour productivity grew at the same rate. Although the sources of differences in sectoral labour productivity growth are numerous (capital deepening, technical change, scale economies, etc.), it can, nonetheless, be seen as a measure of the saving achieved over time in the use of labour.

The relative importance of these two factors varies between manufacturing and services sectors (Figures 2 and 3). Although the speed of decline in manufacturing employment differed across the countries, the lower growth in manufacturing output was the key factor in three countries (France, Germany and the United Kingdom), while faster productivity growth in the manufacturing sector was the major source of change in the other five countries. In particular, the impact of productivity was significant in the Netherlands and Japan. Though a simple decomposition, the productivity factor is identified as the principal factor behind the declining share in manufacturing employment in most countries.

For the private services sector, however, changes in output played a predominant role and, therefore, the deviation between changes in employment and

Figure 2. **Sources of employment share change (manufacturing sector)**

Annual growth rate of employment share

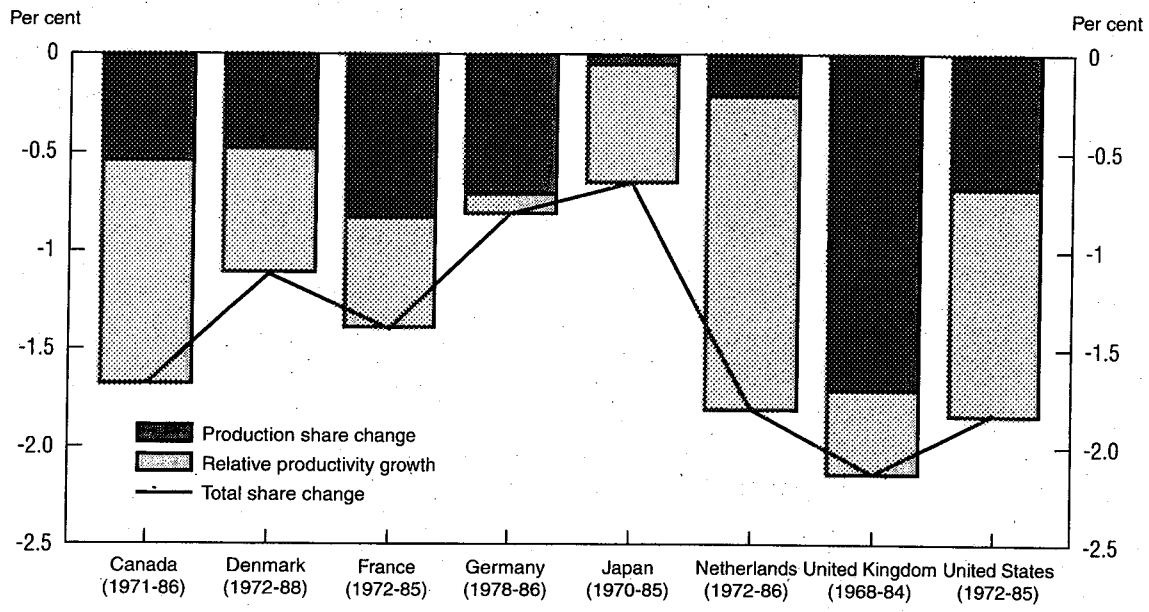
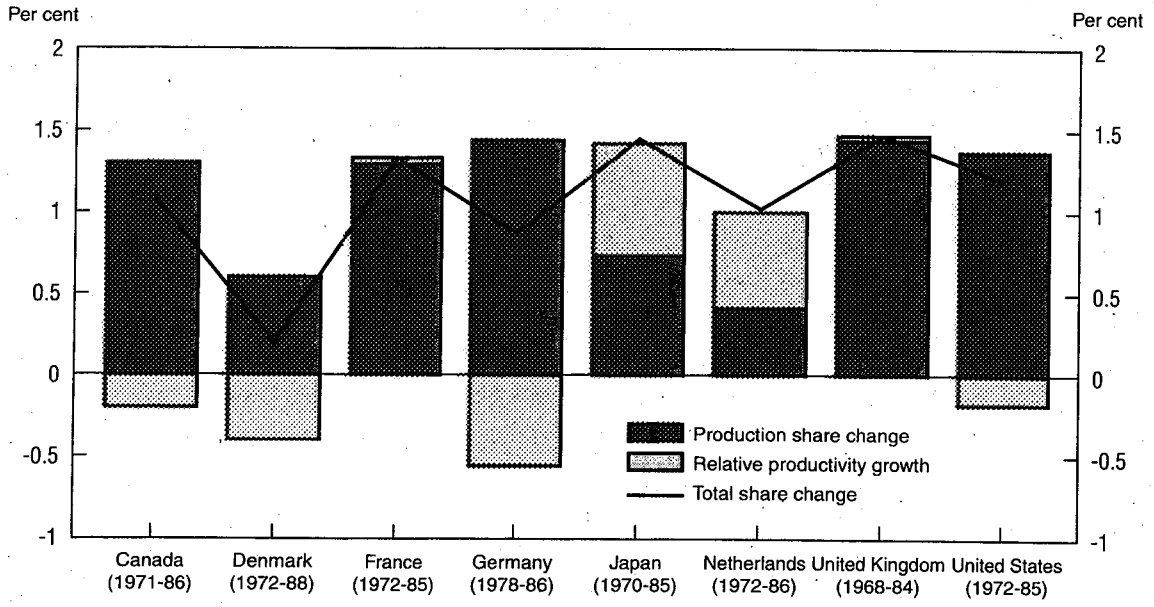


Figure 3. **Sources of employment share change (private service sector)**

Annual growth, rate of employment share



Source: Secretariat estimates from STAN input-output database.

output structure was smaller. However, the productivity factor revealed a negative impact for about half the countries (Canada, Denmark, Germany and the United States), reflecting higher than average productivity in the services sector. In contrast, in the Netherlands and Japan, employment in the services sector was accelerated by the lower than average productivity growth of this sector.

III. SOURCES OF EMPLOYMENT GROWTH

Although deindustrialisation of employment was a common phenomenon observed in the eight OECD countries, employment performance generally differed across the countries. Although the factors generating such cross-country variations can be many, one general cause is associated with the differences which exist in the relationships between employment growth and the various sources of employment demand: demand, trade and technology (see Annex for the decomposition methodology).

Macroeconomy

Canada and the United States were the countries with the fastest employment growth accompanied by the fastest growth in the supply of labour (Table 2). For example, employment in the United States increased by 23.2 million during 1972-85, with a growth rate of 2.0 per cent. In Canada, employment grew at an annual rate of 2.4 per cent between 1971 and 1986, diminishing thereafter.

The contribution of domestic final demand growth was the single largest factor in employment growth in all the countries. Export expansion also played an important role, particularly in small open economies such as Denmark and the Netherlands, and its positive effects generally surpassed import penetration effects in every country except the United Kingdom, where both effects were evenly registered. In contrast, imports hardly affected Japanese employment. Meanwhile, the contribution of changes in input-output coefficients – the deepening and widening interdependency among industries – was small in every country except Japan, where energy-saving technical change had sizeable effects.

Meanwhile, growth in labour productivity (inverse of labour-output ratio) had a large adverse effect in every country. Although its magnitude reflects not only the difference in productivity growth, but also the structural component that arises when resources are allocated from lower productivity to higher productivity sectors, the negative contribution of labour productivity was largest in Japan, followed

Table 2. **Sources of employment growth for eight OECD countries**

Per cent

		Output growth rate	Employ-ment growth rate	Breakdown of employment growth rate				
				Domestic demand expansion	Export expansion	Import penetration	Changes in input-output coefficients	Labour productivity change
Canada	1971-86	3.4	2.4	2.6	1.4	–0.4	0.0	–1.2
	1971-76	4.3	3.2	4.1	1.0	–0.4	–0.4	–1.1
	1976-81	3.4	2.8	2.0	1.1	–0.2	0.4	–0.4
	1981-86	2.6	1.1	1.5	1.7	–0.2	0.0	–1.9
Denmark	1972-88	2.2	0.7	1.3	1.2	–0.3	0.1	–1.6
	1972-77	1.9	0.5	1.4	1.0	–0.4	0.1	–1.6
	1977-80	2.1	0.6	1.1	1.4	–0.2	–0.1	–1.6
	1980-85	2.4	0.7	1.4	1.1	–0.2	0.2	–1.8
	1985-88	2.5	1.2	1.3	1.2	–0.3	0.1	–1.2
France	1972-85	2.2	0.0	1.8	0.8	–0.4	0.1	–2.3
	1972-77	3.0	0.4	2.2	0.9	–0.4	0.1	–2.4
	1977-80	2.8	0.2	2.1	0.9	–0.5	0.3	–2.6
	1980-85	1.0	–0.4	1.2	0.5	–0.3	0.0	–1.8
Germany	1978-86	1.7	0.3	1.1	0.9	–0.5	0.0	–1.2
Japan	1970-85	4.1	0.8	3.9	1.0	–0.1	–0.5	–3.5
	1970-75	4.6	0.6	3.9	0.6	–0.1	–0.5	–3.4
	1975-80	4.5	0.9	3.7	0.8	–0.2	0.2	–3.5
	1980-85	3.1	0.8	2.9	0.7	–0.1	–0.5	–2.2
Netherlands	1972-86	3.3	0.0	1.8	1.5	–0.3	0.2	–3.2
	1972-77	6.3	–0.0	3.9	1.9	–0.4	0.3	–5.7
	1977-81	1.3	0.3	0.5	1.3	–0.2	0.1	–1.4
	1981-86	1.9	–0.2	0.7	1.0	–0.3	0.1	–1.8
United Kingdom	1968-84	1.9	–0.2	2.1	0.7	–0.7	0.2	–2.6
	1968-79	2.8	0.2	2.5	0.9	–0.6	0.6	–3.1
	1979-84	0.1	–1.1	1.4	0.3	–0.7	–0.9	–1.2
United States	1972-85	2.3	2.0	2.6	0.3	–0.3	0.1	–0.8
	1972-77	2.6	2.0	2.4	0.5	–0.3	0.4	–1.1
	1977-82	1.2	1.5	1.4	0.3	–0.1	0.1	–0.1
	1982-85	3.5	2.7	4.3	0.0	–0.4	–0.2	–0.9

Source: Secretariat estimates from STAN input-output database.

by the Netherlands. However, its relative magnitude to the net combination of other effects (namely the production expansion effect) was highest in the Netherlands, followed by (in descending order) France, the United Kingdom, Japan, Germany, Denmark, Canada and the United States, varying in value for the longest-period in each country from –1.0 at the top to –0.33 at the bottom.

Labour adjustment tends to be more severe in a country where the ratio is close to –1.

It is noticeable that periodically the primary source of employment downturn in the mid-1980s was stagnant domestic demand and weak export growth. Other factors did not show any apparent relationship with this downturn. Rather, the labour productivity factor tended to mitigate the adverse shocks by revealing counter-cyclical movements.

Manufacturing sector

Although the manufacturing sector occupies at maximum 20 to 30 per cent of total employment in most OECD countries, it is worthwhile investigating its trend because of its leading role in innovation and broad influence on other sectors, for example as a supplier of capital equipment. Table 3 shows sources of manufacturing employment growth in a relatively long term perspective for three major manufacturing groups, segregated on the basis of wages per employee: high-wage, medium-wage and low-wage. (See annex for these three groupings.)

Three non-European countries – Canada, Japan and the United States – maintained manufacturing employment during the period concerned, while it declined in the five European countries. The key element which brought about such different outcomes tends to be the strength of domestic demand growth. Trade and other factors are usually relegated to secondary importance. However, confronted with stagnant domestic economies, export was the key positive factor for manufacturing employment in most European countries. The large negative impact of labour productivity growth accelerated the weak employment performance in each of the EU countries, except Germany.

In Canada, the high-wage manufacturing group registered the highest growth of the three groups led by export expansion. Employment in the computer and office equipment, aerospace and motor vehicle sectors increased by depending almost exclusively on export-led growth. Although rapid labour productivity increases and import penetration cancelled out most of the potential employment gains, Canada enjoyed positive employment growth due to strong market expansion. Meanwhile, the importance of exports and domestic demand was smaller in the medium- and low-wage manufacturing group. Owing to economy-wide energy-material conservation, the negative impacts associated with changes in input-output coefficients have mainly affected the medium-wage sectors (steel, metals and cement). Similarly, reflecting changing comparative advantages in this country, the negative contribution of import penetration was relatively larger in the low-wage group.

Table 3. **Decomposition of employment growth in the manufacturing sector**

Per cent

	Manufacturing sector	Employ-ment growth rate	Domestic final demand	Exports	Import penetration	Technical change	Labour productivity
Canada (1971-86)	Total	0.7	2.1	2.7	–1.5	–0.2	–2.5
	High-wage	1.9	2.5	6.9	–3.5	0.6	–4.6
	Medium-wage	0.7	2.0	2.6	–1.2	–0.6	–2.2
	Low-wage	0.1	2.1	1.3	–1.1	–0.1	–2.1
Denmark (1972-88)	Total	–0.4	0.5	2.6	–1.1	–0.0	–2.4
	High-wage	0.9	0.3	4.5	–1.3	0.2	–2.9
	Medium-wage	0.1	0.5	2.7	–1.0	0.1	–2.1
	Low-wage	–1.3	0.4	2.2	–1.2	–0.1	–2.6
France (1972-85)	Total	–1.4	1.1	1.7	–1.2	–0.1	–2.9
	High-wage	–0.3	1.8	2.9	–1.5	–0.2	–3.3
	Medium-wage	–1.4	0.9	1.9	–1.2	–0.1	–2.9
	Low-wage	–1.8	1.0	1.0	–1.2	0.1	–2.7
Germany (1978-86)	Total	–0.5	0.6	1.8	–1.1	–0.4	–1.4
	High-wage	1.7	0.9	3.2	–1.1	0.1	–1.5
	Medium-wage	–0.6	0.6	1.4	–0.9	–0.6	–1.0
	Low-wage	–1.3	0.4	1.6	–1.3	–0.2	–1.8
Japan (1970-85)	Total	0.1	3.5	2.6	–0.1	–0.4	–5.6
	High-wage	1.2	6.0	6.7	0.3	3.1	–14.9
	Medium-wage	0.4	3.3	3.0	–0.0	–0.7	–5.3
	Low-wage	–0.6	2.9	0.7	–0.3	–1.1	–2.8
Netherlands (1972-86)	Total	–1.8	0.9	3.3	–0.9	0.1	–5.2
	High-wage	–0.4	0.8	6.7	–0.5	0.3	–7.7
	Medium-wage	–1.5	1.1	2.0	–0.9	0.1	–3.8
	Low-wage	–2.8	0.8	2.8	–1.2	0.1	–5.3
United Kingdom (1968-84)	Total	–2.8	1.1	1.1	–1.8	–0.1	–3.1
	High-wage	–2.5	1.7	2.3	–2.9	0.1	–3.6
	Medium-wage	–3.1	0.9	1.0	–1.5	–0.2	–3.3
	Low-wage	2.7	1.0	0.7	–1.6	0.0	–2.7
United States (1972-85)	Total	0.1	3.0	0.8	–1.0	–0.3	–2.3
	High-wage	1.0	6.2	2.4	–1.2	0.9	–7.3
	Medium-wage	0.7	2.8	0.7	–0.9	–0.6	–1.2
	Low-wage	–1.1	1.7	0.3	–1.0	–0.5	–1.6

Source: Secretariat estimates from STAN input-output database.

In Japan, a net increase in both high- and medium-wage sectors more than offset the decrease in low-wage employment. Although high-wage employment is only a small part of manufacturing employment, it played a leading role in manu-

facturing job creation. Many of the factors offset one another: export expansion and domestic final demand were the dominant positive factors, followed by changes in input-output coefficients, and positive import penetration effects (*i.e.* import substitution or displacement of imports for domestic products). These gains were offset by a large increase in labour productivity. Though causality among factors is not clear, a virtuous circle appears to have been created between supply, demand and productivity. On the other hand, the decrease in employment in the low-wage group is attributable to lower export growth and unfavourable changes in production technology.

In the United States, employment in the high-wage manufacturing sector increased by 0.4 million and in the medium-wage sector by 0.8 million, while there was an offsetting loss in the low-wage sector of 0.9 million. Within the high-wage group, employment increased in such high-technology sectors as pharmaceuticals, computers and office equipment and aerospace, while it decreased in the motor vehicle, industrial chemicals and petroleum refining sectors. The bulk of employment growth in this group was driven by domestic final demand and, to a lesser extent, by exports. However, market growth did not support employment as much in the medium- and low-wage groups as in the high-wage group. In particular, it decreased in all sectors in the low-wage group during 1972-85, as a result of stagnant growth of demand and a higher degree of import competition.

In Denmark, declining employment in the manufacturing sector was due to job losses in the low-wage manufacturing sector, the bulk of which occurred in the 1970s, principally as a result of productivity growth and, to a lesser extent, import competition. The adverse effect of import penetration was greater in the 1980s. Meanwhile, employment growth in high- and medium-wage manufacturing (0.94 and 0.14 per cent respectively) was led by export expansion and, less importantly, by domestic final demand growth. The negative contributions of labour productivity and import penetration were not small, but were more than offset by positive growth factors.

In Germany, manufacturing employment decreased by 326 000 between 1978 and 1986. It had accounted for 38 per cent of total employment in 1970, but fell to 32 per cent in the late-1980s. The major part of the decrease occurred in the low-wage sector and, to a lesser degree, the medium-wage sector. Although labour productivity growth was the largest factor in this decline, the degree of contribution was the smallest among the eight countries, perhaps reflecting Germany's good industrial relations. Unlike the United States and Japan where domestic demand played a significant role, the German manufacturing sector was more dependent on foreign demand.

In France, 917 000 jobs were lost in manufacturing between 1972 and 1985, of which 70 per cent between 1980 and 1985. As in Germany, the growth of domestic final demand was sluggish and export growth was the major contributor

to employment growth. Although import penetration had a sizeable negative effect, the largest factor in declining employment is attributable to labour productivity changes.

In the Netherlands, while manufacturing output grew fast, employment decreased by 264 000. Even in the economic boom of 1972-77, manufacturing employment decreased, despite growth of 6.2 per cent in domestic production, with the low-wage sector accounting for 65 per cent of the decline. The decomposition results indicate that export expansion was the single largest factor for increasing employment, and domestic demand had only a marginal impact. However, such potential jobs were not actually realised because of a substantial rise in labour productivity.

Finally, in the United Kingdom, employment in manufacturing industries declined significantly. The pharmaceuticals sector was the only sector which exhibited positive employment growth. Employment in the manufacturing sector fell by 3.2 million between 1968 and 1984, with more than half the decrease occurring during 1979-84. The rate of decrease in employment was almost evenly distributed across sectors: the high-wage sector contributed to 14 per cent of manufacturing loss, with labour productivity changes being the largest factor, followed by import penetration. Job expansion associated with exports and domestic final demand could not overcome such large negative impacts. Although labour productivity changes played a dominant role in reducing employment, the negative effect of import penetration was significant.

Services sector

In the United States, employment in the private services sector increased by 19 million, accounting for more than 80 per cent of the increase in total employment between 1972 and 1985. The finance, insurance, real estate and business services (FIRB) sector was the key contributor to this surge, with 35 per cent of the increase – the growth of employment in this sector had almost doubled by 1985 to 13.6 millions). Within the FIRB group, the real estate and business services sector registered the highest growth (6.3 per cent) of all the sectors in the economy. The major engines for this growth were rapid domestic final demand growth and deteriorating labour productivity (Table 4). The community, social, and private services (CSPS) sector also grew fast, due to domestic final demand growth. The large negative contribution of the increase in labour productivity in transport and communications is attributable to the increasing efficiency of the communications sector.

In Japan, the services sector as a whole accounted for most of the increase in employment during 1970-85, when 9.2 million jobs were generated; the com-

Table 4. **Decomposition of employment growth in private service sector**

Per cent

	Sector	Employ-ment growth rate	Domestic final demand	Exports	Import penetration	Technical change	Labour productivity
Canada (1971-86)	Trade	3.3	3.3	0.6	–0.2	0.1	–0.5
	Tran. and comm.[1]	1.5	3.7	0.9	–0.2	0.0	–3.0
	FIRB[2]	4.2	4.0	1.0	–0.2	1.5	–2.1
	CSPS[3]	5.2	4.8	0.3	0.0	0.2	0.0
Denmark (1972-88)	Trade	–0.6	1.0	1.5	–0.1	–0.1	–3.0
	Tran. and comm.	1.0	1.2	1.8	–0.1	0.2	–2.1
	FIRB	3.9	2.2	0.2	–0.1	1.1	0.5
	CSPS	0.6	1.5	0.4	–0.1	0.1	–1.3
France (1972-85)	Trade	0.6	1.9	0.4	–0.1	–0.0	–1.5
	Tran. and comm.	1.1	3.1	0.9	–0.3	1.0	–3.7
	FIRB	2.9	2.6	0.8	–0.3	1.2	–1.4
	CSPS	2.4	3.7	0.4	–0.1	0.5	–2.1
Germany (1978-86)	Trade	0.4	1.2	0.8	–0.2	–0.3	–1.0
	Tran. and comm.	0.1	1.4	1.4	–0.4	1.3	–3.7
	FIRB	1.4	2.2	0.6	–0.2	1.8	–3.0
	CSPS	3.1	1.8	0.3	–0.1	0.5	0.7
Japan (1970-85)	Trade	1.6	4.0	0.9	–0.1	–0.8	–2.6
	Tran. and comm.	0.8	2.8	0.8	–0.2	0.1	–2.6
	FIRB	3.2	3.9	0.7	–0.1	1.2	–2.5
	CSPS	3.4	4.1	0.2	–0.1	0.3	–1.1
Netherlands (1972-86)	Trade	–0.1	1.3	1.4	–0.1	–0.1	–2.6
	Tran. and comm.	0.7	1.5	2.1	–0.1	0.6	–3.5
	FIRB	2.2	3.4	1.0	–0.2	1.6	–3.6
	CSPS	2.0	2.9	0.3	–0.0	0.0	–1.2
United Kingdom (1968-84)	Trade	1.2	2.6	0.8	–0.4	–0.1	–1.8
	Tran. and comm.	–0.8	1.2	0.2	–0.6	–0.6	–1.0
	FIRB	4.3	2.4	0.9	–0.1	3.7	–2.6
	CSPS	2.5	2.6	0.6	–0.5	–0.6	0.3
United States (1972-85)	Trade	2.7	3.0	0.3	–0.1	0.3	–0.8
	Tran. and comm.	1.1	2.8	0.4	–0.2	0.2	–2.2
	FIRB	5.2	3.3	0.3	–0.1	0.3	1.5
	CSPS	3.1	3.5	0.2	–0.1	1.0	–1.4

1. "Tran. and comm." refers to transportation and communication sector.
2. "FIRB" refers to finance, insurance, real estate and business service sector.
3. "CSPS" refers to community, social and personal services sector.

Source: Secretariat estimates from STAN input-output database.

munity, social and private service (CSPS) sector being the largest contributor with 4.5 million. Unlike the United States, the increase in employment in the FIRB sector was not large in either growth rate or volume terms. Although domestic final demand growth played a predominant role in increasing employment in the

services sector, changes in input-output coefficients had a significant impact on FIRB employment growth. Labour productivity had a negative effect in every sector, but it was less than the positive impacts of demand growth.

In Germany, employment in services increased by 72 000, with the CSPS sector registering the largest increase – 6 000 – during 1978-86. The expansion of domestic final demand and a decrease in labour productivity were the major factors behind this gain. The FIRB sector registered the second highest growth, led by final demand and, to a lesser extent, changes in input-output coefficients – on average, industries made more intensive use of financial and other business services. However, such gains were partly offset by the negative contribution of labour productivity growth. Employment growth in the transport sector was negligible due to slack demand and strong labour productivity improvements, even though employment grew positively due to domestic demand growth and changes in input-output coefficients.

In France, employment in the services sector as a whole increased by 832 000 in the period 1972-85. The FIRB sector registered the strongest growth, driven by domestic final demand, exports and changes in input-output coefficients – more use of financial and other business services by industries. The CSPS sector showed the second highest growth, led by domestic final demand. The negative impact of labour productivity was pronounced in the transport and communication sector.

In spite of a stagnant overall employment record during the period, employment in the UK services sector registered positive growth, and between 1968 and 1983, 1.9 million jobs were created in the private services sector, including 1 million in the FIRB sector. Although labour productivity increases partly offset the increase in employment in this sector, the effect of market expansion – led mainly by changes in input-output coefficients which favour inputs of financial and business services – more than compensated for this adverse impact. Meanwhile, employment declined in transport and communications, mainly because of slack growth in domestic demand.

In Canada, the CSPS sector attained the highest rate of growth, due principally to strong domestic final demand growth, supported by the absence of labour productivity improvements. The major engine for employment growth in the FIRB sector was also growth in domestic demand and, to a lesser extent, changes in input-output coefficients. Meanwhile, growth in the transport and communication sectors was slower due to productivity improvements.

In the Netherlands, employment in the private services sector increased by 188 000 in the period 1972-86. The fastest growth was attained in the FIRB sector, led by domestic final demand growth, technological change and exports. Within this group, the real estate and business services sector increased by

2.9 per cent, driven by the rapid growth in domestic final demand which occurred between 1972-77 (a boom originated from the surge in Dutch natural gas exports). The CSPS sector also grew quickly, largely because of strong domestic final demand and slower labour productivity increases. However, employment growth in both the FIRB and CSPS sectors stagnated between 1981 and 1986 because of slack domestic demand. Within the transport and communication group, the communication sector registered 1.8 per cent growth, largely due to strong domestic final demand. Meanwhile, the trade sector reduced labour due to the combined effects of low demand growth and high labour productivity growth.

In Denmark, employment in the private services sector increased by 111 000 between 1972 and 1988. The bulk of new employment was created by the finance, insurance, real estate and business services (FIRB) sector, led by domestic final demand growth and changes in input-output coefficients. To a lesser extent, negative labour productivity growth and the expansion of exports also benefited employment in the FIRB sector. The increase in employment in the transport and communication sector was due mostly to expansion of exports and domestic final demand, although two-thirds of these effects were offset by labour productivity growth, the impact of which was greatest in the trade sector.

IV. GROWING/DECLINING SECTORS OF EMPLOYMENT

As seen in the previous section, a major source of employment growth was the private services sector. Although its contribution was much smaller, the high-wage, high-technology manufacturing sector also played an important role. On the other hand, the adverse effects of structural change forced severe adjustments in the low-wage, traditional sectors. It is interesting to look at this change at a detailed sectoral level in order to capture the different patterns of employment performance between growing sectors and declining sectors.

Growing sectors

Table 5 shows the ranking of the ten industries with the fastest employment growth for each of the eight countries over the various time periods available in this study. Most of the services sectors are ranked in the top ten in every country.[4] In particular, the FIRB sector (or its sub-sectors: finance and insurance and real estate and business services) is ranked in the top three in five countries, and even

Table 5. **Ten highest employment growth industries and dominant factor**

	Canada 1971-86	Denmark 1972-88	France 1972-85	Germany 1978-86	Japan 1970-85	Netherlands 1972-86	UK 1968-84	US 1972-85
1	CSPS* *DFD*	Real estate* *DFD/Tech*	FIRB* *DFD*	Non-ferrous *Exports/LP(–)*	Computers* *DFD/Exports*	Real estate* *DFD*	FIRB* *Tech/DFD*	Real estate* *DFD/LP(–)*
2	Computers* *Exports/DFD*	Finance *DFD*	Computers* *DFD/Exports*	Aerospace* *Exports/DFD*	CSPS *DFD*	Aerospace *Exports*	CSPS *DFD*	Computers* *DFD*
3	FIRB* *DFD*	Pharmaceutical* *Exports*	CSPS* *DFD*	Computers* *Exports/DFD*	FIRB* *DFD*	CSPS *DFD*	Government* *DFD*	Finance* *DFD*
4	Hotels *DFD*	Government* *DFD*	EGW* *DFD*	CSPS* *DFD*	Electronics* *Exports/DFD*	Communicat.* *DFD/Tech*	Trade* *DFD*	Hotels *DFD*
5	Plastics* *Exports/DFD*	Instruments* *Exports*	Communicat.* *DFD*	Motor vehicles* *Exports*	Plastics *DFD/Exports*	Government *DFD*	Pharmaceutical* *DFD*	CSPS* *DFD*
6	Aerospace* *Exports*	Electronics* *Exports*	Government* *DFD*	Hotels *LP(–)/DFD*	Government* *DFD*	Finance* *DFD/Tech*	Transport *DFD*	Mining *LP(+)*
7	W &R trade *DFD*	Other transport *Exports*	Electronics* *Exports/DFD*	Government *DFD*	Motor vehicles* *Exports/Tech*	Motor vehicles* *Exports*	Plastics* *Tech/Exports*	Electronics* *DFD*
8	Government *DFD*	Communicat.* *DFD/Tech*	Aerospace* *Exports*	FIRB* *DFD/Tech*	Aerospace* *Import (+)*	Hotels *DFD*	Construction *DFD*	W & R trade* *DFD*
9	Motor vehicles* *Exports*	EGW* *DFD/Tech*	Hotels *DFD*	Plastics* *Exports*	Trade *DFD*	EGW *DFD/Tech*	Food *Tech/Exports*	Aerospace* *DFD*
10	Mining *Exports*	Non-elec. mach. *Exports*	Transport *DFD/Exports*	EGW *DFD/Exports*	EGW *DFD*	Transport *Exports*	Electronics* *Exports/DFD*	Instruments* *DFD*

Notes: The industry with an asterisk indicates that this sector is also listed in the top-ten ranking of output growth rate in the same time period. DFD is domestic final demand; Tech is changes in input-output coefficients; LP is labour productivity increase and LP(–) is its decrease; Imports is import penetration and Import(+) is import substitution.

Source: Secretariat estimates from STAN input-output database.

in the others it is usually listed in the top ten. Similarly, the community, social and personal services (CSPS) sector is listed in the top five in every country except Denmark. The trade sector and its sub-sectors (hotels and restaurants and wholesale and retail trade) also appear in the top ten list of each of the five countries which list hotels and restaurants. Compared with these service sectors, the transport and communication sector is listed in only three countries: Denmark, France and the Netherlands. Another common sector given top ten ranking is the government services sector (including both government and other producers' services), which is listed in all countries but the United States.

The table also shows that employment growth in most of these services was demand-driven (domestic final demand or exports) and that some sectors – FIRB, communications and utilities – also gained from technological change. Although the decrease in labour productivity had a visible effect in some countries (US real estate and German hotels and restaurants), it was exceptional. Therefore, it can be said that given the low labour productivity growth in services, most of the change in services sector employment was associated with consumers' shifting demand for services and technological change – more intensive use of financial, communication and business services by industries.

Although generally characterised by an overall decline in employment, employment did grow in several manufacturing sectors, though their shares in employment were only a small part of total employment (for example, 3.1 per cent for the United States and less than 6 per cent in Japan and Germany). These manufacturing sectors were typically high-wage, high-growth, and high-technology sectors, such as computers and office equipment, aerospace, motor vehicles, pharmaceuticals, electronics (communications equipment and semi-conductors), instruments, and rubber and plastics. Their productivity growth was generally high, but strong growth in exports and final demand outweighed such negative impacts. In particular, the role of exports was significant in all the countries except for the United States. In countries with a relatively small domestic market, exports were the predominant factor over domestic final demand, while the reverse was true in the United States.

Even though the ranking for each country reveals many common industries, the industries not common to all might give an insight into particular comparative advantages or country specific development patterns. For example, only Canada and the United States list the mining sector in the top ten group, as a result of export growth in the former and a decrease in labour productivity in the latter. Germany is the only country to place non-ferrous metals at the top, while Denmark is the sole country to have "other transport" in the top ten. Only Canada, Germany and Japan have the motor vehicle industry in the top group. In Japan, the aerospace industry benefited mainly from import substitution. Only in Denmark and the United Kingdom are pharmaceuticals listed in the top-ten rank-

ing (the only manufacturing sector in the United Kingdom which recorded positive employment growth).

In summary, the key sectors for employment growth were services and a few technologically-sophisticated, high-wage manufacturing industries. Most of these sectors also enjoyed the fastest growth in output which proves a positive correlation between market expansion and employment growth at the sectoral level.

Declining sectors

Conversely, Table 6 shows the ranking of the industries with the lowest employment growth by country. Strikingly, most of these industries co-incide with those listed in the bottom ten for output growth, indicating the increased possibility of parallel adjustment between output and employment (employment growth rates were negative in all listed industries, except for the bottom two in Canada). The list also shows that massive employment adjustment has occurred, because all these manufacturing sectors used to occupy relatively large shares in manufacturing employment and production. Across the eight countries, the decline is particularly concentrated in low-wage, labour-intensive manufacturing industries such as: textiles, footwear and leather; food, drink and tobacco; wood cork and furniture; electrical machinery; other transport; and other manufacturing and heavy industries like ferrous metal; non-ferrous metal; fabricated metal; non-metallic mineral products; and chemicals.

Textiles and shipbuilding are ranked within the five slowest industries for seven of the eight countries, and in five of them they come in the slowest two. The fall of employment in ferrous metal was also significant and is listed within the five slowest industries for five countries and is at the bottom in the United Kingdom and the United States. Other industries with slow employment growth in common include non-metallic mineral products, other transport, non-ferrous metal, food, drink and tobacco, and fabricated metals. Although the list is predominantly manufacturing, it includes some other sectors such as agriculture, mining, construction, and trade.

While the factors responsible for declining employment generally vary between sectors and across countries, the predominance of labour productivity growth is clear, though technical change and import penetration have also played a role. Of the ten industries with the slowest employment growth in each country, labour productivity was the primary factor in nine in France and the Netherlands, eight in Canada, seven in Denmark, Japan and the United Kingdom, while it appears to have had less impact in Germany and the United States. Technical change was less significant, but it was a primary factor in three of the ten slowest industries in Japan and the United States and in two in Germany.

Table 6. **Ten lowest employment growth industries and dominant factor**

	Canada 1971-86	Denmark 1972-88	France 1972-85	Germany 1978-86	Japan 1970-85	Netherlands 1972-86	UK 1968-84	US 1972-85
1	Shipbuilding* *LP/Imports*	Textiles* *LP/Imports*	Textiles* *LP/Imports*	Shipbuilding* *LP/Exports*	Mining* *Tech/Imports*	Textiles* *LP/Imports*	Ferrous metal* *LP*	Ferrous metal* *Tech*
2	Textiles* *LP/Imports*	Shipbuilding* *DFD/LP*	Mining* *LP/Tech*	Textiles* *Imports/LP*	Shipbuilding* *LP/DFD*	Shipbuilding* *Exports/LP*	Instruments* *LP/Imports*	Other transport* *DFD/LP*
3	Non-ferrous* *LP*	Agriculture *LP*	Agriculture *LP*	Ferrous metal* *Tech/LP*	Agriculture* *LP/Tech*	Wood* *LP*	Non-ferrous* *Imports/LP*	Textiles* *LP/Imports*
4	Ferrous metal* *Tech/LP*	Ferrous metal *LP*	Shipbuilding* *LP*	Agriculture *LP*	Wood* *Tech/LP*	Other transport* *LP*	Shipbuilding* *LP/Imports*	Other manuf.* *Imports*
5	Electrical mach.* *LP/Imports*	Stone* *LP/DFD*	Stone* *LP*	Stone* *LP*	Other transport* *LP/Tech*	Stone* *LP*	Textiles* *LP/Imports*	Stone* *Tech/LP*
6	Other transport* *Imports*	Non-ferrous* *Imports/Tech*	Other transport* *LP/Exports*	Other manuf. *LP*	Chemicals *LP*	Mining *LP*	Fab. metals* *Tech*	Food *LP*
7	Agriculture *LP*	Electrical mach.* *LP*	Ferrous metal* *Tech/LP*	Wood* *DFD/Tech*	Textiles* *LP/Tech*	Construction* *LP*	Motor vehicles* *Imports*	Non-ferrous* *Tech*
8	Electronics *LP/Imports*	Trade *LP*	Fab. metals* *LP/Imports*	Construction* *LP*	Stone* *Tech/LP*	Fab. metals* *LP*	Non-elec. mach.* *LP/Imports*	Agriculture *LP*
9	Food* *LP*	Food *LP*	Construction* *LP*	Food *LP*	Fab. metals *LP*	Food *LP*	Mining *LP*	Chemicals *LP*
10	Stone* *LP/Tech*	Construction* *DFD*	Non-elec. mach. *LP*	Mining* *Tech*	Other manuf. *LP*	Electrical mach. *LP*	Chemicals *LP/Imports*	Fab. metals *LP/Tech*

Notes: The industry with an asterisk indicates this sector is also listed in the bottom-ten ranking of output growth rate in the same time period. DFD is domestic final demand; Tech is changes in input-output coefficients; LP is labour productivity increase; Imports is import penetration.
Source: Secretariat estimates from STAN input-output database.

Import penetration was a much less important factor in the declining employment in the bottom ten industries, though it was a primary factor in two sectors in the United Kingdom. However, it appeared relatively frequently as the second largest factor in some declining industries, particularly textiles and shipbuilding (the second dominant factors were listed if their magnitudes were within the ratio of 1:2 against the magnitude of the predominant factor). The frequency of the factor combination of labour productivity and import penetration was high in the United Kingdom and Canada. In contrast, the combination of labour productivity and technology appeared frequently in Japan. Less frequently, labour productivity was also associated with declining exports and/or domestic final demand. Although the causal relationships between factors are not clear, it seems that labour productivity change in declining industries is closely related to other factors: for example, it is likely that the change in labour productivity was triggered by increasing import competition. A more sector-specific model is needed to clarify causality among these factors.

V. IMPACT OF STRUCTURAL CHANGE ON EMPLOYMENT

Although the growth decomposition results give a useful picture of employment growth, they do not provide clear relationships between structural change in the economy and employment, because they include not only the effects of economic growth, but also those of structural change. It is necessary to identify the change in employment due to structural change by separating absolute changes in domestic final demand and exports into the parts accounted for by proportional growth of the economy and those due to a compositional change in demand. It is the latter that bring about compositional change in output (industrial structural change). As a result, the following factors can be distinguished as being causes of structural change in employment: shifting demand and export patterns; change in import penetration ratios; change in input-output coefficients; and labour productivity change.

Table 7 summarises the estimated impacts of structural change on employment over the various periods in time. The actual change in employment is decomposed into three major factors: *i)* part due to proportional economic growth; *ii)* part due to labour productivity change; and *iii) part due to compositional change in real gross output (i.e.* industrial structural change). For every country, the actual change in employment during a period was far less than the hypothetical employment necessary for the economy to enjoy proportional growth. In balanced growth, both output and employment grow at the same rate for every sector. The deviation of actual change in employment from the balanced growth requirements

Table 7. **Impact of structural change on employment**

Thousand persons

Country/period	Canada 1971-86	Denmark 1972-86	France 1972-85	Germany 1978-86	Japan 1972-85	Nether-lands 1972-86	UK 1968-84	US 1972-85
Terminal-year employment	11 347	2 620	21 401	26 856	61 041	4 689	24 060	103 031
Change in employment	3 373	274	97	726	6 607	–1	–785	23 175
a) Proportional growth	5 219	986	6 831	3 657	44 556	2 675	8 923	26 727
b) Productivity change	–2 074	–758	–7 138	–2 609	–37 980	–2 567	–11 630	–10 878
c) Industrial composition	228	46	404	–322	31	–109	1 922	7 326
Shifts in final demand	215	–161	–63	–490	372	–414	2 440	6 593
I-O coefficients	13	51	302	11	–4 413	163	915	1 520
Net trade	26	157	166	157	4 072	142	–1 434	–787
Shifts in exports	578	294	1 370	1 175	5 336	371	1 374	2 847
OECD area	555	151	663	1 283	4 155	321	460	1 227
DAEs + China	32	10	91	66	1 081	14	57	421
ROW	16	18	285	–330	343	–73	–90	305
Non-manuf. exports	–25	114	331	157	–243	110	947	894
Import penetration	–552	–137	–1 204	–1 018	–1 264	–229	–2 808	–3 634
OECD area	–496	–105	–1 033	–874	–81	–178	–2 293	–1 838
DAEs + China	–144	–31	–82	–95	–252	–41	–270	–1 384
ROW	–5	–20	–157	–95	55	11	–197	–377
Non-manuf. imports	92	19	68	47	–985	–21	–48	–36

Note: The regional breakdown of trade flows is only done for manufacturing trade.
Source: Secretariat estimates.

are therefore attributable to disproportional factors, namely, change due to labour productivity and change due to compositional change in output (see also the methodological annex for a more detailed explanation of this type of model).

The result shows that labour productivity change is the predominant factor explaining most of the deviation, revealing a large-scale labour-saving effect in every country, and especially in Japan. Change in industrial structure had only a marginal effect in most countries, except for the United States and the United Kingdom. This may suggest that the impact of compositional change in output on employment is by and large negligible, at least in a macroeconomic context, and that job creation is much more dependent on economic growth itself.

However, for two swiftly deindustrialising countries – the United States and the United Kingdom – structural change had a visible labour-augmenting impact, mainly led by shifts in domestic final demand. For other countries, though not significant, the effects of a changing industrial structure were labour-saving in Germany and the Netherlands, and labour-augmenting in Canada, France and Denmark.

A few points can be made about the different contributions of structural factors across the countries. Changes in input-output coefficients were most prominent in Japan and three-quarters of this effect came from the agricultural sector. For other countries, technical change was rather labour-augmenting, typically through the widening and deepening of linkages between manufacturing and services. On the other hand, international trade had a positive net impact in most countries, except for the United Kingdom and the United States, and Japan was the largest gainer from trade. Shifts in exports include changes in both export-output ratios and in the sectoral composition of exports. In general, the net employment effects of shifting exports and import penetration differed between three trading partners and across countries. Trade with the OECD area revealed a negative employment impact in the United Kingdom, the United States and France. Although the magnitude of the impact was smaller, trade with the Dynamic Asian Economies (DAEs) and China benefited Japan and, to a lesser extent, France. Non-manufacturing trade (agriculture, mining and autonomous services trade) might have played a significant role in employment in every country except Japan, which is poorly endowed with natural resources.

VI. TRADE AND EMPLOYMENT

International trade has frequently been identified as a cause of unemployment. As already shown, it is a major factor in the changing structure of output

and, thus, allocation of labour across sectors. The importance of trade can be shown by the fact that exports grew faster than domestic production, and imports faster than domestic final demand (Table 8). Trade exposure has increased, particularly in high-wage manufacturing sectors, in both exports and imports.

Geographic change in trade is also very pronounced in every country. Dependency on intra-OECD exports increased in every country. In particular, intra-OECD exports have become more concentrated in high-wage, high-technology products. Exports to non-OECD countries have varied.[5] The share of exports to the DAEs plus China has increased rapidly in every sector and every country, while exports to the rest of the world have declined drastically since the early 1980s because of increased economic difficulties in the OPEC and other developing countries. Similarly, imports from the DAEs plus China have increased dramatically in every country, especially for categories of low-wage products. Reflecting increasing international linkages, the import shares from this region are higher in the Pacific-rim countries (Japan, the United States and Canada). Although

Table 8. **Export orientation and import penetration in manufacturing sector**

Per cent

		Export-output ratio				Import penetration ratio			
		Total	High-wage	Medium-wage	Low-wage	Total	High-wage	Medium-wage	Low-wage
Canada	1971	24	32	28	14	26	38	28	15
	1986	37	55	36	19	40	59	37	23
Denmark	1972	34	35	30	37	42	65	39	32
	1988	50	52	46	52	53	70	52	46
France	1972	17	21	17	13	15	16	19	11
	1985	27	35	26	20	26	31	26	20
Germany	1978	23	29	24	16	19	24	15	19
	1986	30	35	29	24	25	31	20	25
Japan	1970	8	7	9	6	6	12	4	5
	1985	14	26	15	7	6	8	4	7
Netherlands	1972	43	60	37	36	40	51	40	35
	1986	56	80	41	47	52	72	47	45
United Kingdom	1968	19	25	20	13	16	17	15	17
	1984	27	42	26	18	32	44	27	28
United States	1972	5	6	5	3	7	8	6	6
	1985	8	12	7	5	13	15	12	12

Source: Secretariat estimates from STAN input-output database.

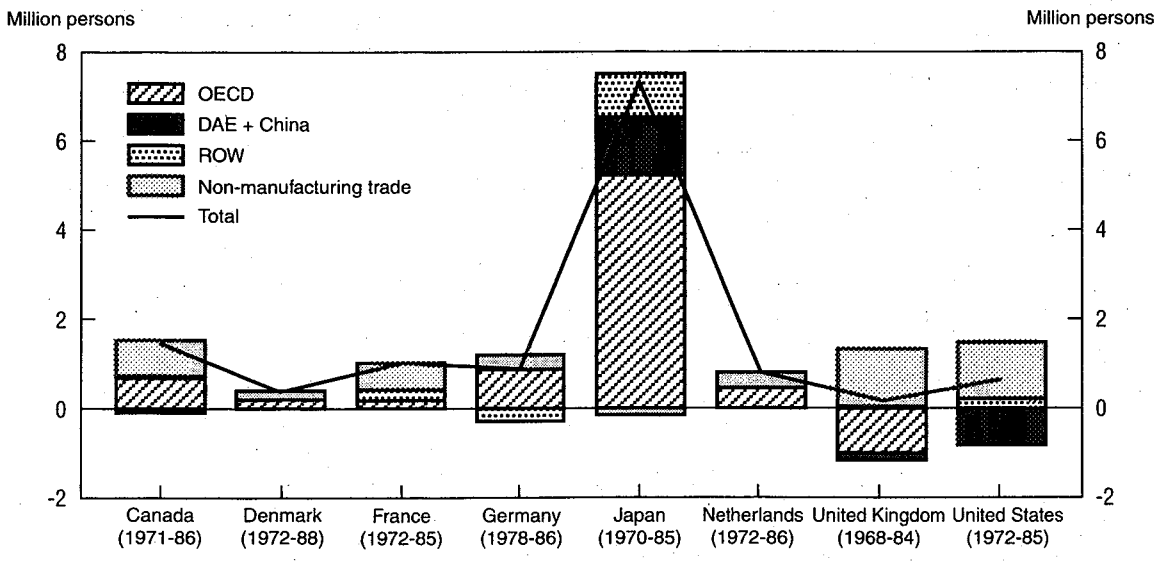
imports from this area have previously been concentrated on low-wage, labour-intensive products, some capital-intensive, high-technology products are increasing rapidly.[6]

Net impacts on employment: growth accounting results

The increasing trade dependency of domestic activities also implies that an increasing portion of employment is exposed directly or indirectly to international trade. Figure 4 shows the net impact of trade on employment in the eight OECD countries (note that the results show potential impacts subject to constant labour productivity).

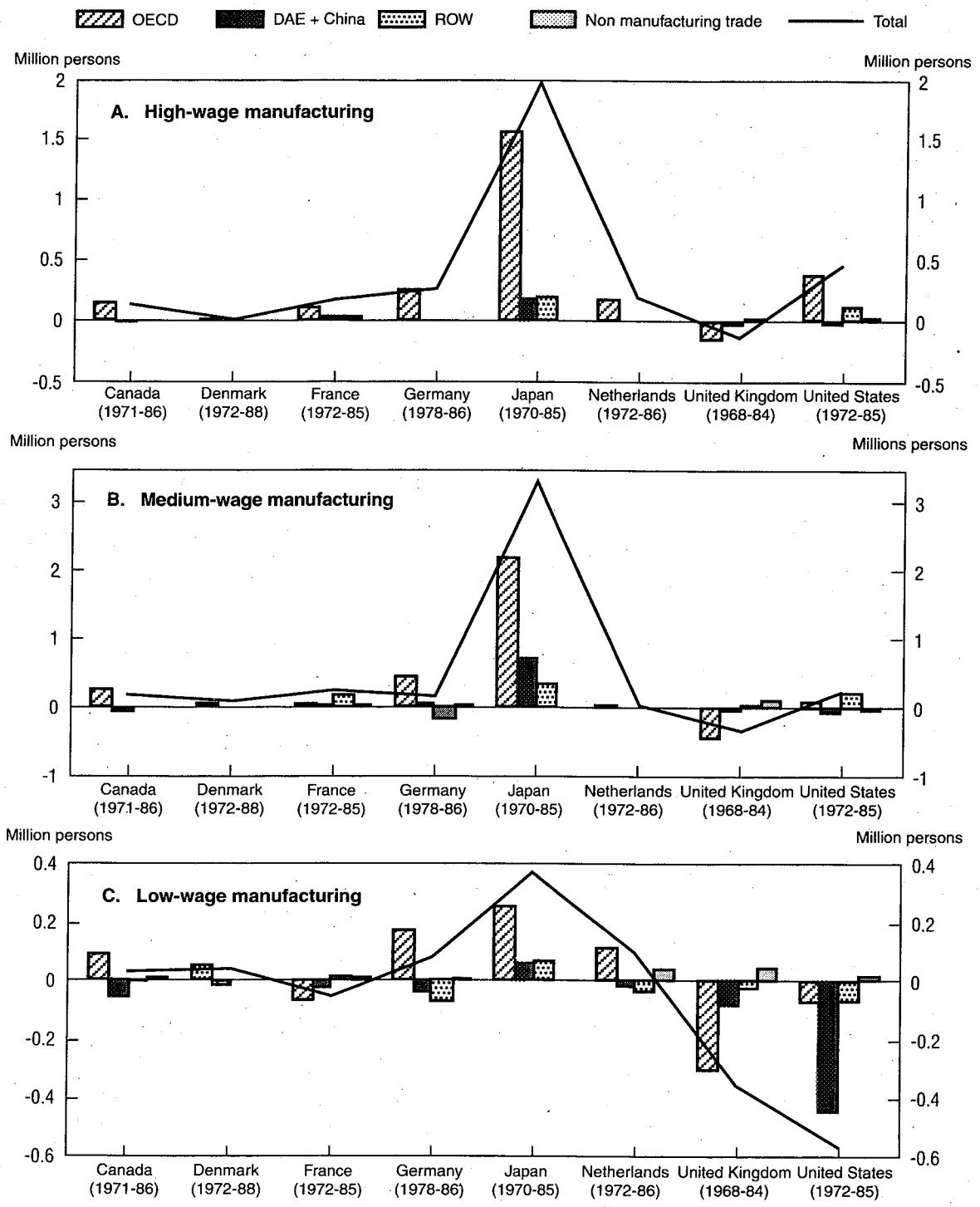
Remarkable net employment gains in Japan amount to 7.3 million, equivalent to 12 per cent of total 1985 employment. More than two-thirds of this large gain stems from intra-OECD trade. Although the magnitude is much less, the other seven countries by and large gained from trade. However, the gains were distributed across the countries and, relative to the latest measures of employment, are as follows: the Netherlands (17 per cent), Denmark (14 per cent), Canada (13 per cent), France (5 per cent), Germany (3 per cent), the United Kingdom and the

Figure 4. **Trade impacts on employment**
Total economy



Source: Secretariat estimates from STAN input-output database.

Figure 5. **Manufacturing employment balance**



Source: Secretariat estimates from STAN input-output database.

United States (less than 1 per cent). It is interesting that, with the exception of Germany, the Netherlands and Japan, manufacturing trade did not contribute as much to employment as non-manufacturing trade. Intra-OECD trade generally had a positive impact on domestic employment in every country except the United Kingdom. The trade with the DAEs plus China had an adverse impact in the United States and, to a lesser extent, in the United Kingdom and Canada. Although less important, manufacturing trade with the rest of the world was beneficial for every country except Germany.

Figure 5 shows the net employment impacts of trade for three manufacturing groups. Japan gained in every group and from every region and its manufacturing gains accounted for three-quarters of the total gains. In contrast with Japan, the effects were adverse in the United Kingdom and the United States. The United Kingdom registered the loss of 826 000 jobs in the manufacturing sector during 1968-84, with 458 000 in the low-wage sector especially resulting from trade with the DAEs and China. For the other five countries, trade was beneficial for manufacturing employment during the periods concerned.

Several researchers stress the potential causalities among responsible factors, for example, those between import competition and labour productivity change. If this is true, some portion of labour productivity effects is attributable to increasing foreign competition and in this case positive gains in employment from trade might be overestimated. They also insist that the low-wage, low-skilled jobs are being replaced by imports from developing countries. However, they overlook the other side of the coin, that trade brings about an increase in high-wage, high-skilled, high-quality jobs, as stated in the traditional theory of comparative advantage. If trade-induced employment loss is a problem, attention should be paid to enhancing the performance of sectors where advanced countries have a comparative advantage.

Employment content of exports and imports

Since the bulk of the empirical literature on the impacts of trade on employment has been concerned with the employment content of trade, it might be useful to present estimates of this alternative type of indicator.

Table 9 shows the percentage of the workforce which is directly or indirectly engaged in exports and imports (for imports, it is measured negatively by the notional number of workers displaced by imports).[7]

Generally, the dependency of employment on trade (both imports and imports) is especially high in Denmark, the Netherlands and Canada, accounting for about 30 per cent of total employment, and lower in the United States and Japan. Nevertheless, domestic employment became more dependent on export

Table 9. **Percentage shares of employment engaged in international trade**

Total employment = 100

		Total exports	Total imports	Manufacturing exports				Manufacturing imports			
				Total	OECD	DAEs[1]	ROW	Total	OECD	DAEs[1]	ROW
Canada	1971	27.1	–23.1	13.6	12.4	0.1	1.1	–14.0	–12.6	–0.4	–1.0
	1976	27.4	–26.9	12.4	11.0	0.2	1.2	–15.2	–13.7	–0.7	–0.8
	1981	29.6	–26.3	13.7	12.0	0.3	1.4	–14.8	–13.2	–0.8	–0.8
	1986	32.3	–24.2	14.5	13.2	0.3	1.0	–15.5	–13.4	–1.2	–0.9
Denmark	1972	24.0	–24.4	16.6	14.0	0.2	2.3	–18.2	–16.6	–0.3	–1.3
	1977	24.1	–23.2	16.0	12.8	0.2	3.1	–19.0	–16.8	–0.6	–1.6
	1980	25.5	–21.4	17.2	14.0	0.3	2.8	–16.7	–14.9	–0.5	–1.3
	1985	26.5	–21.5	18.5	14.9	0.5	3.1	–19.0	–16.9	–0.6	–1.5
	1988	27.4	–20.9	18.1	15.2	0.5	2.5	–19.1	–16.8	–1.0	–1.4
France	1972	13.2	–16.0	9.6	7.3	0.1	2.3	–8.3	–7.3	–0.1	–0.9
	1977	15.0	–16.3	11.5	7.8	0.2	3.6	–9.6	–8.3	–0.2	–1.1
	1980	15.8	–16.5	11.9	8.2	0.2	3.6	–10.9	–9.4	–0.3	–1.2
	1985	16.4	–15.8	12.0	8.6	0.4	3.0	–11.4	–9.8	–0.4	–1.2
Germany	1978	20.4	–19.5	16.7	12.2	0.4	4.2	–12.2	–10.2	–0.5	–1.5
	1986	23.2	–20.3	19.2	15.8	0.6	2.8	–14.3	–12.1	–0.7	–1.6
Japan	1970	8.6	–12.9	6.2	3.3	1.2	1.7	–3.8	–3.2	–0.1	–0.1
	1975	9.5	–12.1	7.2	3.0	1.3	2.9	–3.2	–2.7	–0.2	–0.3
	1980	9.9	–11.8	7.6	3.6	1.6	2.5	–3.6	–3.0	–0.3	–0.4
	1985	10.9	–10.7	8.5	5.1	1.8	1.7	–3.4	–2.7	–0.3	–0.3
Netherlands	1972	29.5	–23.2	18.3	14.1	0.2	4.1	–19.8	–17.8	–0.4	–1.6
	1977	28.9	–22.8	17.6	12.9	0.1	4.6	–19.9	–17.4	–0.6	–1.8
	1981	30.5	–21.5	17.7	14.1	0.3	3.3	–18.6	–18.6	–0.7	–1.2
	1986	30.9	–22.8	18.1	15.6	0.3	2.2	–19.8	–19.7	–0.8	–1.1
United Kingdom	1968	19.1	–18.7	14.3	9.5	0.6	4.3	–11.5	–9.2	–0.5	–1.9
	1979	22.6	–22.3	14.9	9.8	0.6	4.4	–15.8	–12.6	–0.8	–2.4
	1984	19.6	–21.0	11.6	8.0	0.6	3.0	–14.9	–12.2	–0.9	–1.8
United States	1972	4.3	–4.1	2.7	1.7	0.1	0.9	–3.8	–2.8	–0.2	–0.7
	1977	6.0	–5.5	3.7	2.1	0.2	1.4	–4.4	–2.9	–0.7	–0.8
	1982	6.8	–5.6	4.0	2.2	0.4	1.5	–5.0	–3.3	–1.0	–0.8
	1985	5.5	–6.4	3.3	2.0	0.4	0.9	–6.2	–4.0	–1.2	–0.9

1. DAEs cover Korea, Taiwan, Hong Kong, Singapore, Malaysia, Thailand plus China.
Source: Secretariat estimates.

activities in every country, in spite of a perception that deindustrialisation might increase the portion of workers engaged in non-traded sectors. The relative balance of employment engaged in exports and displaced by imports is likely to be largely affected by non-manufacturing trade, in particular that of the primary

sectors (agriculture and mining). In France and Japan manufacturing trade had a positive balance, but registered negative in the total balance because of a large negative contribution by the mining sector. Due to differences in natural resource endowments, employment dependency on total trade tends to suffer from this type of disturbance.

Meanwhile, the percentage of workers engaged in manufacturing exports is less than 20 per cent in every country, although the trend is increasing. The same is true for the portion of workers displaced by manufacturing imports. For both exports and imports, trade with the OECD area accounted for the majority and trade with other regions is still small (ranging in recent years from 0.3 per cent to 1.8 per cent for trade with the DAEs and China, and from 0.9 per cent to 3 per cent for trade with the rest of the world). It is interesting that the impact of trade with the DAEs and China revealed a labour-saving bias, while trade with the rest of the world had a rather strong labour-increasing effect.

The above impact indicator is subject to change in the volume of exports and imports and it is, therefore, difficult to trace the employment impacts of the difference in commodity structure in exports and imports. Generally, it is considered that developing countries export labour-intensive products and import capital-intensive ones. Hence, changes in the same amount of exports and imports may cause considerable labour-saving effects on employment in industrialised countries. Table 10 shows the estimated total employment intensity of exports (imports) for recent years. The figures are evaluated in terms of the labour required to produce $1 billion of manufacturing exports (imports) between three trading partners.[8, 9]

The calculated indicator of the employment content of exports and imports reflects not only the different composition of exports and imports, but also the differences in sectoral labour productivity, production technology, the degree of import penetration, etc., and exchange rate fluctuations. Nevertheless, it is likely that countries which export relatively large amounts of goods produced with high productivity have a lower labour content in exports than countries which import products which are relatively labour-intensive. Therefore, a lower employment content in exports from the United States and the Netherlands is associated with a large share of high-wage exports in these countries (for example, they accounted for 53 per cent of US, and 45 per cent of Dutch exports). Conversely, the higher labour content of Danish exports is attributable to the higher shares of low-wage, low-productive products in total exports.

Across the trading partners, the employment content of exports to developing countries is higher than to developed countries, with the exception of Japan. However, the differences between developed and developing countries are not so large. For five of the eight countries, trade with the DAEs and China area was the most labour-intensive. The reason for the reverse magnitude of Japanese labour

Table 10. **Effects of trade on employment across trading partners**

	Canada (1986)	Denmark (1988)	France (1985)	Germany (1986)	Japan (1985)	Netherlands (1986)	UK (1984)	US (1985)
	Employment dependent on exports (1 000 persons engaged per $1 billion of exports at 1982 prices)							
Total economy	24.4	36.2	34.4	31.5	33.5	16.8	38.0	19.4
OECD	24.2	36.2	34.0	31.4	34.0	16.9	37.1	18.9
DAEs + China	25.8	38.0	35.2	32.5	32.8	17.5	40.4	20.3
ROW	28.2	35.8	35.5	31.9	32.9	16.4	40.1	20.2
	Employment equivalent of imports (1 000 persons engaged per $1 billion of imports at 1982 prices)							
Total economy	22.8	33.3	34.0	29.7	33.4	21.3	39.4	21.2
OECD	22.0	34.0	34.4	29.7	32.4	21.9	39.1	20.7
DAEs + China	29.5	39.7	37.7	33.2	53.1	24.3	45.1	25.7
ROW	31.5	24.9	29.9	28.1	29.3	14.3	38.5	18.9
	Ratio of exports/imports							
Total economy	1.07	1.08	1.01	1.06	1.00	0.79	0.96	0.91
OECD	1.10	1.06	0.99	1.06	1.05	0.77	0.95	0.91
DAEs + China	0.88	0.96	0.93	0.98	0.62	0.72	0.89	0.79
ROW	0.89	1.44	1.18	1.13	1.12	1.14	1.04	1.07
Total manufacturing	0.94	0.98	1.02	1.11	1.25	0.70	0.96	0.88
OECD	0.98	0.94	0.97	1.10	1.33	0.69	0.94	0.88
DAEs + China	0.66	0.93	0.92	1.00	0.65	0.64	0.85	0.71
ROW	0.86	1.63	1.35	1.28	1.61	1.16	1.11	1.15
High-wage manufacturing	0.99	0.82	1.26	1.38	2.05	0.61	1.14	1.36
OECD	0.95	0.70	1.22	1.30	2.37	0.59	1.07	1.20
DAEs + China	2.09	2.40	4.92	2.98	2.09	0.94	1.90	2.41
ROW	1.13	1.79	1.74	2.04	2.85	1.76	1.38	2.16
Medium-wage manufacturing	1.03	0.93	1.00	1.32	1.83	0.73	1.09	0.96
OECD	0.99	0.81	0.86	1.20	1.67	0.68	0.96	0.81
DAEs + China	1.66	1.92	1.08	2.98	2.66	1.10	1.40	1.09
ROW	1.68	3.77	2.29	2.04	3.16	1.67	2.24	1.78
Low-wage manufacturing	0.77	1.09	0.88	0.76	0.50	0.77	0.70	0.53
OECD	1.00	1.23	0.99	0.85	0.53	0.80	0.81	0.75
DAEs + China	0.22	0.31	0.31	0.31	0.19	0.43	0.44	0.24
ROW	0.35	0.74	0.63	0.56	0.58	0.82	0.47	0.48

Source: Secretariat estimates.

content between the OECD area and developing countries might be found in its relatively higher proportion of medium-wage exports to the OECD region and the lower proportion of low-wage exports to developing countries.

Meanwhile, for five countries (Canada, Denmark, France, Germany and Japan), the employment content of imports is lower than that of exports. Hence the balanced expansion of total exports and total imports is labour-increasing for these countries and labour-saving for the other three countries (the Netherlands, the United Kingdom and the United States).

Compared with exports, regional differences in the employment content of imports vary considerably: labour intensity is higher in imports from the DAEs and China region and lower in imports from the rest of the world. Therefore, a balanced expansion of trade with the rest of the world is generally favourable for domestic employment, while with the DAEs and China region it has a strong labour-saving tendency. In a balanced trade framework, the negative impacts of trade with the DAEs and China are higher in Japan, the Netherlands and the United States, and lower in Germany, Denmark and France. Lastly, while balanced trade with the OECD area has a labour-using impact in Canada, Denmark, Germany and Japan, it is labour-saving in the Netherlands, the United States, the United Kingdom and, to a slight extent, in France.

For the manufacturing sector, a balanced increase in trade is especially favourable for Japan and Germany. They are the only two countries which gain from this type of trade with the OECD area. For most countries, employment is increasing in trade with the rest of the world, while trade with the DAEs and China reveals a tendency towards labour-shedding. Within the manufacturing sector, a balanced growth of high-wage sector trade has a large labour-augmenting effect in five countries (Japan, Germany, the United States, France and the United Kingdom) and the gains are larger in trade with developing countries. In contrast, a balanced expansion of trade has a considerable labour-saving impact on the low-wage manufacturing sector, regardless of the sources of imports. Denmark is the only country which had a positive employment effect in this sector.

Considering the revealed growth dispersion among developing countries, arguments on the employment impacts of North-South trade need a suitable breakdown in the South. Although the use of trade flows might currently be the only effective way of measuring the employment impacts of globalisation, it is also important to analyse the impacts by focusing on the functional behaviour of multinational enterprises in international factor allocation. Domestic employment opportunities will be reduced not only by import inflows, but also by the shift of production facilities abroad. It is easy to think of numerous potential routes affecting employment (FDI-related exports of automobile parts, the so-called boomerang phenomenon, the usage of capital gains from FDI). Thus, our current calculations can only explain the tip of the iceberg and more comprehensive research will be needed as a basis for reliable policy recommendations.

VII. CONCLUSIONS

The current weak employment performance in most OECD countries has many roots and this analysis only begins to shed light on some of its economic impact: principally the relationship between employment and economic growth and structural change. Even in this narrower scope, explanations vary across countries and general conclusions are elusive. Nevertheless, our findings can provide a bridge into policy discussions.

Deindustrialisation is a common feature characterising structural change in major OECD countries. Led by domestic demand growth, the private services sector is the major engine of employment growth. With the creation of high-quality services through investment in new information technologies, deregulation policy might positively contribute to this surge. Thus, privatisation or deregulation in other service sectors (telecommunications and wholesale and retail trade) will generally lead to new employment. Although the resulting rationalisation of such services may have an adverse impact on employment, there is no evidence that such labour-saving impacts exceed the positive gains of market growth in the economy as a whole.

Another avenue for creating new employment can be found in the further development of advanced manufacturing sectors. As the high-technology sectors (aerospace, pharmaceuticals, motor vehicles) were the cluster of manufacturing industries which increased employment, continuing efforts for developing new products should be a key focus of industrial policy. Since information technologies have not been fully exploited for commercialisation because of the long time-lag involved in society adapting to a new technology paradigm, technology and innovation policy should enhance the capacity for adopting and implementing these technologies. Since new manufacturing activities tend to have close ties with information services, their promotion also stimulates employment in service sectors. Without innovation in manufacturing firms, software companies cannot sustain increasing employment.

International trade is an important source of employment growth due to new products. It is more important for small open economies to exploit the benefits of economies of scale and other production-demand gains. As long as free trade has a mechanism of allocating resources from low-productive sectors to high-productive sectors, a free trade stance should be accommodated with the above technology and industrial policies.

Meanwhile, structural change entails a restructuring with associated pain in declining low-productivity sectors. Although employment adjustment in such sectors might have been accelerated by import penetration and adverse technical change, stagnant growth of domestic demand and exports was found to be a

major factor. As long as declining demand is an autonomous factor, adjusting employment is necessary if distressed firms are to survive and cope with the harsh competition from cheap foreign products.

With regard to structural change, the analysis confirms that the contribution of change in industrial structure was not so large in most OECD countries, with the exception of the United States and the United Kingdom, where rapid deindustrialisation, led by shifting final demand, revealed a sizable labour-using effect. As a result, productivity factors accounted for most labour-saving in all the countries concerned. Needless to say, productivity growth itself contributed to enhancing economic activities and economic welfare. However, it might not be easy to translate these into welfare gains if the observed change in labour productivity was mainly driven by various distortions maintained in labour markets. Thus, active labour market policies will be needed to reduce the burden of labour costs and prevent excessive restructuring in firms.

All these concerted efforts to improve employment performance will contribute to higher economic growth and therefore to creating new employment. One necessary condition is the enhancement of the adaptive and innovative capacity of economies in order to provide workers with good-quality jobs. Although tackling large-scale unemployment is high on the policy agenda, the most advanced countries should not commit themselves to the creation of low-wage jobs at the expense of blocking imports from developing countries, or by retarding ongoing technological innovations and their wide diffusion.

Annex

DATABASES AND DECOMPOSITION METHODOLOGY

Databases

The OECD databases used in this paper are compiled for a common industrial classification (ISIC Rev. 2) at a relatively fine level of manufacturing (22 industries) which includes technology-intensive and trade-oriented sectors such as aerospace, computers and communication equipment and semiconductors.

Internationally-comparable input-output tables

This database currently covers the G7 countries plus Australia, Denmark and the Netherlands. For most of the countries, the input-output data have four component matrices: domestic intermediate transaction matrix, imported intermediate flow matrix, domestic fixed investment flow matrix, and imported fixed investment flow matrix. The data typically cover benchmark years for each country, spanning from the early-1970s to the mid-1980s. The database exists in both current and constant price terms for almost 33 ISIC sectors.

Bilateral trade database

From the foreign trade component of the OECD COMTAP (COMpatible Trade and Production) database, bilateral trade flow matrices describing imports and exports of the manufacturing sector by partner countries were compiled at the same classification level as used in the input-output database. The period covered ranges from 1967 to 1987 for 14 OECD countries and a "Rest of the OECD" category on a nominal US dollar basis.

Time-series sectoral employment data

The sectoral employment data compatible with the input-output classification are from the employment component of the ISDB and STAN databases. The data start around 1970.

Wage-based grouping for manufacturing sector

The following industrial grouping was applied for 22 manufacturing sectors to help in the interpretation of the results.[10, 11] The classification of industries into high, medium and low wage groups was built by using the average labour compensation data (including supplementary benefits) across nine countries: Australia, Canada, Finland, Germany, Japan, Norway, Sweden, the United Kingdom and the United States for the year 1985. The groupings were tested for 1975 and 1980, as well as for additional country groupings where data was available, and appeared quite stable.

High-wage group

Chemicals (ISIC code 351 + 352 – 3522); Pharmaceuticals (3522); Petroleum refineries; coal and petroleum products (353 + 354); Office equipment and computers (3825); Motor vehicles (3843); Aircraft (3845).

Medium-wage group

Paper products and printing (340); Rubber and plastic products (355 + 356); Non-metallic mineral products (36); Iron and steel (371); Non-ferrous metals (372); Metal products (381); Non-electrical machinery (382 – 3825); Radio, TV and communication equipment (3832); Shipbuilding and repairing (3841); Instruments (385).

Low-wage group

Food, beverages and tobacco (31); Textiles, apparel and leather (32); Wood, cork and furniture (33); Other electrical machinery (383 – 3832); Other transport (3842 + 3844 + 3849); Other manufacturing (900).

Decomposition methodology

This part of the annex presents the technical background of the accounting procedure which decomposes changes in employment into its sources.[12] Although a more systematic model is clearly needed, the growth accounting approach remains useful for its easy implementation and for providing a first interpretation of changes in employment.

Assuming sectoral demand for labour is linearly proportionate to output, the labour demand function takes a form of $L_i = l_i X_i$ ($i = 1, 2, 3, ...n$) where L_i is employment of sector i, X_i is gross output of sector i, and l_i is the average labour-output ratio (the reciprocal of labour productivity). Then, the change in employment in an industry during a period can be separated into two major parts: one due to the change in gross output and the other due to the change in labour requirements per unit of output. Namely, we obtain:

$$\Delta L_i = L_i^1 - L_i^0 = L_i^0 \Delta X_i + \Delta l_i X_i^1 = l_i^1 \Delta X_i + \Delta l_i X_i^0 \qquad (1)$$

where the numbered superscripts refer to the two years compared, base year 0 and comparative year 1. Note that the two kinds of expression in decomposed terms appear in such a discrete time setting.[13]

Using the material balance equation in an input-output framework, the effects of a change in output (ΔX_i) on employment in the above equation can be further decomposed into demand factors that explain the change in output. Equation (2) describes the balance equation in an import-competitive input-output account:

$$X_i = u_i(\sum_{j=1}^{n} X_{ij} + F_i) + E_i \qquad (i = 1, 2, 3, ...n) \qquad (2)$$

where X_{ij} is the demand for the output of industry i purchased by industry j, F_i is the total domestic final demand for the output of industry i, E_i is the exports and u_i is the ratio of demand for domestically produced goods relative to total domestic demand for industry i defined as $(X_i - E_i) / (\Sigma X_{ij} + F_i) = 1 - M_i / (\Sigma X_{ij} + F_i) = 1 - m_i$, where m_i is the import penetration ratio for industry i.

In matrix notation and using an input-output coefficient matrix, equation (2) can be transformed to:

$$X = (I - \hat{u}A)^{-1}(\hat{u}F + E) = B^d(\hat{u}F + E) \qquad (3)$$

where matrix $B^d = [b^d_{ij}]$ is the Leontief inverse defined by the domestic input-output coefficient matrix $\hat{u}A$ and the hat ^ over a variable denotes a diagonal matrix.

Decomposition of absolute change in employment

The decomposition model is formulated in two ways. One is the absolute comparison or "first-difference model" which directly compares changes in a variable in a given time period. The other is the "deviation model" which compares the comparative year with the hypothetical balanced growth point which would have been realised, had the industrial structure not changed during the time. Since the latter is derived in the same way as the former, we start with the formulation of the first-difference model.[14]

From the balance equation (2), it follows that changes in sectoral production over time can be traced back to changes in domestic final demand, exports, domestic demand ratios,

and input-output coefficients. The absolute change in output $\Delta X(X(t) - X(t-1))$ can be decomposed as:

$$\Delta X = X^1 - X^0 = B^{d0}\hat{u}^0\Delta F + B^{d0}\Delta E - B^{d0}\Delta\hat{m}(F^1 + W^1) + B^{d0}\hat{u}^0\Delta AX^1 \qquad (4)$$

and hence by substituting equation (4) into equation (1), the decomposition of the change in employment is derived for a particular industry i as:

$$\begin{aligned}
\Delta L_i = {} & l^0_i \sum_{j=1}^{n} b_{ij}^{d0} u_j^0 \Delta F_j && \text{domestic final demand expansion} \\
& + l^0_i \sum_{j=1}^{n} b_{ij}^{d0} \Delta E_j && \text{export expansion} \\
& - l^0_i \sum_{j=1}^{n} b_{ij}^{d0} \Delta m_j (F_j^1 + W_j^1) && \text{import penetration} \\
& + l^0_i \sum_{j=1}^{n} b_{ij}^{d0} u^0_j \sum_{k=1}^{n} \Delta a_{jk} X_k^1 && \text{change in input-output coefficients} \\
& + \Delta l_i X_i^1 && \text{change in labour-output ratio}
\end{aligned} \qquad (5)$$

where W is the total intermediate demand vector defined as $W = AX = (\Sigma a_{ij} X_j)$.[15]

The first term in the decomposition indicates changes in employment induced by the expansion of domestic final demand (household consumption, fixed investment, government expenditures etc.). The second term measures the effects of a change in exports on employment. The third term measures the direct and indirect effects of import penetration on employment. The fourth term measures the employment effect of changes in intermediate demand provoked by changes in input-output coefficients. The last term defines the effects of labour productivity change on employment. All these decomposed terms are defined to include not only the direct effects, but also the indirect effects through the expansion of intermediate demand among industries concerned. Hence, for example, even if exports for steel do not change during a period, the export contribution on employment can change if the exports for downstream users (automobiles, etc.) change. Similarly, even though steel imports do not change, import penetration effects for the steel industry can be large when the import penetration ratio in the automobile sector rises.

Factors underlying changes in the above individual terms cannot be detected in our model. Changes in domestic final demand are related to a host of exogenous variables such as relative prices, demographics, tastes and income level, as well as government policies. Changes in exports are caused by natural resources and endowments of human capital, exchange rates, trade policies and the openness of markets and the rates of growth in those markets to which the country is exporting. They will also depend on factors specific to each industry such as labour costs, the rate of long-term investment and expenditure on innovation.

The degree of import penetration depends more directly on the level of internationalisation of a country and the rate of trade exposure of its industries. A negative value in this term indicates that purchases of imports have increased, reducing the potential output

growth of the domestic industry. On the other hand, a positive value represents a displacement of imports for domestic products.

Intermediate demand tends to refer to raw materials, semi-finished goods, and business services. They are provided by suppliers to an industry which transforms them, using capital and labour inputs, into the industry's output. This combination or mix of inputs represents the industry's production recipe since it reflects not only the ingredients used to make its product, but also the know-how involved in combining these inputs into a final product. The pattern of input mixes across all industries is called the "technology" of the economy. An increase in the use of inputs relative to total output is an indicator of increased specialisation of the production process: industries are "out-sourcing" more of their inputs. There could be many reasons for this. Relative prices may change, favouring raw materials over capital and labour. Anti-trust or other regulatory influences may lead to the breakup of large corporations. Conversely, a decrease in the use of inputs as a proportion of output indicates that more processes are being undertaken "in-house", possibly to capture economies of scale. Alternatively, innovations may lead to an increase in production efficiency in the use of raw materials which results in fewer inputs being required to produce the same output level. Or it may simply reflect the substitution into other materials or primary inputs. Whatever the cause, these production recipes are a reflection of the technology of the economy and are subject to all the forces of technological change.

Changes in labour productivity also reflect various factors: factor substitution in response to technological developments and changes in factor prices, as well as changes in production efficiency or in "Solow's residual". It may also depend on economies of scale and the growth of markets whether demand comes from the domestic market or abroad. Moreover, import competition may stimulate labour-saving technological progress or labour shedding through rationalisation. In a short-term perspective, there is also a cyclical aspect to productivity movements. In a recession, firms do not always lay off as many workers as would be indicated by falling sales. They often practise labour hoarding and consequently, when the economy recovers, it may be some time before they hire more workers. Although labour productivity growth is generally considered as an indicator for economic welfare, it is interpreted in this sectoral analysis as measuring the degree of saving achieved over time in use of labour per unit of output.

The above decomposition formula for employment growth can be applied in various forms. Dividing the individual terms by ΔL_i yields share distributions of individual factors, indicating how the decomposed terms contributed to changes in employment. Growth rate measures of decomposition used in this paper are simply obtained by multiplying such factor shares by the annual growth rate of sectoral employment in a specific period.

Decomposition of deviation from balanced growth

While the absolute change model does not distinguish between the effects of growth and those of structural change, the deviation model concentrates only on the factors of structural change in the economy. To do so, a proportionate growth point is selected for

comparison, in which all sectors grow at the same rate equal to aggregate output growth. In balanced growth, the composition of output remains constant and in this sense there is no structural change. The model then examines deviations between balanced and terminal-year situations of the economy and measures the factors which brought about non-proportional growth.

Let λ denote the ratio of total output of the comparative to base year and define $\delta X_i = X^1_i - \lambda X^0_i$ as measuring the deviation between the comparative-year production and the balanced growth production. Then, analogous to the first-difference model, the deviation from balanced growth on employment can be decomposed into:

$$\delta L = \hat{l}^0 B^{do} \hat{u}^0 \delta F + \hat{l}^0 B^{do} \delta E - \hat{l}^0 B^{do} \Delta \hat{m} (F^1 + W^1) + \hat{l}^0 B^{do} \hat{u}^0 \Delta A X^1 + \Delta \hat{l} X^1 \qquad (6)$$

The deviation model thus eliminates proportionate expansion effects of the economy: it is only the differential part of growth that remains. The deviation model thus deals directly with changes in the structure of the economy rather than with growth rates *per se*. In equation (6), the first four terms, namely changes in the composition of final demand and exports (for export, these include effects of the change in export ratio to output), changes in import penetration ratio and input-output coefficients, indicate the effects of change in industrial structure on employment, and the last term accounts for the direct effect of productivity growth.

Lastly, the relationship between the absolute model and deviation model can be shown as:

$$\Delta L = (L^1 - \lambda L^0) + (\lambda L^0 - L^0) = \delta L + (\lambda - 1) L^0 \qquad (7)$$

where λL is the balanced growth labour inputs required to produce the balanced growth output (λX). Absolute change in sectoral employment can be thus decomposed into the deviation portion from balanced growth and the proportional growth portion. Since the deviation part can be largely divided into effects of compositional change in output and labour productivity growth, actual change in employment during a period is decomposed into (due to economic growth) + (due to change in industrial structure) + (due to change in labour productivity).

Impacts of regional trade on employment

The decomposition model can be extended to measure the impacts of exports and imports respectively to the country of destination and by the country of origin. Using the bilateral trade flow data for manufacturing, the trade components in input-output data were split between trade partners or regions.[16]

$$E^M = \sum_{k=1}^{m} E^M_k , \qquad M^M = \sum_{k=1}^{m} M^M_k \qquad (8)$$

where E^M_k is the vector of manufacturing exports for region k and M^M_k is the vector of manufacturing imports from region k, with zero values for the non-manufacturing elements in both vectors.

The second and third term in equation (5) can be thus decomposed into respectively:

$$l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta E_j = \sum_{k=1}^{m} (l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta E^M_{jk}) + l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta E^S_j \qquad (9)$$

$$- l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta m_j (F^1_j + W^1_j) = - \sum_{k=1}^{m} (l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta m^M_{jk} (F^1_j + W^1_j)) - l^0_i \sum_{j=1}^{n} b_{ij}{}^{d0} \Delta m^S_j (F^1_j + W^1_j) \qquad (10)$$

where E^S is the vector of total non-manufacturing exports, m^M_k is the import penetration ratio defined for manufacturing imports from region k, and m^S is the import penetration ratio for non-manufacturing imports. Since the above decomposed terms include indirect effects of trade on employment, manufacturing trade affects not only manufacturing employment itself, but also employment in the non-manufacturing sector.

NOTES AND REFERENCES

1. For example, the development of new information technology has contributed to the economic growth in Japan by 10 to 20 per cent of the annual growth rate in this period and without such a technological breakthrough, *per capita* income of Japan would have been lower than its actual level by approximately 12 per cent (see T. Kuriyama and H. Oniki (1992), "Contribution of New Information Technology to the Growth of the Japanese Economy for 1974-85", *Journal of Applied Input-Output Analysis*, Vol. 1, No. 1.

2. In their most radical scenario of technological change, which drives the US economy to significant economies in labour use relative to the production of the same bill of goods, Leontief and Duchin have estimated that over 20 million fewer workers would be required in the year 2000. They have pointed out the changing composition of labour occupations resulting from computer-based technological change, and have estimated that jobs for professional workers would increase, but those for clerical workers and managers would decline. See *The Future Impacts of Automation on Workers* (1986), Oxford.

3. The different time-periods chosen for each country correspond to the initial and terminal years of input-output tables available in our database. Although they do not cover more recent years due to delays in the publication of input-output data, the general employment trend does not change even when recent periods are included.

4. Because of the limitations of available data on employment, the FIRB sector is not broken down into its sub-sectors: finance and insurance, and real estate and business services, in four countries: France, Germany, Japan, and the United Kingdom. Similarly, the trade sector cannot be separated into wholesale and retail trade, and hotels and restaurants for Japan and the United Kingdom. For Canada, Japan, and the United Kingdom, transport and communications were not separated into transport and storage, and communications.

5. The DAEs are six rapidly growing Asian countries: Korea, Taiwan, Hong Kong, Singapore, Malaysia and Thailand.

6. For example, the 1990 share of imports of computers and office equipment from this region was 42 per cent in the United States and 19 per cent in Japan, and for communication equipment and semiconductors this region accounted for more than 35 per cent in the imports of both countries.

7. The formula used for the calculation of the employment content of trade is defined respectively as:

$$L^E = \hat{I}(I-\hat{u}A)^{-1}E,\ L^M = \hat{I}(I-\hat{u}A)^{-1}M$$

8. Similar calculations are also reported for example in OECD (1979), *The Impact of the Newly Industrialising Countries*; A. Sapir and D. Schumacher (1985), "The Employment Impact of Shifts in the Composition of Commodity and Services Trade" in OECD, *Employment Growth and Structural Change*; D. Schumacher (1983), "North-South Trade and Shifts in Employment" in *International Labour Review*, 123, No. 3; as well as A. Wood (1991), "How much Does Trade with the South Affect Workers in the North" in *The World Bank Research Observer*, Vol. 6, No. 1. Except for Schumacher (1983), the bulk of the literature is not based on the input-output framework and hence fails to take into account the indirect effects of trade on employment.
9. As Sapir and Schumacher (1985) found, the inter-temporal constancy of the employment content of trade can also be found in our calculations, as long as labour productivity change between periods is not taken into account. For this reason, estimates for the previous years were omitted in the current presentation. Corresponding to the employment content of trade, the employment content of domestic final demand can be equally defined. Since domestic final demand contains the bulk of demand for services, the employment content is much larger than that of trade in every country.
10. For details, see OECD (1994), *Manufacturing Performance: A Scoreboard of Indicators*, Paris.
11. Because of the different levels of classification used in each country, certain industries are missing and included in other industries as listed below. Australia: computer and office equipment is included in radio, TV and communication equipment; Denmark: computer and office equipment is included in non-electrical equipment, motor vehicle and aerospace in other transport equipment; Germany: pharmaceuticals are included in chemicals, radio, TV and communication equipment in electrical machinery, other transport in metal products, non-electrical machinery, and motor vehicles; the Netherlands: non-ferrous metals are included in iron and steel, radio and TV and communication equipment in electrical machinery.
12. The method presented here depends basically on the framework of the World Bank study described in H.B. Chenery, S. Robinson, and M. Syrquin (1986), *Industrialization and Growth: A Comparative Study*, London Oxford University Press. The basic methodology of their approach was developed in H.B. Chenery, S. Shishido and T. Watanabe (1962), "The Pattern of Japanese Growth, 1914-54", *Econometrica* 30, January.
13. The use of mixed weights in equation (1) eliminates the so-called interaction terms (since $X^1 = X^0 + \Delta X$, the interaction terms are easily obtained). Although several authors have explicitly treated the interaction terms in the calculation and given economic interpretations for them, this problem is avoided here by using the mixed weight presentation. Rather, they are treated purely as a statistical problem and the arithmetic average of these two alternative formulae is adopted. The simple average of two expressions has a favourable property in that the interaction terms become negligible

[see J.P. Martin, and J.M. Evans (1981), "Note on Measuring the Employment Displacement Effects of Trade by the Accounting Procedure", *Oxford Economic Papers*, 33, pp. 154-64].

14. For the detailed process on derivation, see OECD (1992), *Structural Change and Industrial Performance: A Seven Country Growth Decomposition Study*, Paris.

15. However, the formula cannot be uniquely defined due to the discrete time setting. For example, the alternative formula for the decomposition of ΔX [equation (4)] is obtained as:

$$\Delta X = B^{dl}\hat{u}^{1}\Delta F + B^{dl}\Delta E - B^{dl}\Delta\hat{m}(F^{0}+W^{0}) + B^{dl}\hat{u}^{1}\Delta AX^{0}$$

The two alternative decompositions reflect an underlying index-number problem. The decomposition can be defined either by the base-year coefficients and the comparative-year volume weights [as in equation (4)] or by the comparative-year coefficients and the base-year volume weights (as in the above equation). The two expressions are analogous to Laspeyres and Paasche indexes (note that the use of mixed weights eliminates the so-called interaction terms). In order to avoid this type of index-number problem in actual calculation, the arithmetic average of Laspeyres and Paasche decomposition was adopted.

16. In the current calculation, the following three trading partners were distinguished: OECD, DAEs + China, and the rest of the world (ROW). Because of lack of data on bilateral flows, the trade in non-manufacturing sectors (agriculture, mining and various services) was not separated by region.

GLOBALISATION, TECHNOLOGY AND EMPLOYMENT: CHARACTERISTICS AND TRENDS

CONTENTS

This article was written by George Papaconstantinou of the Economic Analysis and Statistics Division of the OECD's Directorate for Science, Technology and Industry.

SUMMARY

The paper examines the role of industrial globalisation in shaping employment in OECD countries. Globalisation is a process of broadening geographical inter-linkages of products, markets, firms and production factors. It is characterised by the relocation of industrial activities of firms, by shifts in world trade, by the central role of foreign investment and by growing international sourcing of production inputs. It is driven by technological advance, by the liberalisation of trade and investment and by a process of regional integration.

The evidence in the paper suggests that trade does not have a large impact on the aggregate level of employment. At the same time however, intensified technology-based international competition both within the OECD area and between OECD and non-OECD countries has altered the structure of demand for labour, with employment losses in low-wage, low-technology industries. In terms of foreign investment, the evidence on the direct employment impact of inward investment shows that foreign affiliates have increased employment faster than domestically-owned companies, paid higher wages and have had higher productivity. However, the overall impact of foreign investment as well as of other aspects of globalisation is difficult to ascertain due to lack of empirical work and to severe methodological difficulties.

I. INTRODUCTION

Globalisation and technological change are central to the ongoing debates about the high unemployment rates that OECD countries are experiencing and about their ability to safeguard existing jobs or create new ones. The relocation of activities of multinational firms, imports from the non-OECD area, as well as the rapid pace of technological advance are often blamed for employment losses in OECD countries, and especially in certain manufacturing industries. Such claims have a certain intuitive appeal and tend to capture the popular imagination: stories

of plant closings and relocation of firms because of high-wage costs appear regularly in the press, while consumer goods manufactured in countries outside the OECD area are an everyday experience for OECD consumers. The undeniable truth that certain jobs do get lost as a direct or indirect result of shifts in the international structure of production and trade does, however, often tend to be confused with the importance of such shifts for overall OECD employment.

This paper examines some of the evidence on the relationship between globalisation and employment. Industrial globalisation is a complex phenomenon, so the paper first looks at some of its characteristics, trends and guiding forces. The empirical evidence on the changing pattern of international production, trade and investment is then confronted with some of the medium-term trends and structural shifts in employment. The type of questions addressed are: in which industries have jobs been gained and in which have they been lost? Has structural change in employment occurred faster in the recent period than in previous periods? Are shifts in international trade currently particularly pronounced? Has import penetration in OECD countries increased, and if so, in which industries? Has the nature of trade changed due to globalisation? Does the current level and pattern of foreign investment represent a clear break with past experience? Is the employment and wage behaviour of foreign firms different than that of domestic ones? Is it possible to calculate the jobs lost and gained due to foreign investment flows?

The evidence presented allows some tentative conclusions to be drawn about the impact of trade and international investment on the structure and levels of OECD employment. At the same time, however, the lack of solid empirical work on the relationship between some of the facets of the globalisation process and employment makes it impossible at this point to draw general conclusions about the overall importance of globalisation for employment. Nevertheless, the evidence presented on the nature of the structural shifts in international production and trade underway point to policy measures that favour the development of immobile factors of production and that increase the capacity of national economies to develop and absorb new technologies.

The paper is organised as follows. Section II looks at some characteristics and driving forces of the process of industrial globalisation. Section III examines the medium-term trends and structural shifts that have occurred in OECD employment and trade. Section IV focuses on the relationship between trade and employment, while Section V examines issues relating to foreign direct investment, the relocation of production and employment. Conclusions are presented in Section VI.

II. CHARACTERISTICS AND DRIVING FORCES OF INDUSTRIAL GLOBALISATION

Characteristics

"Globalisation" is a much-quoted catch-phrase, whose increasing presence in policy discussions is only matched by disagreements over what it actually means and over whether it represents a good description of the reality of the international economic environment. The process of globalisation can be said to refer to the broadening geographical inter-linkages of products, markets, firms and production factors, with a larger component of each derived, generated or available in more countries and regions (including NIEs, Central and Eastern Europe and developing countries) (OECD 1992*a*).[1] This process is the outcome of the progressive international expansion of firms since World War II.

Since the 1970s, we observe an acceleration of two mutually reinforcing trends: some convergence in technical capabilities of industrialised nations and closer international links or global integration of formerly discrete national firms. Multinational enterprises have reorganised their activities on a regional or global basis, responding to increased global competition, shorter product-cycles, national "managed trade" policies, wider markets, and a growing number of globally dispersed sources of new technology and technical competence. Firm strategies have shifted from exporting, through local sales networks and local assembly, to fully integrated foreign operations with local headquarters functions and networks of suppliers and co-operating firms.

The changing strategies of multinational corporations (MNEs) and the move towards more internationally-integrated networks of production and trade is reflected in the increasing importance of MNE activities in both their home and host markets. In OECD countries such as Belgium, Canada, the Netherlands, Switzerland and the United Kingdom, the combined value added of foreign-based MNES and foreign output of home-based MNEs account for more than half of all economic activity (UNCTC, 1992).[2] In Australia, France, Italy and Germany they account for more than 30 per cent, while in the United States and Japan they represent more than 20 per cent of GDP.

Globalisation adds new dimensions to issues previously connected with MNEs and internationalisation. Since it involves increased international mobility in factor and product markets, it implies a more efficient use of resources on a global scale. At the same time, sector- or region-specific adjustment problems may impose costs that governments are not willing to bear and bring forth protectionist responses in an attempt to slow down change or mitigate its effects. Furthermore, the broad scope of globalisation changes the ability of traditional public policies to

achieve national objectives such as increasing competitiveness and changing the mix and application of mobile and immobile factors of production (National Academy of Engineering, 1987, 1991, OECD 1992*b*, Dunning 1992, Reich, 1990, 1991, Tyson, 1991).

Driving forces of industrial globalisation

Broadly speaking, the process of industrial globalisation is being driven by two sets of interrelated factors. The first relates to rapid technological and organisational change coupled with falling communication and transport costs. The second relates to institutional changes such as investment liberalisation and market deregulation and systemic differences between countries. This combination is increasingly integrating national economies and changing the nature of global competition.

Technological change underpins globalisation. The increasingly international knowledge and technology base, shorter product cycles, high entry costs caused by high capital intensity, the importance of non-price factors in competitiveness (R&D, design, marketing) are all underlying causes of the tendency towards globalisation (Ohmae, 1990). Firms seek to expand their capabilities through foreign investment, acquisitions and mergers, or complement them through alliances and other forms of co-operation. They invest abroad, delocalise or create closer links with firms in other locations in order to take advantage of the R&D resources, skill base and technological infrastructure of host countries, in order to spread high fixed costs and reap learning curve economies, or in order to be better able to service foreign markets. Globalisation is thus increasing and is driven by the search for competitive advantages based on innovation.

One question that is often raised in this context is the importance of wage cost differentials in international production and sourcing. Economic theory would predict international sourcing or manufacturing when components and sub-assemblies of final products use different factor proportions in their production, so that cost pressures require the location of operations in countries where factor costs are more favourable. This would suggest that the sourcing of labour-intensive components in low-wage countries is a main factor behind foreign investment and globalisation (OECD, 1993*a*). Empirical evidence on the importance of this type of international sourcing however paints a more complex picture. A large part of international sourcing is intra-OECD and high-technology industries are more likely to source internationally (OECD, 1993*b*). Furthermore, rising wage levels in some non-OECD countries, which have developed their technological base and infrastructure in the last two decades, have changed the incentives behind much relocation and out-sourcing.

The fall in the price of communications and transport in real terms has facilitated the globalisation process, as it has increased the feasibility of dispersed manufacturing networks (Antonelli, 1984). In many OECD countries, call charges have declined in price by more than 20 per cent in real terms in the period 1985-91. More importantly, changes in communications technology, such as the diffusion of private branch exchanges, the increased capabilities of leased equipment or developments in high speed digital line technology seem to have had an important impact in stimulating the use of communications by enterprises (OECD, 1991*a*). Telecommunication regulatory changes which now allow for the use of leased lines have also been important in stimulating the use of intra-company networks. The service industries have in particular benefited from these technological developments.

Globalisation has also been driven by the opportunities opened up by trade and investment liberalisation, as well as by a process of regional integration. Financial market liberalisation has increased the availability of capital on a world scale, while opportunities to locate in many countries have increased with market deregulation. Thus, for example, the fastest growing areas for foreign direct investment have been the service sectors where the trade and investment climate has become more open and market-oriented (Julius, 1990). Regional integration has increased competitive pressures to operate in all of the major integrated regions evolving in East Asia, Europe and North America (the "Triad"). Rationalisation in the EC before the 1993 Single Market has also driven recent foreign investment by inducing competition in EC countries to attract foreign firms, and by making firms from outside the EC willing to locate within the Single Market or to forge closer links with EC firms in order to avoid potential restrictions on trade flows or discriminatory practices. Public policy in the EC, in the form for example of local content requirements, may also have been an important factor behind the foreign investment levels in the Community (Pavitt and Patel, 1992).

The process of industrial globalisation is faced also with a number of obstacles that hinder the integration of products and markets which constitute its essential element. Some of these are technical. While technology reduces the costs of telecommunications and facilitates the integration of an international supply chain, it may also constrain international production when change is rapid or when technology increases the complexity of products in the production process. Other obstacles relate to organisational aspects of production. Japanese-style "lean production" manufacturing systems, such as "just-in-time" delivery, may discourage the division of the manufacturing process into geographically separated units. Similarly, long-term cooperative relationships with suppliers, as well as the reduction in minimum efficient scale in production which is implied in modern flexible and specialised production may also tend to favour local, or at least regional, patterns of manufacturing (Oman, 1994). Empirical evidence

showing that the pattern of globalisation of US multinationals involves firms producing abroad in order to service the local or regional markets, rather than the global market, supports this view (Wells, 1992).

Finally, different national systems are also important factors both driving the process of globalisation and creating obstacles. When products need to be tailored to the requirements of different national or regional markets, for example, because of differing tastes or standards, it is difficult to rationalise production on a global basis. Such differences give an unequal distribution of benefits and costs, lead to different policy responses to increase national benefits or overcome disadvantages (particularly related to inward globalisation), and in some cases lead to frictions and broader problems. Financial systems and investment financing (*e.g.* differences in capital costs); employment and labour systems (*e.g.* training and production knowledge); technology and innovation systems (*e.g.* government involvement in technology development, openness to foreign firms); distribution systems (questions of market access) are all examples.

III. THE EVOLUTION AND STRUCTURE OF OECD EMPLOYMENT AND TRADE

The analysis of the impact of globalisation on employment needs to start with the evidence on the evolution and structure of OECD employment and trade. In terms of employment, a number of structural shifts stand out. The long-term decline in manufacturing employment has been exacerbated in the current downturn, while the composition of manufacturing employment has steadily changed. Jobs in low-technology, low-wage and low-skill industries have been steadily declining both in absolute and in relative terms; employment in medium- and high-technology and in medium- and high-wage industries has proved to be the most resistant to the economic downturn. In terms of trade, the steady expansion of world commerce has been accompanied by geographical shifts and changes in its commodity composition, by increases in the rates of import penetration and by an increasing share of intra-industry and intra-firm trade.

Structural shifts in employment

The shift in employment from manufacturing to services

Looking over the medium and long term, the structural transformation of OECD economies has been characterised by a long-term decline in manufactur-

ing employment, which fell by nearly one per cent each year during the 1980s (Graph 1 and Table 1). The decline occurred primarily during the two economic downturns of the early 1980s and the early 1990s, with manufacturing employment relatively stable or even slightly increasing during the intervening period. This suggests that manufacturing jobs lost in recessions in OECD countries are not regained easily when economies pick up again. In contrast, employment in services has increased steadily, and its rate of growth only dampened slightly in the early 1990s as the downturn reduced demand for services. Despite this slowdown, employment in services stood in 1992 over 25 per cent higher than in 1980. It is this steady increase in services jobs that has resulted in the rise in employment in combined industry (covering, in addition to manufacturing, also mining and electricity, gas and water) and services between 1980 and 1992. This upward trend since mainly 1982 peaked in 1990 and jobs performance has been poor since.

Underlying this overall picture are important differences by geographical region. North America is characterised by one of the fastest-growing services sectors in terms of net jobs created, with 30 per cent more services jobs in 1992 than in 1980. In the European Community, more than in any other geographical area of the OECD, developments in services and in manufacturing contrast sharply: services employment has risen steadily during the 1980s and was 25 per cent higher in 1992 than in 1980, while during the same period almost 20 per cent of all manufacturing jobs have been lost. A similar pattern can be seen in EFTA countries, with two differences: a sharper fall in manufacturing employment since 1990, coupled with a decline in services employment unique among all OECD groups of countries.

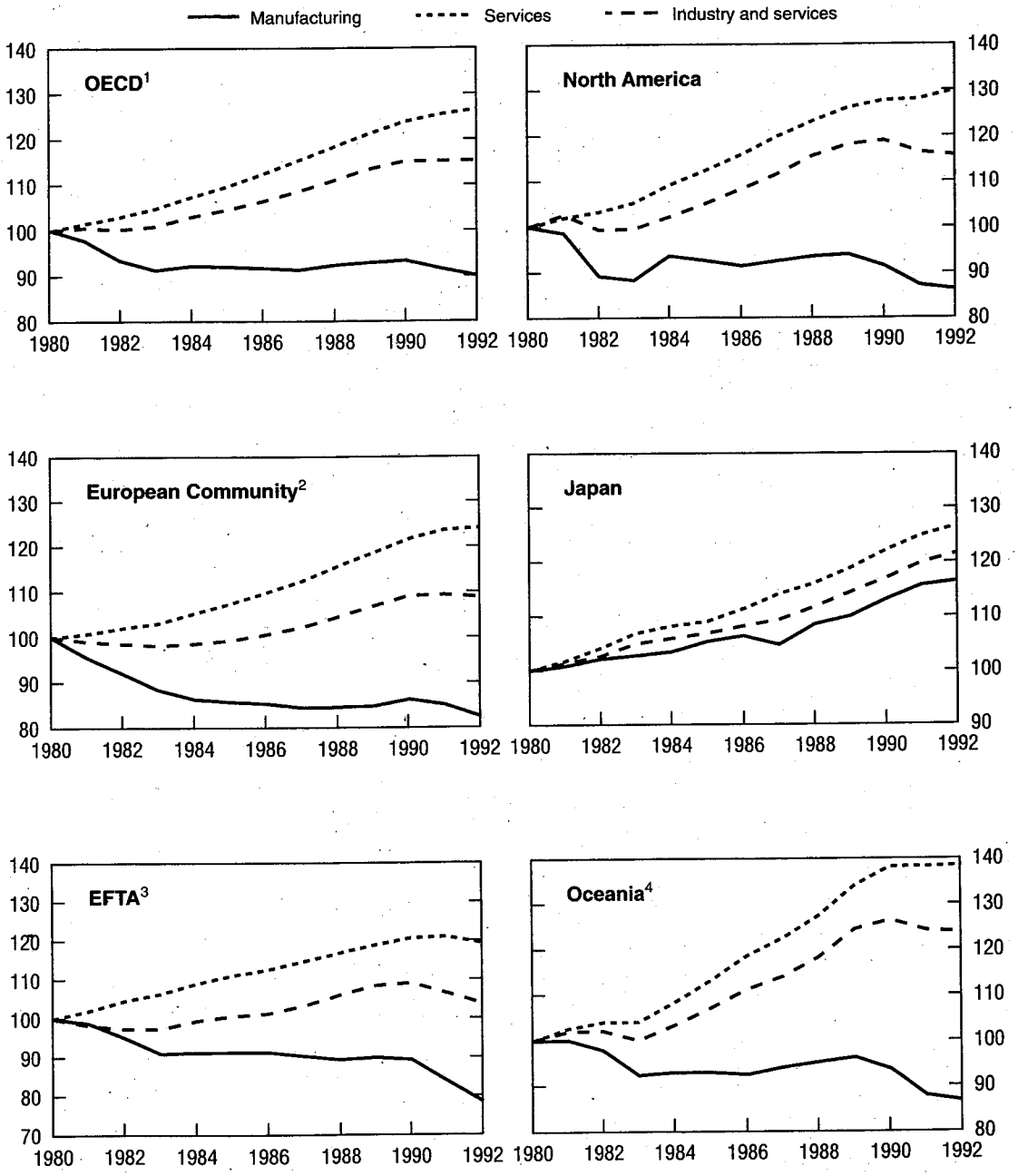
In Japan, the medium-term evolution of employment contrasts sharply with that of the rest of the OECD. Manufacturing employment has, excluding a decline in 1986-87, risen steadily since 1980 and was in 1992 over 10 per cent higher than in the early 1980s. Services employment has also risen and at a fast pace, with 25 per cent more jobs in 1992 than in 1980. Japan is also unique in exhibiting little cyclical variation in either manufacturing or services employment, with both continuing to rise during the downturns of the early 1980s and the early 1990s. Finally, employment trends in Oceania mirror those in North America: a steady but not particularly steep decline in manufacturing employment, coupled with the strongest growth in services jobs in the OECD area. The sharp increase in services jobs however came to a halt in 1990, leading to an overall decline since then in total employment.

Shifts in manufacturing employment

The long-term decline in manufacturing employment in both relative (to services) and absolute terms has not been uniform in all manufacturing industries; it

Graph 1. **Employment in manufacturing and in services by OECD region**

Indices, 1980 = 100



1. 22 countries for manufacturing; 16 for services and industry and services.
2. Excludes Belgium for manufacturing; also Greece, Ireland, Denmark, Luxembourg and the Netherlands for services and for industry and services.
3. Includes Austria, Finland, Norway, Sweden, Switzerland.
4. Australia only for services and for industry and services.

Source: OECD, *Indicators of Industrial Activity; Labour Force Statistics;* DSTI/EAS Division.

Table 1. **Employment shares in industry and services**

	Industry[1]			Services		
	1970	1980	1992	1970	1980	1992
United States	34.4	30.5	24.6	61.1	65.9	72.5
Canada	30.9	28.5	22.7	61.4	66.0	73.0
Japan	35.7	35.3	34.6	46.9	54.2	59.0
France	..	..	29.5[2]	..	..	64.8[2]
Germany	48.5	43.7	38.7	42.9	51.1	58.1
Italy	39.5	37.9	32.3[2]	40.3	47.8	59.2
Portugal	..	..	33.4	..	..	55.3
Spain	36.4	36.1	32.4	38.7	44.7	57.5
United Kingdom	44.7	37.5	26.6	52.1	59.9	71.2
Austria	40.7	40.2	36.7[2]	40.5	49.1	55.7[2]
Finland	34.6	34.7	27.8	42.8	51.8	63.5
Norway	33.1	28.7	21.7	51.5	59.8	63.9
Sweden	38.4	32.2	26.6	..	62.2	70.1
Switzerland	45.9	38.1	34.4[2]	45.6	55.0	60.0
Australia	37.0	31.0	23.9	55.0	62.5	70.8
New Zealand[3]	..	..	23.0	..	..	66.0

1. Industry includes mining, manufacturing, and electricity, gas and water.
2. 1991.
3. National source.

Source: OECD, *Labour Force Statistics.*

has instead been accompanied by important shifts in the composition of manufacturing employment. Manufacturing industries can be classified into different groups with differing characteristics on the basis of criteria such as technology (intensity of R&D expenditures), skills, wages and orientation (see Box). Graph 2 compares the evolution of manufacturing employment as a whole with the different industry groupings that can be constructed within manufacturing.

It is first of all clear that the employment in the high-technology segment of manufacturing has expanded since 1970, in sharp contrast to the stagnation in employment in medium-technology sectors and the job losses in low-technology. Total manufacturing employment has declined overall due to the greater weight of the low-technology segment. Detail by country (Table 2) shows that high-technology manufacturing employment rose faster than any other segment of manufacturing in all countries except Canada and Sweden, and that where high-technology jobs declined, they did so at a more moderate pace than in medium- or low-technology industries. Most countries have shifted out of low-technology manufacturing employment and into high- and medium-technology jobs, with the larg-

Classifying manufacturing industries

The text uses a number of different aggregation schemes for classifying manufacturing industries into groups: one based on technology, one on wages, one on orientation and one on skills.

Technology. Industries are grouped on the basis of their RandD intensity in the OECD area as a whole, defined as the ratio of business-enterprise RandD to production. The following high-, medium- and low-technology groups emerge:[1]

High-technology. Aerospace (ISIC 3845), computers and office equipment (ISIC 3825), communication equipment and semiconductors (ISIC 3832), electrical machinery (ISIC 383 – 3832), pharmaceuticals (ISIC 3522), scientific instruments (ISIC 385).

Medium-technology. Chemicals excluding drugs (ISIC 351 + 352 – 3522), rubber and plastic products (ISIC 355 + 356), non-ferrous metals (ISIC 372), non-electrical machinery (ISIC 382 – 3825), motor vehicles (ISIC 3843), other transport equipment (ISIC 3842 + 3844 + 3849), other manufacturing (ISIC 39).

Low-technology. Food, beverages, tobacco (ISIC 31), textiles, apparel and leather (ISIC 32), wood products (ISIC 33), paper and printing (ISIC 34), petroleum refining (ISIC 353 + 354), non-metallic mineral products (ISIC 36), iron and steel (ISIC 371), metal products (ISIC 381), shipbuilding (ISIC 3841).

Orientation. This classification is based on the primary factors believed to affect competitiveness. Industries are classified into resource-intensive (access to natural resources), labour-intensive (labour costs), scale-intensive (length of production runs), specialised-supplier (differentiated products), and science-based (rapid application of scientific advance).[2]

Resource-intensive. Food, beverages, tobacco (ISIC 31), wood products (ISIC 34), petroleum refining (ISIC 353 + 354), non-metallic mineral products (ISIC 36), non-ferrous metals (ISIC 372).

Labour-intensive. Textiles, apparel and leather (ISIC 32), fabr. metal products (ISIC 381), other manufacturing (ISIC 39).

Specialised-supplier. Non-electrical machinery (ISIC 382 – 3825), electrical machinery (ISIC 383 – 3832), communication equipment and semiconductors (ISIC 3832).

Scale-intensive. Paper and printing (ISIC 33), chemicals excl. drugs (351 + 352 – 3522), rubber and plastics (ISIC 355 + 356), iron and steel (ISIC 371), shipbuilding (ISIC 3841), motor vehicles (3843), other transport (ISIC 3842 + 3844 + 3849).

Science-based. Aerospace (ISIC 3845), computers (ISIC 3825), pharmaceuticals (ISIC 3522), scientific instruments (ISIC 385).

Wages. The classification of industries into high-, medium-, and low-wage groups is based on the average labour compensation (calculated in US PPPs as labour compensation per number engaged) across nine countries (Australia, Canada, Finland, Germany, Japan, Norway, Sweden, United States and United Kingdom) for 1985. The high-wage grouping then defined as industries in which the wage was more than 15 per cent above the median, the medium-wage grouping as industries within 15 per cent of the median and the low-wage grouping as indus-

(continued on next page)

(continued)

tries with wages at least 15 per cent below the median. The groupings appear to be quite stable to two other time periods (1975 and 1980) and for additional countries.

High-wage. Chemicals excl. drugs (351 + 352 – 3522), aerospace (3845), pharmaceuticals (3522), petroleum refining (ISIC 353 + 354), computers and office equipment (ISIC 3825), motor vehicles (ISIC 3843).

Medium-wage. Paper and printing (ISIC 33), rubber and plastics (ISIC 355 + 356), non-metallic mineral products (ISIC 36), iron and steel (ISIC 371), non-ferrous metals (ISIC 372), metal products (ISIC 381), shipbuilding (ISIC 3841), non-electrical machinery (ISIC 382 – 3825), scientific instruments (ISIC 385), communication equipment and semiconductors (ISIC 3832).

Low-wage. Food, beverages, tobacco (ISIC 31), textiles, apparel and leather (ISIC 32), wood products (ISIC 34), electrical machinery (ISIC 383 – 3832), other transport (ISIC 3842 + 3844 + 3849), other manufacturing (ISIC 39).

Skills. Manufacturing industries are classified into skilled and unskilled on the basis of estimates for the proportion of production workers in manufacturing employment by industry.

Skilled. Food (ISIC 31), paper (ISIC 34), chemicals products (ISIC 351 + 352 – 3522), pharmaceuticals (ISIC 3522), petroleum refining (ISIC 353 + 354), fabricated metal products (ISIC 381), office and computing equipment (ISIC 3825), communication equipment and semiconductors (ISIC 3832), aerospace (ISIC 3845) and scientific instruments (ISIC 385).

Unskilled. Textiles (ISIC 32), wood products (ISIC 33), rubber and plastics (ISIC 355 + 356), non-metallic mineral products (ISIC 36), ferrous metals (ISIC 371), non-ferrous metals (ISIC 372), non-electrical machinery (ISIC 382 – 3825), electrical machinery (ISIC 383 – 3832), shipbuilding (ISIC 3841), motor vehicles (ISIC 3843) and other transport equipment (ISIC 3842 + 3844 + 3849).

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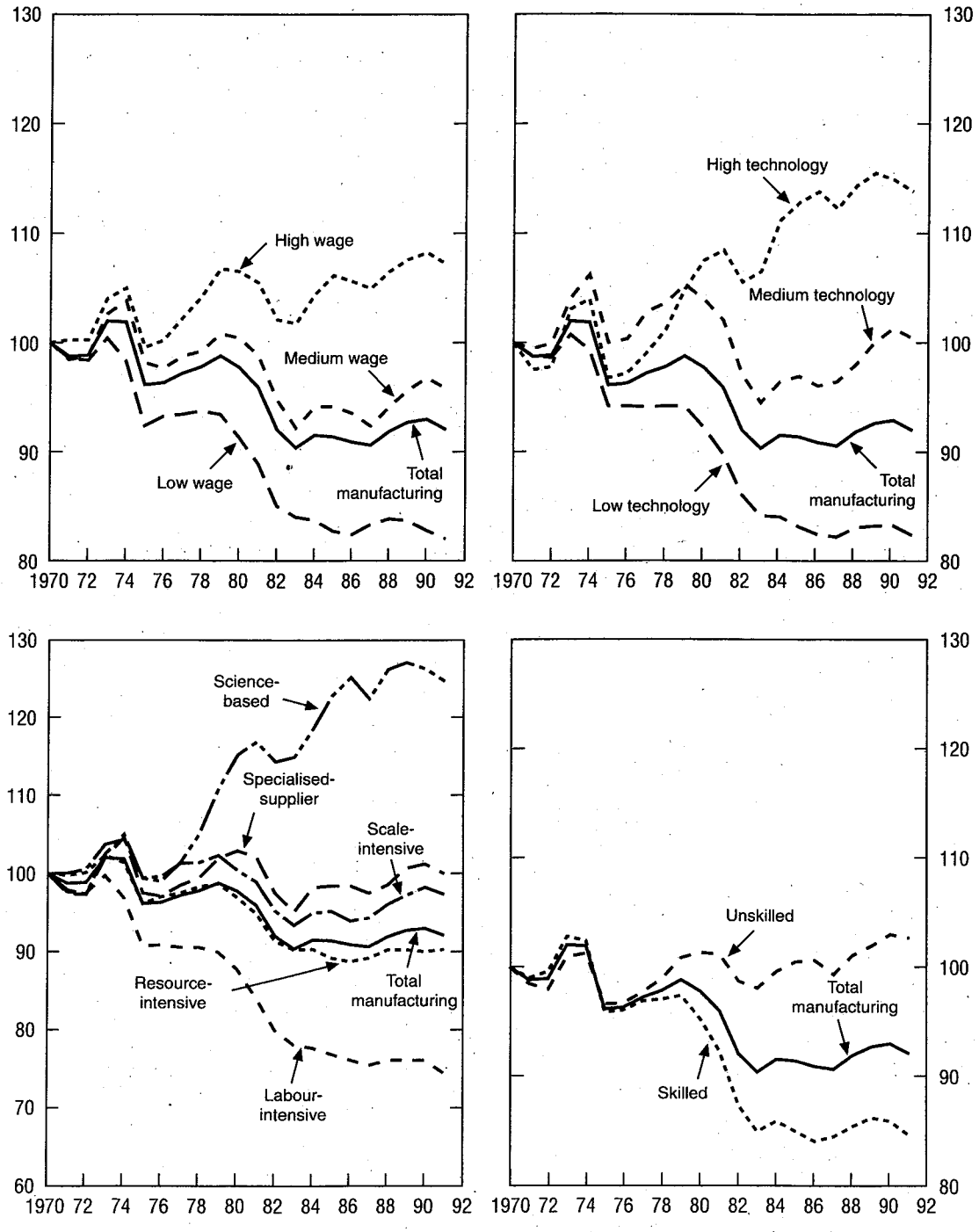
1. See OECD (1992), *Industrial Policy in OECD Countries: Annual Review 1992* for a further discussion on this classification.
2. See OECD (1987), *Structural Adjustment and Economic Performance.*

Graph 2. **Manufacturing employment by type of industry: wages, technology, orientation, skills**
(OECD – 13 countries; indices, 1970 = 100)



Source: OECD, STAN database (DSTI/EAS Division).

Table 2. **Employment by type of manufacturing industry**

Shares and average annual growth rates

		Total manuf.	High-wage	Medium-wage	Low-wage	High-tech	Medium-tech	Low-tech	Re-source intensive	Labour intensive	Scale intensive	Special-ised supplier	Science-based	Skilled	Unskilled
Australia	Share 1970	100.0	14.3	41.2	44.5	11.9	24.1	64.1	29.0	24.2	12.6	29.0	5.2	41.7	58.3
	Share 1991	100.0	14.1	43.4	42.5	10.7	23.8	65.6	34.0	21.1	9.5	30.0	5.5	48.5	51.5
	Gr. 70-91	–0.9	–1.0	–0.7	–1.2	–1.4	–1.0	–0.8	–0.2	–1.6	–2.3	–0.8	–0.7	–0.2	–1.5
Canada	Share 1970	100.0	14.4	42.6	43.1	10.4	26.6	63.1	29.4	23.0	13.5	30.5	3.6	44.7	55.3
	Share 1991	100.0	17.1	46.0	36.9	10.0	30.5	59.5	26.9	22.3	13.1	33.6	4.1	47.2	52.8
	Gr. 70-91	0.7	1.6	1.1	0.0	0.6	1.4	0.4	0.3	0.6	0.6	1.2	1.3	1.0	0.5
Denmark	Share 1970	100.0	4.7	47.4	47.9	9.6	21.7	68.7	33.1	22.4	18.9	23.3	2.4	44.7	55.3
	Share 1991	100.0	6.6	53.6	39.8	12.3	28.5	59.2	29.8	18.3	23.3	23.5	5.1	49.3	50.7
	Gr. 70-91	–0.6	1.1	0.0	–1.4	0.6	0.7	–1.3	–1.1	–1.5	0.4	–0.5	3.2	–0.1	–1.0
Finland	Share 1970	100.0	6.0	47.3	46.7	5.7	21.9	72.4	30.6	22.3	16.0	29.7	1.3	39.5	60.5
	Share 1991	100.0	9.8	55.4	34.8	10.5	23.9	65.6	28.5	15.4	18.9	33.4	3.9	50.5	49.5
	Gr. 70-91	–0.8	1.6	0.0	–2.2	2.1	–0.4	–1.2	–1.1	–2.5	0.0	–0.2	4.5	0.4	–1.7
France	Share 1970	100.0	16.9	43.9	39.3	14.0	28.3	57.7	20.8	27.5	16.7	29.6	5.3	40.5	59.5
	Share 1991	100.0	19.3	44.6	36.1	18.4	30.6	51.1	22.4	20.0	19.2	30.5	7.9	46.6	53.4
	Gr. 70-91	–1.1	–0.5	–1.1	–1.5	0.1	–0.8	–1.7	–0.8	–2.6	–0.5	–1.0	0.8	–0.5	–1.6
Germany	Share 1970	100.0	13.7	51.6	34.8	16.5	27.8	55.7	20.6	23.6	21.7	28.7	5.3	40.9	59.1
	Share 1991	100.0	18.4	53.1	28.5	20.1	34.3	45.6	20.5	17.4	24.2	31.0	6.9	45.1	54.9
	Gr. 70-91	–0.5	0.9	–0.4	–1.5	0.4	0.5	–1.5	–0.6	–2.0	0.0	–0.2	0.7	–0.1	–0.9
Italy	Share 1970	100.0	12.0	39.7	48.3	10.2	22.6	67.2	25.3	36.0	13.4	21.6	3.6	32.1	67.9
	Share 1991	100.0	12.2	42.7	45.2	10.9	23.5	65.6	23.2	35.8	14.5	21.9	4.6	35.0	65.0
	Gr. 70-91	–0.3	–0.3	0.0	–0.6	0.0	–0.1	–0.4	–0.7	–0.3	0.1	–0.3	0.8	0.1	–0.5
Japan	Share 1970	100.0	11.3	48.2	40.5	16.0	26.5	57.6	23.1	25.7	22.3	24.9	4.1	39.0	61.0
	Share 1991	100.0	13.8	50.5	35.7	21.8	28.5	49.7	21.1	20.4	26.0	26.9	5.6	44.3	55.7
	Gr. 70-91	0.4	1.4	0.6	–0.2	1.9	0.8	–0.3	0.0	–0.7	1.1	0.8	1.9	1.0	0.0
Netherlands	Share 1970	100.0	11.5	51.3	37.2	13.4	20.1	66.5	27.8	23.6	18.0	27.5	3.2	56.9	43.1
	Share 1991	100.0	15.2	56.1	28.8	15.7	24.2	60.1	27.6	16.1	19.6	32.0	4.7	64.2	35.8
	Gr. 70-91	–1.2	0.1	–0.8	–2.4	–0.5	–0.4	–1.7	–1.3	–3.0	–0.8	–0.5	0.6	–0.7	–2.1
Norway	Share 1970	100.0	6.1	53.9	40.1	6.6	19.2	74.2	32.7	18.4	11.6	36.3	1.1	44.1	55.9
	Share 1991	100.0	10.1	55.2	34.7	9.9	26.2	63.9	34.5	11.9	17.7	32.2	3.8	52.4	47.6
	Gr. 70-91	–1.5	0.9	–1.4	–2.1	0.5	0.0	–2.2	–1.2	–3.5	0.5	–2.0	4.7	–0.7	–2.2

Sweden	Share 1970	100.0	10.4	55.6	34.0	12.0	26.0	62.0	23.2	20.9	19.7	32.3	4.0	41.9	58.1
	Share 1991	100.0	17.5	55.0	27.5	13.8	34.9	51.4	20.5	18.5	20.7	35.2	5.1	48.2	51.8
	Gr. 70-91	–0.1	2.4	–0.2	–1.1	0.5	1.3	–1.0	–0.7	–0.7	0.1	0.3	1.0	0.5	–0.7
United K.	Share 1970	100.0	15.0	51.0	34.0	16.3	30.5	53.2	18.3	22.7	22.7	29.5	6.8	40.6	59.4
	Share 1991	100.0	16.8	51.0	32.1	19.4	31.3	49.3	21.0	16.7	23.1	29.2	10.0	47.4	52.6
	Gr. 70-91	–2.2	–1.7	–2.2	–2.5	–1.4	–2.1	–2.6	–1.6	–3.6	–2.1	–2.2	–0.4	–1.5	–2.8
United S.	Share 1970	100.0	15.2	48.6	36.3	17.6	25.9	56.6	21.6	24.0	19.0	27.7	7.8	46.0	54.0
	Share 1991	100.0	16.8	51.0	32.2	21.0	27.5	51.5	20.7	19.2	19.4	30.0	10.7	50.0	50.0
	Gr. 70-91	–0.1	0.4	0.1	–0.7	0.7	0.2	–0.6	–0.3	–1.2	0.0	0.2	1.4	0.3	–0.5
OECD-13	Share 1970	100.0	13.6	48.1	38.3	15.5	26.6	58.0	22.2	25.2	19.6	27.3	5.6	41.6	58.4
	Share 1991	100.0	15.9	50.0	34.1	19.1	29.0	51.9	21.8	20.4	21.3	28.9	7.6	46.3	53.7
	Gr. 70-91	–0.4	0.3	–0.2	–0.9	0.6	0.0	–0.9	–0.5	–1.4	0.0	–0.1	1.0	0.1	–0.8

Source: OECD, STAN database (DSTI/EAS Division).

est shifts out of low-technology occurring in Sweden, Germany, Japan, Denmark and Australia.

Classifying industries in terms of skills shows a clearly divergent path for the 13 OECD countries taken together between skilled and unskilled manufacturing employment. Employment in industries characterised by a majority of skilled employees has increased since 1970, while jobs in industries characterised by a majority of unskilled workers declined by about 1 per cent a year. Furthermore, this divergence appears only in the 1980s: during the 1970s, skilled and unskilled employment evolved in a similar fashion. The largest increase in skilled manufacturing employment has been in Japan. Skilled employment has also increased in Canada, Finland, Sweden, the United States and Australia. Of the four large EC countries, skilled employment has declined in Germany and especially in the United Kingdom, while remaining stable in France and Italy. Unskilled manufacturing employment declined most in France and the United Kingdom.

A similar evolution can be seen when manufacturing industries are classified based on the level of wages. For the OECD countries for which these classifications can be constructed, employment in high-wage industries has expanded in the last 20 years while jobs in medium-wage and low-wage sectors have been lost. A clear shift can thus be discerned in the composition of OECD manufacturing employment, with low-technology, low-skill and low-wage jobs being shed and high-technology, high-skill and high-wage manufacturing employment continuing to expand.

Graph 2 also classifies manufacturing industries in terms of their orientation or the main factors believed to affect competitiveness in each industry. Thus, science-based industries have had a remarkable job expansion, while the only other type of industry which had more jobs at the end of the 1980s than in 1970 was the specialised supplier group, industries which produce differentiated products. Scale-intensive and resource-intensive industries shed jobs during the period but at a relatively slow pace, while in the late 1980s employment in the labour-intensive industry group was 25 per cent below its 1970 level.

Shifts and patterns in international trade and competitiveness

Shifts in the structure of world trade

Total OECD trade expanded during the 1970s at an annual average of nearly 20 per cent, bringing trade flows during that decade from 13 per cent to just over

20 per cent of total OECD GDP. During the 1980s, the expansion of OECD trade was much slower and occurred at about the same rate as the expansion of output. It was on average just over 6 per cent between 1980 and 1989, with an acceleration in 1990, before dropping to below 3 per cent in 1991. In 1992, trade picked up again at over 7 per cent and resumed its role as an engine of growth.

The shifts that have occurred in the geographical distribution of world trade between different regions in the last thirty years are shown in Table 3. As a percentage of total world imports, North American imports increased from 19 per cent in 1966-68 to 20 per cent in 1987-89, while the share of total world imports originating in North America (*i.e.* North American exports) declined from 22 per cent to 18 per cent. Japanese imports increased slightly to 5.5 per cent of total world imports, while exports doubled during the period to account for 11 per cent of the total. Both EC imports and exports increased as a share of world trade, with a large part representing trade between EC member States. EFTA imports remained stable as a share of world imports, whereas exports more than halved to represent only 3 per cent of total world imports. Outside the OECD area, imports of the newly industrialised countries (NIEs) increased from 1.8 per cent to 5.1 per cent of world imports. More importantly, the share of world imports originating in the NIEs (*i.e.* NIE exports) jumped from 1 per cent to 5 per cent during the last thirty years.

The changing composition of world exports by commodity classes is shown in Table 4. The top panel of the table shows the shares in total world exports of regional groupings in each of the main commodity classes. The bottom panel shows the commodity composition of the exports of different regional groupings and countries. A few significant shifts are worth mentioning. Developing economies doubled their share of world exports in machinery and transport equipment during the 1980s, with Asian countries in particular increasing their share from 4 per cent to 10 per cent. Japan has also made significant gains in this product category, which increased from one-quarter of total commodity exports in 1980 to account for over a third of commodity exports in 1989. The shares of the United States, Canada and the EC in this product category have declined. Such shifts across regional groupings are underlined by the compositional shift of exports within each country grouping (bottom panel of the table). Thus 70 per cent of Japanese exports in 1989 were accounted for by machinery exports (up from 50 per cent in 1980), while the corresponding share for Asian countries is 27 per cent (up from 13 per cent in 1980).

Changing patterns of import penetration

The weight of imported manufactured goods in the total domestic demand for goods in manufacturing industry varies significantly from country to country across the OECD (Table 5). Of the countries in the table, the highest import

Table 3. **Trade among regional groups and countries**[1]

Percentages of world imports, 1966-68 and 1987-89

Origin			Can.-US	Japan	EC	EFTA	Aus./N-Z	NIEs	Other	Total
Can.-US	Total imports	1966-68	7.4	1.9	4.4	0.6	0.3	0.5	4.0	19.1
	Total imports	1987-89	6.4	4.2	4.2	0.7	0.2	2.2	2.2	20.1
	Manufactured	1966-68	8.6	3.1	6.0	0.9	0.1	0.7	0.6	20.0
	Manufactured	1987-89	5.8	5.4	4.7	0.8	0.1	2.8	2.0	21.5
Japan	Total imports	1966-68	1.6	..	0.4	0.1	0.4	0.1	0.8	4.4
	Total imports	1987-89	1.8	..	0.9	0.2	0.4	0.7	1.5	5.5
	Manufactured	1966-68	0.9	..	0.6	0.1	0.0	0.0	0.1	1.8
	Manufactured	1987-89	1.1	..	0.9	0.2	0.0	0.1	0.5	3.7
EC	Total imports	1966-78	5.3	0.6	20.2	3.6	0.8	0.2	8.0	38.7
	Total imports	1987-89	3.4	2.0	27.3	4.3	0.3	0.8	6.7	44.9
	Manufactured	1966-68	4.6	0.8	24.0	4.0	0.1	0.3	2.5	34.9
	Manufactured	1987-89	3.3	2.5	27.5	4.2	0.0	1.1	2.0	40.5
EFTA	Total imports	1966-68	0.6	0.2	4.8	1.1	0.0	0.0	0.6	7.4
	Total imports	1987-89	0.4	0.4	4.9	1.1	0.0	0.1	0.2	7.1
	Manufactured	1966-68	0.7	0.3	6.4	1.5	0.0	0.1	1.7	9.1
	Manufactured	1987-89	0.4	0.5	5.5	1.2	0.0	0.2	0.5	7.8
Aus./N-Z	Total imports	1966-68	0.5	0.2	0.8	0.1	0.1	0.0	0.2	2.0
	Total imports	1987-89	0.4	0.3	0.4	0.1	0.1	0.1	0.1	1.5
	Manufactured	1966-68	0.8	0.4	1.2	0.1	0.1	0.1	0.1	2.7
	Manufactured	1987-89	0.4	0.5	0.5	0.1	0.1	0.2	0.0	1.8
NIEs	Total imports	1966-68	0.5	0.6	0.2	0.1	0.0	0.1	0.3	1.8
	Total imports	1987-89	1.2	1.7	0.7	0.1	0.2	0.4	0.8	5.1
	Manufactured	1966-68	0.4	1.0	0.4	0.1	0.0	0.1	0.5	2.0
	Manufactured	1987-89	0.9	2.1	0.8	0.2	0.0	0.5	0.6	5.2
Other	Total imports	1966-68	6.2	2.2	9.0	1.2	0.5	0.2	7.4	26.7
	Total imports	1987-89	4.2	2.7	7.2	1.2	0.5	1.0	2.4	19.2
	Manufactured	1966-68	..	..	..	..	..	..	..	..
	Manufactured	1987-89	..	..	..	..	..	..	..	..
Total	Total imports	1966-68	22.0	5.7	39.2	6.8	2.2	1.1	22.9	100.0
	Total imports	1987-89	17.8	11.3	45.6	3.1	1.2	5.5	15.4	100.0
	Manufactured	1966-68	..	..	..	..	..	..	..	..
	Manufactured	1987-89	..	..	..	..	..	..	..	..

1. Numbers may not add because of rounding.
Source: UN Comtrade database.

penetration can be found in the Netherlands, where imports represented 70 per cent of total domestic demand in the manufacturing sector in 1989. A number of small European economies such as Denmark, Norway and Sweden come next, followed by Canada and Finland, and by all four large European countries, as well as Australia. The lowest import penetration rates are in the United States and Japan (respectively 13 per cent and 6 per cent in 1989).

Table 4. **Structure of world trade by commodity classes and regions**

		Commodity composition of total exports of selected regions						
		World	US	Japan	EC	EFTA	Aus./N-Z	Asia
Total commodities	1980	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SITC 0-9	1990	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Food, bev., tobacco	1980	10.0	14.0	1.2	10.5	4.0	36.3	12.0
SITC 0 and 1	1990	8.7	9.7	0.6	9.8	3.7	23.4	7.5
Oils and fats	1980	6.9	11.9	1.2	3.5	8.6	28.9	13.1
SITC 2 and 4	1990	5.2	7.5	0.7	3.1	5.4	17.8	5.4
Minerals	1980	24.0	3.7	0.4	8.0	10.1	9.1	20.5
SITC 3	1990	10.1	3.3	0.4	3.7	8.4	14.7	8.2
Chemicals	1980	7.0	9.6	5.1	11.4	9.7	2.5	2.7
SITC 5	1990	8.8	10.4	5.5	12.0	11.2	2.8	4.4
Mach./transport	1980	25.6	39.0	58.4	32.7	28.1	5.0	12.9
SITC 7	1990	35.7	46.1	70.7	38.3	32.7	5.6	28.6
Other man. goods	1980	24.0	17.9	32.4	32.0	38.8	13.9	37.0
SITC 6 and 8	1990	28.6	18.9	20.5	31.3	38.2	14.3	44.7
		Origin of exports of major commodity classes						
		World	US/Can.	Japan	EC	EFTA	Aus./N-Z	Asia
Total commodities	1980	100.0	14.0	6.5	34.5	5.6	1.3	8.1
SITC 0-9	1990	100.0	14.7	8.5	39.8	6.6	1.4	13.3
Food, bev., tobacco	1980	100.0	18.6	0.8	36.1	2.2	4.8	9.7
SITC 0 and 1	1990	100.0	15.8	0.5	45.1	2.9	3.8	11.6
Oils and fats	1980	100.0	27.7	1.1	17.6	6.9	5.6	15.3
SITC 2 and 4	1990	100.0	26.7	1.2	23.6	6.9	4.8	13.9
Minerals	1980	100.0	3.7	0.1	11.5	2.3	0.5	6.9
SITC 3	1990	100.0	7.2	0.4	14.5	5.5	2.0	10.7
Chemicals	1980	100.0	17.2	4.7	55.8	7.7	0.5	3.1
SITC 5	1990	100.0	15.3	5.3	54.5	8.5	0.4	6.7
Mach./transport	1980	100.0	19.7	14.8	43.9	6.1	0.3	4.1
SITC 7	1990	100.0	18.1	16.7	42.7	6.1	0.2	10.6
Other man. goods	1980	100.0	10.9	8.7	45.8	9.0	0.8	12.5
SITC 6 and 8	1990	100.0	9.9	6.0	43.5	8.9	0.7	20.8

Source: United Nations (1993), *1991 International Trade Statistics Yearbook.*

Despite these large cross-country differences, import penetration rates increased in every one of the OECD countries in the table during the period from 1970 to the end of the 1980s. The strongest increase by far was in the United States, where imports more than tripled as a proportion of domestic demand in the 1970-89 period. Import intensities doubled in France, Germany and the United Kingdom. For many countries however this increasing trend was more pronounced in the 1970s than in the 1980s. Import penetration accelerated in the 1980s only in Denmark, the Netherlands, Finland and Sweden. In general,

Table 5. **Import penetration in manufacturing**

Imports as a percentage of total domestic demand

	1970	1980	1991	Average annual growth rate	
				1970-80	1980-91
United States[1]	5.1	8.7	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	20.9	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	43.2	–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

1. 1990 data used instead of 1991.
Source: OECD, STAN/COMTAP databases (DSTI/EAS Division).

the share of imports in domestic demand increased most in countries where import intensities were initially low. The exceptions are the Netherlands and Japan; import penetration rose sharply from a very high base in the Netherlands, while hardly changing in Japan. In 1970, Japan had an import penetration rate equal to that of the United States, but at the end of the 1980s had a rate only half as high.

Underlying these trends in import penetration at the level of total manufacturing are differences in industry groupings with different technological characteristics (Table 6). Overall, both in the G7 group of countries and in other OECD countries for which disaggregated data are available, high-technology industries are characterised by higher import penetration rates, followed by medium-technology sectors, while the total domestic demand in low-technology industries tends to be mostly satisfied by domestic production. There are some exceptions: medium-technology industries in France, Italy, the Netherlands and the United States are more import intensive than high-technology sectors. When classifying industries in terms of wages, it is the high-wage group that tends to be most import-intensive, followed by the low-wage and the medium-wage groups. Of the G7 countries, import penetration was higher at the end of the 1980s in the low-wage group of industries only in Japan. This result seems to run counter to

Table 6. **Import penetration by industry in the G-7 group of countries**

Imports as a percentage of total domestic demand

ISIC	United States		Japan		France		Germany		United Kingdom		Italy		Canada	
	1980	1990	1980	1990	1980	1991	1980	1990	1980	1990	1980	1990	1980	1989
3 Total manufacturing	8.7	14.0	5.5	6.6	21.3	30.9	19.6	25.7	22.9	31.3	19.9	20.9	30.7	35.8
31 Food, beverages and tobacco	4.7	4.6	6.8	8.1	12.6	16.9	12.0	14.6	13.8	15.9	14.9	16.9	10.4	10.5
32 Textiles, apparel and leather	12.0	25.0	9.8	14.8	25.5	44.1	39.5	54.8	28.6	44.4	11.2	13.8	22.9	31.2
33 Wood products and furniture	7.2	8.6	6.9	10.6	17.8	22.3	15.3	19.4	20.8	24.8	10.6	8.9	9.4	12.6
34 Paper, paper products and printing	4.3	4.7	2.9	2.3	15.1	17.1	18.5	22.9	15.1	18.5	10.9	11.6	12.3	13.9
35 Chemical products	6.6	10.3	8.4	9.0	22.1	32.4	19.8	24.1	18.7	26.4	34.9	27.1	20.4	27.5
Chemicals excl. drugs	6.9	11.2	7.8	9.9	40.2	54.9	25.3	34.8	26.6	40.9	39.0	..	37.7	39.6
Drugs and medicines	4.4	4.8	7.2	6.6	11.5	20.4	16.2	21.2	11.2	18.8	16.4	..	20.8	18.8
Petroleum refineries and products	6.4	10.3	12.3	17.9	11.6	16.9	17.4	15.4	14.4	13.0	41.0	20.5	5.0	11.3
Rubber and plastic products	7.6	10.9	1.2	2.2	17.4	22.6	14.1	16.0	12.2	18.7	18.6	12.8	23.1	28.6
36 Non-metallic mineral products	4.9	8.6	1.0	2.8	13.3	18.2	10.3	13.9	6.9	12.1	6.2	6.2	18.3	21.6
37 Basic metal industries	12.2	13.8	3.5	5.7	25.6	31.0	21.5	23.8	31.2	33.1	26.0	21.9	18.6	23.9
Iron and steel	9.4	11.7	0.8	2.4	22.1	27.5	15.5	20.4	17.4	23.8	17.5	16.8	19.7	21.7
Non-ferrous metals	16.6	16.6	10.0	14.9	31.7	36.8	34.4	29.7	52.7	48.1	63.9	37.7	17.5	26.4
38 Fabricated metal products	11.3	20.0	3.8	4.9	25.3	38.2	19.4	27.6	27.9	42.3	23.9	27.2	56.2	59.4
Metal products	4.7	8.0	1.4	1.9	15.5	20.4	13.7	13.6	12.3	18.4	10.8	12.9	18.8	25.9
Non-electrical machinery	8.6	15.1	3.4	4.0	28.0	39.6	13.3	19.5	23.3	35.2	26.5	..	58.5	58.2
Office and computing machinery	9.5	37.1	8.0	7.9	42.3	51.0	62.7	75.2	73.4	76.7	89.4	..	92.5	83.1
Electr. mach. excl. comm. equip.	8.3	20.6	2.2	3.4	20.9	31.7	14.9	21.9	18.9	33.4	12.9	..	32.1	50.9
Radio, TV and commun. equip.	14.0	30.7	3.5	4.5	23.7	37.1	18.5	26.3	21.9	44.5	29.6	..	55.0	60.2
Shipbuilding and repairing	2.2	3.5	8.4	4.5	14.7	16.6	12.8	14.9	15.4	135.4	9.9	..	16.3	22.9
Motor vehicles	23.5	27.9	1.0	3.3	28.0	40.9	17.7	27.1	32.6	46.0	29.8	..	73.3	68.3
Aircraft	5.7	10.2	47.3	45.8	14.6	46.1	58.2	80.4	52.0	35.5	22.3	..	58.8	59.8
Other transport equipment	18.2	27.4	37.4	8.6	16.1	37.2	36.1	54.8	20.7	31.0	3.7	..	28.1	21.0
Professional goods	10.7	12.0	18.1	29.5	64.1	77.0	51.5	90.3	79.8	102.6	29.7	49.6	145.7	143.1
39 Other manufacturing, nec	20.9	35.3	12.2	18.1	34.5	37.9	59.1	61.0	131.0	99.9	20.6	32.9	38.4	23.8
High wage industries	10.0	17.6	7.7	8.4	24.3	39.1	22.3	31.6	28.0	38.6	35.1	..	45.0	51.5
Medium wage industries	8.2	12.2	3.2	4.2	21.9	28.5	17.1	21.4	20.6	29.1	18.9	..	31.3	35.4
Low wage industries	7.9	12.8	7.0	9.3	17.9	26.1	20.0	25.9	21.6	27.3	12.8	..	17.4	20.8
High technology industries	9.6	19.8	6.0	7.0	25.4	40.5	25.3	36.9	34.0	46.7	23.5	..	57.0	62.6
Medium technology industries	13.1	18.7	5.0	6.3	30.6	41.1	20.7	26.4	31.9	40.6	31.0	..	49.7	50.4
Low technology industries	6.4	8.7	6.0	7.0	15.7	21.2	17.8	20.8	16.6	19.8	15.6	14.1	12.8	16.9
Resource intensive industries	6.8	8.2	7.5	7.9	15.6	19.6	18.6	19.7	18.8	18.8	21.3	14.7	11.4	16.7
Labour intensive industries	9.8	19.6	6.7	9.3	22.7	33.2	31.0	34.9	31.3	38.7	11.7	14.5	23.9	27.9
Scale intensive industries	11.7	16.4	3.1	4.8	27.2	37.2	18.7	25.8	23.3	36.1	23.1	..	41.9	43.9
Specialised supplier industries	10.1	20.9	3.1	4.0	25.3	36.9	14.9	21.9	21.9	37.3	22.1	..	51.9	57.0
Science based industries	7.7	15.3	12.6	13.1	29.2	46.2	44.9	64.8	52.1	53.7	31.3	..	76.1	71.7

Source: OECD, STAN database (DSTI, EAS Division).

the perception that OECD countries mainly import low-technology, low-wage goods. It can be explained by the fact that most trade of OECD countries occurs with other countries in the OECD area, which also specialise in high-technology, high-wage industries.

The importance of exports in production

The international orientation of economies and their exposure to foreign competition can be examined both by analysing the importance of imports in satisfying domestic demand as well as by the fraction of production that is destined for exports or the export coverage at the level of individual industries of industry groupings. Table 7 shows the evolution over time of the share of exports in manufacturing production for a group of 13 OECD counties. Export coverage was at the end of the 1980s highest in the Netherlands, where over 70 per cent of production is exported. Denmark, Sweden Germany, Canada, Finland and Norway followed, while about a quarter of production in France, Italy and the United Kingdom was destined for export. The lowest export coverage of all the countries in the table is in Australia, Japan and the United States, where exports account for only one-tenth of production.

Table 7. **Export coverage in manufacturing**

Exports as a percentage of production

	1970	1980	1991	Average annual growth rate	
				1970-80	1980-91
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	2.7
Germany	18.4	25.0	30.0	3.1	1.7
Italy[1]	18.3	22.1	22.5	1.9	0.2
Netherlands	40.9	55.3	68.3	3.1	1.9
United Kingdom	16.3	23.4	28.0	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	38.0	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, STAN database (DSTI, EAS Division).

In the majority of countries, the importance of exports has increased over time. During the 1970s, export coverage increased in all countries except Norway, and during the 1980s in all bar Australia and Japan. During the 1970s, the share of exports in production increased fastest in the United States from a very low base (only 5 per cent of manufacturing production was being exported in 1970), followed by France, the United Kingdom, Japan and Germany. During the 1980s, this movement towards greater export orientation slowed down. Even though, with two exceptions, exports represented at the end of the 1980s a larger part of production than in 1980 in all countries (and without exception a larger part than in 1970), the rate of growth of export coverage slowed down in all the countries in the table except Denmark, Germany and Norway.

Below the level of total manufacturing, the structure by industry of the export orientation of countries differs greatly. In every G7 country, exports represented in 1989 a larger share of production in high-wage industries than in medium-wage or low-wage sectors. In addition, the export orientation of high-wage industries increased during the 1980s, whereas that of the medium-wage or low-wage groups has in many cases declined. In terms of technology, export coverage is highest in the high-technology group of industries in the United States, Japan, the United Kingdom, whereas it is highest in the medium-technology group in Germany and Canada, as well as in France and Italy in 1980.[3] Science-based industries tend to be the most export-oriented group, with resource-intensive and labour-intensive industries the group with the lowest export coverage.

Performance in export markets

Trends in export market shares provide information about competitiveness over the medium and longer term as they are a measure of the success that countries have had in capturing foreign markets. Table 8 illustrates the large intra-OECD shifts that occurred in manufacturing export markets between 1970 and 1990. Germany has consistently had the highest overall export market share in the OECD area during the past two decades, fluctuating between 16 and 18 per cent, slightly above that for the United States. The share of Japan, third on the list, has steadily increased during the period, but has also experienced some fluctuation following the movements in its exchange rate, attaining over 15 per cent in the mid-1980s from about 11 per cent during the 1970s, but falling below 13 per cent in 1990. The shares of France and Italy have remained stable at about 8 per cent and 7 per cent respectively while the United Kingdom and Canada have lost ground steadily, declining by about two percentage points each during the period.

Although their share remains very small in total OECD manufacturing exports, significant growth in export market shares can be seen in Ireland, Spain,

Table 8. **OECD export market shares in manufacturing**[1]

	Percentages				Average annual growth rate		
	1970	1980	1985	1992	1970-80	1980-85	1985-92
United States	17.8	15.7	15.6	15.6	–1.2	–0.2	0.1
Canada	6.4	4.2	6.0	4.2	–4.1	7.3	–4.9
Japan	9.7	11.7	15.6	13.9	1.9	5.9	–1.6
Belgium-Luxembourg	5.5	5.4	4.4	4.7	–0.2	–4.1	1.2
Denmark	1.5	1.4	1.3	1.4	–1.0	–0.3	1.2
France	8.2	9.4	8.0	8.9	1.4	–3.2	1.7
Germany[2]	16.6	16.8	15.8	17.3	0.1	–1.2	1.3
Greece	0.2	0.4	0.3	0.3	8.3	–3.3	0.1
Ireland	0.4	0.7	0.8	1.1	6.5	4.2	4.1
Italy	6.5	7.0	6.9	6.7	0.8	–0.3	–0.4
Netherlands	5.1	5.6	5.2	5.1	0.9	–1.7	–0.1
Portugal	0.4	0.4	0.5	0.7	–0.8	4.0	5.9
Spain	1.0	1.7	2.0	2.4	5.7	3.0	2.8
United Kingdom	9.2	8.8	7.1	7.2	–0.4	–4.2	0.2
Austria	1.4	1.5	1.5	1.8	1.2	–0.6	2.7
Finland	1.1	1.3	1.2	1.0	1.0	–1.3	–2.8
Iceland	0.0	0.1	0.1	0.1	7.9	–4.5	–2.3
Norway	1.1	0.9	0.8	0.8	–2.5	–1.0	–1.6
Sweden	3.3	2.7	2.6	2.3	–1.8	–0.7	–2.1
Switzerland	2.6	2.7	2.4	2.7	0.2	–1.9	1.5
Turkey	0.1	0.1	0.6	0.5	5.3	44.8	–2.1
Australia	1.4	1.1	0.9	0.8	–2.0	–4.0	–2.2
New Zealand	0.6	0.4	0.4	0.3	–2.4	–0.1	–3.9

1. Manufacturing exports of a given country in total OECD exports.
2. Figures for Germany up to and including 1990 refer to the western part of Germany only; from 1991 onwards they refer to the whole of Germany.

Source: OECD, STAN database (DSTI, EAS Division).

Greece and Turkey. Ireland and Spain more than doubled their share from 1970 to 1990, with increases across the board in most manufacturing industries. Greece nearly doubled its export market share of total manufacturing but remains at 0.3 per cent of the OECD market. Turkey experienced the highest relative growth, raising its export market share to slightly more than 0.5 per cent in 1990 from 0.1 per cent in the early 1970s. In these last two countries the increase was largely due to the growth in the textiles industry. In contrast, besides those in the United States, the United Kingdom and Canada, losses in market shares occurred in Australia, and to a lesser extent in Norway and Sweden.

High-technology industries accounted for 16 per cent of OECD total manufacturing exports in 1970 and rose to 23 per cent in 1990. Within this group, there has been considerable movement and redistribution especially between the

United States and Japan (Table 9). Japan's share increased by over seven percentage points to reach over 19 per cent in 1990. While its share in aerospace and pharmaceuticals remains very small, its market share increases in electronics, computers and electrical machinery have been significant. Exports of medium-technology industries accounted for 44 per cent in total manufacturing in 1990, barely higher than the 42 per cent share in 1970. The shares of the United States and of Canada have declined, that of Japan has increased while the variation in the European countries was small. The US share of OECD motor vehicle exports fell from over 18 per cent in 1970 to below 11 per cent in 1990. Meanwhile, Japan's share tripled to nearly 22 per cent in 20 years.

Low-technology exports are a shrinking part of total OECD manufacturing exports, falling from 41 per cent in 1970 to 32 per cent in 1990. Three overall trends can be discerned in these industries over the past two decades. The United States share of the market has remained stable at about 11 per cent, Japan's has fallen from 11 per cent to 6 per cent while, in general, the European countries moderately increased their shares. Of the large European economies, only the share of the United Kingdom decreased marginally. The combined shares of Germany, France and Italy increased, while that of Canada declined slightly. A few notable developments in individual low-technology industries are Japan's near total movement out of exports in the food, drink and tobacco, and wood, cork and furniture industries and its significant export market share decline in textiles, footwear and leather. Germany's share increased across the board in low-technology sectors, and notably in the food and paper industries.

New forms of trade: intra-industry and intra-firm trade

Besides the shifts in the international orientation of economies and in their export performance, the recent period seems to be characterised by an increasing component of intra-industry and intra-firm trade in total trade, both types of trade that do not conform to the product specialisation hypothesis in traditional trade theory. Intra-industry trade (IIT) is trade between countries within the same broad industry or product group. This trade pattern reflects a number of factors: the increasingly oligopolistic structure of markets, with firms engaged in fierce competition at home seeking outlets overseas, often as a precursor to foreign direct investment; and the differentiation of products that follows the more diverse tastes in advanced economies. It is often related to international investment and overseas production, intra-firm trade, and international sourcing of inputs by global firms.

Table 10 shows the evolution of intra-industry trade since 1970 in the OECD area. For almost all countries, the proportion of total trade that is accounted for by intra-industry transactions has increased significantly in the period 1970-90. At the same time, important inter-country differences remain. The highest IIT indices

Table 9. **Export market shares by industry**[1]

ISIC	United States		Japan		Germany[2]		France		United Kingdom		Italy		Canada	
	1980	1992	1980	1992	1980	1991	1980	1992	1980	1992	1980	1992	1980	1989
3 Total manufacturing	15.7	15.6	11.7	13.9	16.8	17.3	9.4	8.9	8.8	7.2	7.0	6.7	4.2	4.2
31 Food, bever. and tobacco	14.8	15.1	1.7	1.0	10.6	11.4	13.3	13.8	7.5	7.2	4.2	4.3	3.3	3.1
32 Textiles, wear. apparel and leather	11.5	8.6	7.8	4.9	13.5	15.6	10.0	9.2	7.8	5.8	18.1	20.4	0.8	0.8
33 Wood, cork and furniture	10.8	13.5	1.0	1.0	11.6	12.2	5.3	5.9	2.9	2.3	10.8	12.7	16.0	17.0
34 Paper, print and publishing	14.4	15.4	2.6	2.9	10.4	14.0	6.0	7.3	5.3	5.9	3.2	3.9	18.2	13.6
35 Chemicals	14.8	15.2	6.0	8.2	17.3	18.0	10.7	10.4	10.1	9.1	6.4	4.8	3.1	3.0
Industrial chemicals	19.0	16.6	7.3	9.5	19.7	19.7	10.4	10.7	9.7	8.7	4.5	4.2	2.9	2.8
Pharmaceuticals	15.4	11.9	2.3	3.1	17.3	15.6	11.8	11.2	12.7	11.7	5.6	5.8	0.7	0.7
Petroleum refining	5.2	14.6	1.2	3.9	9.9	9.9	10.0	6.3	11.0	9.7	9.9	1.7	3.9	6.0
Rubber and plastic products	9.4	11.7	10.8	9.7	18.5	19.0	13.8	11.9	9.1	7.2	11.5	9.7	1.9	3.6
36 Non-metallic miner. prod.	8.3	8.8	9.5	9.7	16.9	16.5	11.1	10.9	8.0	5.9	17.2	15.0	1.5	1.9
37 Basic metal industries	8.6	7.5	17.2	12.4	16.3	16.8	10.1	9.9	6.6	6.7	4.6	5.7	5.7	6.8
Ferrous metals	5.0	4.9	24.8	16.8	18.4	17.7	11.6	11.0	3.6	6.7	6.0	7.0	2.8	2.9
Non-ferrous metals	14.4	11.6	5.1	5.2	13.1	15.4	7.5	8.0	11.5	6.7	2.3	3.6	10.3	13.2
38 Fabr. metal products and machinery	19.0	17.9	16.7	20.1	19.3	18.9	8.5	8.0	9.1	7.0	6.2	5.6	3.6	4.0
Fabricated metal products	12.1	11.0	11.8	9.0	19.9	21.7	10.3	9.6	8.7	6.0	10.1	11.8	2.1	2.7
Non-electrical machinery	20.9	16.3	10.1	16.0	21.3	23.1	7.5	6.4	10.3	6.7	9.0	9.5	2.4	1.7
Computers and office machinery	34.9	26.1	9.7	25.5	13.2	8.8	7.6	6.1	10.8	11.1	7.3	2.5	3.3	2.7
Electrical machinery	14.4	15.4	15.3	19.1	21.8	21.0	10.5	9.3	8.7	6.0	6.9	7.3	1.1	1.6
Communicat. equip. and semic.	15.7	20.4	33.9	34.0	14.0	11.4	5.8	5.6	6.3	7.5	3.1	2.6	2.2	3.2
Shipbuilding	7.3	7.4	37.6	36.4	8.2	12.5	5.9	6.7	7.2	2.6	2.2	2.3	2.1	0.8
Other transport equipment	7.0	8.7	46.6	36.1	9.6	17.2	9.3	8.7	5.3	2.6	8.3	10.2	4.3	3.3
Motor vehicles	12.9	11.7	21.3	22.9	23.0	22.1	10.7	8.6	6.6	5.1	4.9	3.8	7.3	8.8
Aerospace	51.5	44.6	0.3	0.9	9.7	12.8	6.1	14.7	21.0	12.1	2.1	3.8	2.9	3.1
Instruments	20.2	20.0	19.3	20.2	16.6	17.0	6.8	6.3	9.7	7.9	3.1	3.6	1.6	1.3
39 Other manufacturing	12.0	10.4	8.2	11.4	8.2	9.6	6.1	5.8	20.2	11.9	9.9	12.5	1.6	0.9
High technology industries	24.1	23.5	16.5	20.0	15.8	14.3	7.8	8.3	10.7	8.9	4.5	4.1	2.0	2.3
Medium technology industries	16.6	14.0	12.4	15.9	19.7	20.7	9.3	8.6	9.6	6.9	6.3	6.1	4.4	5.0
Low technology industries	10.6	11.6	8.9	6.4	13.5	14.7	10.2	10.0	7.0	6.2	9.0	9.5	4.8	4.8
Resource intensive industries	11.7	13.7	2.9	2.9	11.6	12.4	10.5	10.7	8.5	6.7	7.0	6.1	5.9	6.5
Labour intensive industries	11.8	9.7	9.2	7.2	14.7	16.5	9.4	8.8	10.3	6.9	14.0	16.5	1.4	1.4
Scale intensive industries	13.3	12.8	15.9	16.0	18.9	19.6	10.2	9.5	7.1	6.4	5.1	4.6	5.8	6.3
Specialised supplier industries	18.6	17.2	15.8	21.6	20.0	19.4	7.8	6.8	9.2	6.8	7.4	7.1	2.1	2.1
Science based industries	32.2	27.8	9.4	14.1	13.9	13.2	7.4	9.3	13.6	10.5	4.1	3.6	2.3	2.2

1. Exports of a given country in a given industry as percentage of total OECD exports in that industry.
2. Figures for Germany up to and including 1990 refer to the western part of Germany only; from 1991 onwards they refer to the whole of Germany.

Source: OECD, STAN database (DSTI, EAS Division).

Table 10. **Intra-industry trade indices, all products**[1]

	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/Luxembourg	61.4	67.5	72.8
Germany	55.8	56.6	72.2
United States	44.4	46.5	71.8
Netherlands	63.4	60.5	69.8
Sweden	52.3	58.2	64.2
Denmark	55.0	54.8	62.2
Switzerland	52.5	59.8	60.2
Canada	52.1	51.5	60.0
Italy	48.7	54.8	57.4
Ireland	48.2	55.1	56.9
Greece	32.4	28.3	50.5
Portugal	39.8	39.5	49.2
Finland	29.4	37.8	45.7
Norway	52.3	42.5	41.9
Turkey	6.7	12.5	34.6
Japan	21.4	17.1	32.4
Australia	20.7	21.6	30.5
New Zealand	10.6	16.3	25.9

1. Grubel-Lloyd indices calculated on SITC Rev.2 3-digit level; adjusted for overall trade imbalances.
Source: OECD, DSTI/EAS Division.

in 1990 can be found in the United Kingdom, France and Austria (where over three-quarters of total trade is accounted for by intra-industry transactions). In general, country differences reflect the fact that high IIT indices should be expected in countries with high per capita incomes, which imply demand for variety and bring about trade in differentiated products, or for countries at a similar stage of development, belonging to regional trading zones (such as the EC member States). Low IIT indices should in contrast be expected in countries that are geographically distant from the areas where the bulk of world demand and trade is concentrated and in countries that have a very high specialisation in one group of products (for example natural resource-based economies) or a high import dependence on others.

Table 11 summarises intra-industry trade by product group for the G7 countries. It confirms that intra-industry trade is more important in manufactured products than it is for primary commodities. IIT indices tend to be highest in the chemicals, manufactured goods, machinery and transport, and miscellaneous and other manufacturing products groups in most G7 countries. In these groups

Table 11. **Intra-industry trade in the G-7 countries by product group**

SITC section		0 Food	1 Beverages	2 Raw materials	3 Mineral fuels	4 Oils and fats	5 Chemicals	6 Manu-factured goods	7 Machinery and transport	8 Misc. manu-facturing	9 Other n.e.c.
United States	1970	22.9	19.1	41.5	18.8	19.0	52.7	60.2	46.9	41.3	60.5
	1980	24.9	26.4	38.8	6.4	15.7	63.7	62.1	56.8	50.0	63.2
	1990	50.6	24.7	56.2	16.8	67.5	74.3	62.1	71.0	45.6	80.9
Japan	1970	14.8	25.9	2.8	2.5	42.7	56.2	19.4	30.2	43.3	62.3
	1980	11.5	6.5	4.3	0.9	54.7	63.9	24.1	16.8	46.5	77.0
	1990	9.5	9.4	6.8	4.3	40.0	66.3	43.1	27.1	42.5	71.8
Germany	1970	31.2	36.7	29.1	27.6	52.7	58.5	69.6	49.5	63.3	76.3
	1980	46.5	51.8	35.4	22.6	59.5	69.3	76.4	54.9	68.5	75.6
	1990	58.5	57.4	43.0	28.2	68.8	74.5	80.6	65.8	70.6	82.4
France	1970	46.5	61.7	46.7	20.9	47.5	80.8	72.5	75.9	77.2	3.7
	1980	49.5	35.4	52.8	22.8	66.1	72.8	80.0	76.3	82.6	26.7
	1990	59.7	30.2	53.3	25.9	75.3	72.0	83.4	83.4	77.3	92.2
United Kingdom	1970	18.8	38.3	21.8	31.7	16.9	66.1	62.1	56.4	76.7	58.4
	1980	39.8	53.4	33.7	94.2	42.9	71.4	79.4	72.8	82.5	64.0
	1990	46.0	69.5	33.7	83.5	39.8	76.4	76.4	83.3	77.1	77.6
Italy	1970	23.1	47.4	20.5	6.3	29.5	78.1	53.7	70.9	32.8	78.7
	1980	23.9	3.1	21.5	27.1	42.6	81.3	58.5	70.3	34.8	60.1
	1990	36.5	4.6	25.0	30.6	62.2	70.7	64.1	69.3	39.9	63.9
Canada	1970	29.7	43.4	24.8	57.8	41.5	39.4	35.4	63.3	46.2	40.3
	1980	28.0	82.2	33.7	45.2	18.5	36.1	40.3	67.0	47.4	35.5
	1990	39.4	90.9	31.8	72.5	51.2	54.7	51.7	67.9	44.9	88.7

Source: OECD, NEXT database; DSTI/EAS Division.

products tend to be the most differentiated, and there are also high levels of foreign direct investment in the industries producing them. Nevertheless, despite this broad tendency for IIT trade to be highest in manufactured goods, country-specific factors remain very important. Of all the countries in the G7 group, Japan is the one with the lowest overall IIT index and the most variance in the level of intra-industry trade between product groups. It is also unique among countries in having a comparatively low level of intra-industry trade, while being a highly developed economy specialising in manufacturing products.

Intra-firm trade (IFT) refers to trade in products which are sold internationally, but which stay within a multinational enterprise (MNE); it represents a significant portion of foreign trade for several OECD countries. Recent OECD work in this area for the United States and Japan shows that over a third of US trade is intra-firm but that, contrary to expectations, the overall share of intra-firm trade in total US trade has not shown a significant increase between 1977 and 1989 (OECD, 1993*c*). US IFT is concentrated on industries with relatively high R&D and human capital intensity, including transportation equipment and other machinery. The only component of US IFT which has shown a significant increase between 1977 and 1989 was US affiliates' imports from their foreign parents. This increase is mostly due to increased activity by firms from Japan and South Korea and is concentrated in the wholesale trade of motor vehicles and equipment. In Japan, intra-firm trade is – as for the United States – relatively more important for the machinery industries, including transportation equipment. Moreover, wholesale and retail trade account for a significant share of total Japanese IFT, both on the import and the export side, reflecting the significance of corporate networks established by Japanese trading firms in foreign trade activities.

Intra-firm trade can be regarded as the replacement of market transactions by internal transactions within MNEs. Market imperfections and high transaction costs provide an incentive for MNEs to internalise international transactions of goods which are embodied with firm-specific knowledge and expertise. Results for the United States and Japan support the "internalisation" theory of IFT by showing that this type of trade is more prevalent in manufacturing industries characterised by higher R&D and/or human capital intensity and greater international orientation.

IV. THE LINKS BETWEEN TRADE AND EMPLOYMENT

The consequences of the globalisation process for employment and unemployment have not been studied much. Analysis of globalisation has tended to

focus on defining its characteristics and driving forces, or examining its consequences for the structure of world production or for government policies; relatively little analysis has focused directly on the implications on the level and type of employment. When the employment implications of the various aspects of globalisation have been considered, formal analysis has tended to concentrate almost exclusively on the impact of trade patterns on the level or structure of employment. The argument about the impact on employment of the changing nature of international competition is however broader, and encompasses other aspects aside from trade that can all be considered as representing different facets of the globalisation process. The broader question relates to the impact on employment of foreign direct investment, or of new patterns of relocation of firms, of international sourcing of inputs, or of the creation of international networks of co-operation between firms. These are all questions that have been studied very little, partly because of the paucity of data and partly because of the difficulty in formulating and testing empirically-clear hypotheses.

The theoretical argument of the relationship between trade and employment

Economic theory predicts that changes in a country's pattern of trade or direct investment only temporarily affect its aggregate employment level. Starting from a position of equilibrium, an external shock which tends to increase a country's imports relative to its exports will initially lead to a trade deficit and to a reduction in income and employment levels (under fixed exchange rates). The resulting decrease in the money supply gives rise to higher interest rates and to further reductions in incomes and employment due to lower investment. The existence of unemployment would then tend to drive money wages downwards as wage contracts come up for renegotiation, and would result in lower real wages. This would be translated into increased employment by firms in response to lower unit costs, and an improved trade balance as domestic prices fall relative to foreign prices. Under flexible exchange rates, a depreciation of the currency would further facilitate this increase to the initial level of employment. Thus in the long-run, market forces operate to bring employment to the level where unemployment is at its so-called "natural rate", a rate determined by various structural features of an economy, such as its demographic composition, the degree of unionisation, or the minimum wage level (Baldwin, 1995).

Two points are worth making with respect to this brief description of the economic mechanisms linking trade and employment. First, this adjustment process does not preclude that in the short run, there may be employment effects of such international economic shocks, such as shifts in the volume or composition

of trade, with the length of these effects depending largely on the institutional capability of countries to adjust to structural change and on labour-market flexibility, including wage flexibility. In situations where external trade shocks which can be traced to structural change and technology succeed each other, such employment effects can be long-lasting and persisting.

Second, even where adjustment mechanisms operate efficiently, there is no counterpart of the impact of external trade shocks on employment to the impact of such external shocks on relative wages in a given country. There is no "natural" relative wage pattern to which wages can revert once an external shock has been absorbed. The structure of wages depends on factors such as the nature of its technology, domestic and foreign preferences for goods and services, the educational and training conditions, institutions in the labour market, etc. Shifts in trade may therefore lead to lasting changes in the structure of wages, depending on whether resources in a given country move towards the production of activities that require highly skilled and higher-paid workers or remain centred around the production of goods and services that require lower-skill workers whose compensation levels are correspondingly lower.

Persistent negative impacts of trade on employment can be traced to the presumed increased role and the particular characteristics of technology-based international competition. Analytically, the net effect on jobs of technological advances is determined by the balance between two forces: "direct" effects, and "indirect" or "compensating" effects. The former relate to the net changes in jobs at the point of introduction of new technology; they have a negative impact with labour-saving technology, except in the case where product rather than process innovations dominate. Indirect effects fall into two categories, both tending to increase employment (though with a lag): technology multiplier effects, due to the demand and employment that is generated in supplier industries and the capital goods sector by the increase in gross investment to install new technology; and price and income effects. These latter arise because technical change creates the potential for productivity increases, leading to lower production costs, increased profits and wages or lower prices, all leading to higher real incomes and demand (OECD, 1986).

The impact of technology on employment is however transformed by the globalisation process. The balance between the direct and the indirect – "compensating" – effects of technology on jobs is now determined to a large extent in international markets. Intensified international competition implies that productivity improvements are no longer automatically translated into higher wages (a provision of many union contracts in the past) and profits, and the demand and supply-side conditions for increased investment are thus often not present. Wages tend to lag behind productivity gains because of pressure from lower-wage competitors and the need to constantly reduce costs, while in many coun-

tries the increased domestic purchasing power leaks out into imports. Furthermore, in periods of slower productivity growth, the feasible rate of growth of the real wage is lower (at a given unemployment rate); if wage aspirations do not simultaneously moderate the result is higher unemployment.

Global competition also tends to be oligopolistic in nature, with the implication that the evolution and industrial structure characteristics of many international markets depend largely on the strategic use of technology and on rent-sharing, rather than on considerations of efficient resource allocation (Harris, 1989; Spence, 1984; Krugman, 1986; Tyson, 1992). The presence of imperfect competition in product markets will then tend to raise equilibrium unemployment. A constant or declining marginal cost of production (or a decreasing mark-up with declines in activity) or equivalently the presence of increasing returns to scale associated with many technologies and leading to imperfectly competitive international markets can generate this result (Weitzman, 1982; Bean, 1992).

Evidence on the impact of trade patterns on employment

Empirical studies examining the evidence on the impact of trade on employment have generally tended to conclude that the overall effects, if any, are small, but that there is an impact on the structure of OECD employment (OECD, 1994*a*). The majority of studies look at North-South trade and the methodology commonly used consists of calculating the factor content of trade by finding out how much labour is required to produce the goods that are exported to the South and estimating how much labour would have been required to produce domestically those goods that are imported from the South. The net effect on trade can then be estimated as the difference in labour content between exports and imports, which can be calculated both in aggregate and for particular industries and skill-levels. The labour content of manufactured imports will tend to exceed that of manufactured exports, given that less developed countries tend to specialise in labour-intensive products. A balanced expansion of trade will therefore tend to reduce employment in industrial countries. Since however industrial countries as a group tend to have a large surplus in trade in manufactures, some studies have argued that such trade generally increases employment in manufacturing in OECD countries (Balassa, 1989).

Early OECD work on this issue reported that increased trade in goods tends to intensify the process of structural change in OECD economies, especially with respect to trade with non-OECD countries, which has a labour-saving effect and affects the structure of demand for labour. While job losses are concentrated on unskilled workers and women, demand for skilled personnel and men is stimulated. Trade between OECD countries also tends to have a labour-saving effect to

the disadvantage of unskilled and female workers, but the impact is less significant. Overall however, the conclusion was that a balanced expansion of trade generally leads to only slight shifts in the pattern of labour requirements (OECD, 1985). Other studies come up with similar results pointing to changes in the structure of demand for labour, identifying the same set of winning and losing industries and skill-groups. In terms of industries, the losers include food processing, wood products, textiles and clothing, leather goods and footwear, with these losses offset by increased employment in the machinery and chemicals sectors.[4] In terms of the skill composition of employment, skilled workers tend to gain from trade, and unskilled workers lose (Borjas *et al.*, 1991).

The results of these studies are based on a number of methodological assumptions. While the labour content of exports is straightforward to calculate, estimates of the labour content of imports requires an assumption about the extent to which imports "compete" with domestic consumption (Baldwin, 1995; Wood, 1991*a*). Estimating the hypothetical labour content of imports in a certain industry from the actual amount of labour used in the domestic industry assumes that all imports concerned "compete" with domestic production. An alternative methodology assumes that only one part of imports from the South are "competing", while the remaining (such as black-and-white TV sets) are no longer produced in industrial countries and are thus "non-competing". This implies that conventional calculations may underestimate the amount of labour displaced by imports.

Using these alternative assumptions, recent work has suggested that the net effect of trade (with non-OECD countries) on OECD employment has been seriously underestimated (Wood, 1991*a*, 1991*b*). Usual calculations estimate the employment content of imports of manufactures by the North from the South to exceed the employment content of exports from the North to the South by about 1 million person-years over the last three decades. The alternative calculations put the figure at about 9 million person-years, and suggest that the difference would be appreciably higher if one took into account the labour-saving technical progress stimulated in the North in reaction to competition in the South.[5] Even this larger number however is considered small relative to total employment in industrial countries. Furthermore, and common to other studies, this work also argues that trade with non-OECD countries has probably significantly altered the sectoral composition of OECD employment, shifting workers out of manufacturing and into non-traded services. More importantly, it has had a differential impact depending on skills, reducing demand for unskilled labour relative to that of skilled labour.

Decomposition of employment growth

Other analysis has attempted to go beyond establishing whether there have been changes in the direct labour content of exports and imports and tried to

capture the ripple effects of trade throughout the economy with the use of inter-industry transactions. Such ripple effects occur because of the upstream and downstream linkages of industries, so that the total positive (negative) effect of exports (imports) on jobs exceeds the direct impact in the industry concerned. Evidence for the United States pointed to overall net job gains from a balanced trade expansion, with a tilt in employment towards professional, managerial, marketing and clerical positions (OTA, 1988; Belous and Wyckoff, 1987). Another study from the United States has estimated that the employment effects of the trade deficit have been large, with over three million jobs lost in manufacturing, and two million jobs lost in industries related to manufacturing, primarily business services (Duchin and Lange, 1988).

Using a similar input-output methodology, recent OECD work on the growth decomposition of employment in seven large OECD economies during the period since the first oil shock paints a contrasting picture by country (OECD, 1992*a*). The overall impact of trade on employment growth in the United States (1972-85) has been small, with job losses from the import of intermediate and final goods cancelling job gains from exports. Employment growth in Japan (1970-85) has mostly been due to domestic demand expansion, but exports also played a significant part, while there is no evidence of job displacement through imports. In Europe, imports displaced more jobs in the United Kingdom (1968-84) than were gained by exports, while the reverse is true for France (1977-85) and Germany (1978-86). In all countries, however, factors other than trade have tended to be more important in determining overall employment growth: domestic demand was the main positive influence, with increased labour productivity the main negative influence.[6]

The results from this recent OECD study, as well as the other studies briefly mentioned above, all ascribe a small part of aggregate job losses to trade, even when particular industries or skills are affected in an important way. Labour productivity growth shows up as the main factor responsible for employment reduction in industry. It is however a mistake to separate the two: pressures on employment arising from international competition show up either in direct job losses associated with imports, or as improved labour productivity which comes about as firms introduce new labour-saving technologies in an effort to remain internationally competitive. To a large extent, technological knowledge is transferred by trading goods (Meyer-Krahmer, 1992). The elimination of inefficient firms, intensified pressures to cut costs and invest in new technology, and capital/labour substitution are all mechanisms through which international competition can raise productivity.

Disentangling the effect on employment of trade and of trade-induced labour productivity growth is not easy. One attempted estimate suggests that from the early 1960s to the mid-1980s the cumulative trade-induced reduction in the

demand for labour in manufacturing in all industrial countries was between 10 million and 30 million person-years. This result implies that in the absence of expanded trade with developing countries, the manufacturing sector's share in total employment in industrial countries would have remained constant between 1975 and 1985, rather than declining from 29 per cent to 22 per cent (the absolute number of workers in manufacturing did not fall) (Wood, 1991*a*).[7]

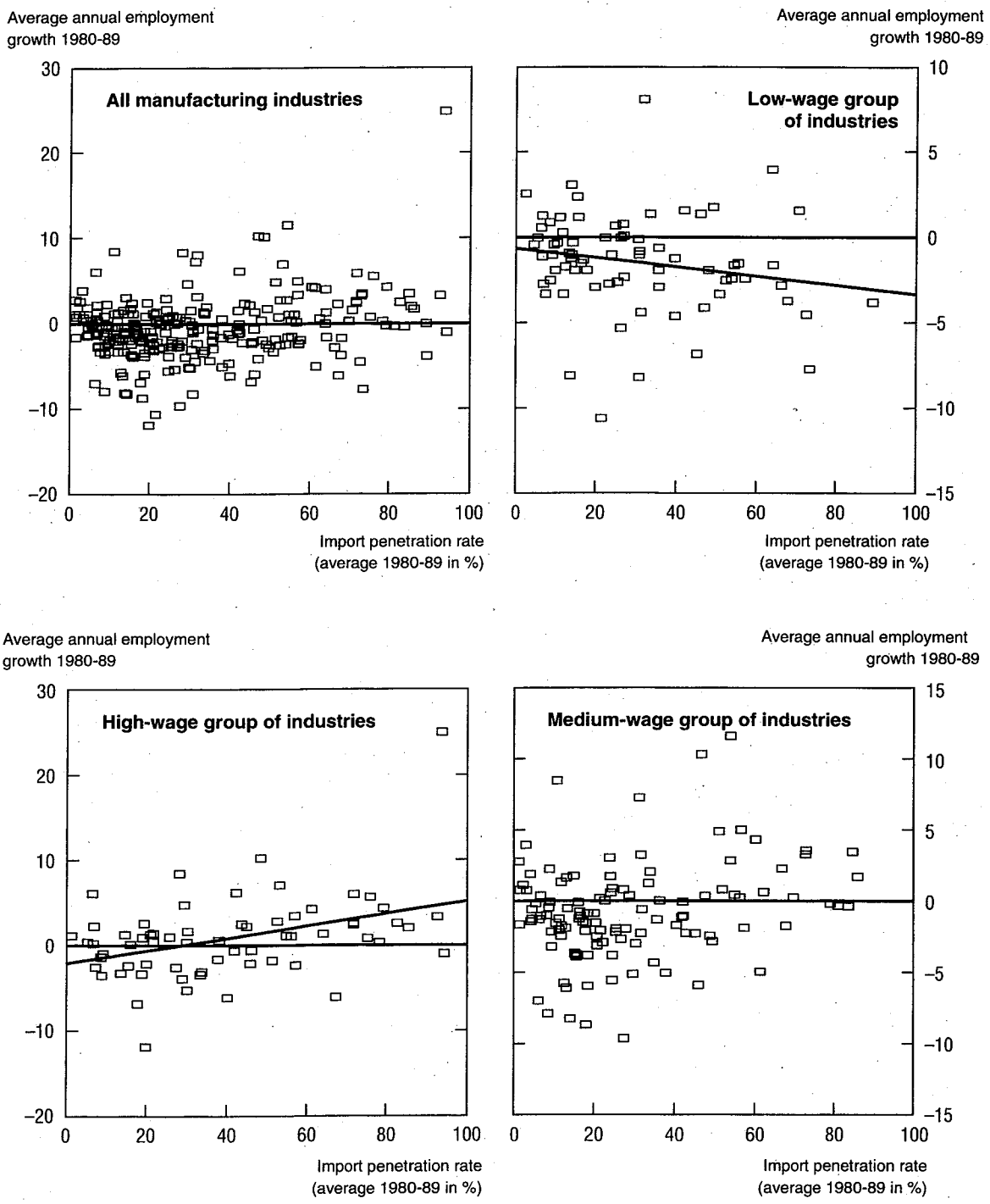
Employment and trade: correlations and elasticities

Further evidence on the relationship between trade and employment based on more recent data can be found by examining the relationships between import penetration and employment growth as well as in that between export market shares and gains in employment. Graph 3 investigates the relationship between the growth of employment in 13 OECD countries at a detailed sectoral level for the 1980-89 period and the average import penetration (imports as a proportion of total domestic demand) in the same period. When all industries are pooled together, the graph shows no systematic relationship between openness to trade, as this is reflected in import penetration rates, and employment growth. The same is true if one looks at the correlation between employment growth and change in import penetration: thus neither the degree of openness nor trade liberalisation leading to a greater part of domestic demand being satisfied by imports are associated with overall employment losses.[8]

The picture changes when one looks at the same relationship at a more disaggregated level. A negative (but weak) relationship between employment growth and import penetration is evident for the low-wage group of industries. Higher import penetration rates are associated with higher employment losses. In contrast, for the high-wage group, openness to trade is associated with employment gains, as industries respond to competitive pressures from an open international environment. A similar relationship is apparent when industries are classified according to their technology intensity (not shown in the graph): employment growth in high-technology sectors is positively correlated with import penetration, while there is a (weak) negative correlation for low-technology industries.

The impact of trade variables on employment is however best examined in a context where their importance can be compared with the influence on other variables such as technology, investment and labour compensation. Table 12 reports the results of such an analysis carried out for the G7 countries during the 1980-89 period. The figures in the table represent the elasticity of employment growth to a number of variables: the growth in import penetration, in export market shares, in investment intensity, in R&D intensity, in export coverage, in value added per employee, and in labour compensation per employee.[9]

Graph 3. **Import penetration and employment growth**[1]



1. Correlations on 22 manufacturing industries (2, 3-digit ISIC); 13 countries.
Source: OECD, STAN database (DSTI/EAS Division).

Table 12. **Employment elasticities**[1]

	Import penetration	Export market shares	Investment intensity	R&D intensity	Export coverage	Value added per employee	Compensation per employee	Observations/R^2
United States								
All man. industries		0.4	0.1	–0.1	–0.3			189/0.31
High technology		0.4	0.2	–0.1	–0.3		1.3	54/0.66
Medium technology	0.3	0.6			–0.4		–1.0	63/0.39
Low technology	0.1	0.4	0.1	–0.1	–0.3			72/0.50
High wage		0.2	0.1	–0.2				54/0.39
Medium wage		0.5	0.1		–0.4		0.8	81/0.50
Low wage	0.6	0.6	0.2		–0.5	0.3	–0.9	54/0.48
Resource-intensive	0.2		0.1	–0.1				45/0.51
Labour-intensive		0.3			–0.3		–0.9	27/0.74
Specialised-supplier		0.9			–1.0		1.3	27/0.93
Scale-intensive	0.2	0.6			–0.4		–1.2	54/0.49
Science-based						–0.3		36/0.53
Japan								
All man. industries		0.3	0.0		–0.2		–0.8	185/0.36
High technology	–0.2		0.1		–0.3		–0.8	48/0.53
Medium technology					–0.2		–0.9	55/0.67
Low technology		0.4	0.1		–0.4		–0.7	81/0.49
High wage	–0.1	0.2			–0.2		–0.9	49/0.58
Medium wage		0.5	0.1		–0.4		–0.6	90/0.41
Low wage		0.2	0.1		–0.2		–0.7	46/0.67
Resource-intensive		0.4			–0.4		–0.9	45/0.69
Labour-intensive							–0.9	27/0.75
Specialised-supplier		0.4			–0.5		–0.8	27/0.77
Scale-intensive		0.3					–0.5	55/0.45
Science-based			0.1		–0.3		–1.0	31/0.48
Germany								
All man. industries		0.1		–0.1		–0.1		198/0.18
High technology				–0.1				54/0.27
Medium technology			–0.1			–0.3		63/0.58
Low technology				–0.1		–0.1		81/0.14
High wage								54/0.36
Medium wage		0.2			–0.2		–0.4	90/0.4
Low wage		0.2			–0.2			54/0.64
Resource-intensive						–0.3	–0.7	45/0.59
Labour-intensive							–0.6	27/0.76
Specialised-supplier								27/0.45
Scale-intensive		0.2		–0.1	–0.2			63/0.26
Science-based				–0.1				36/0.31
France								
All man. industries						–0.2	–0.1	142/0.21
High technology								21/0.26
Medium technology	–0.3						–0.4	42/0.49
Low technology	0.1		0.1					74/0.51
High wage								35/0.54
Medium wage	0.1		0.1	–0.1				54/0.64
Low wage	–0.2	–0.2						32/0.56
Resource-intensive								43/0.14

Table 12. **Employment elasticities**[1] *(cont'd)*

	Import penetration	Export market shares	Investment intensity	R&D intensity	Export coverage	Value added per employee	Compensation per employee	Observations/R^2
France								
Labour-intensive								27/0.55
Specialised-supplier								
Scale-intensive		–0.1			0.1			36/0.65
Science-based								21/0.26
United Kingdom								
All man. industries								150/0.11
High technology		0.3						40/0.4
Medium technology								40/0.56
Low technology		–0.2			–0.1			75/0.21
High wage	–0.2							48/0.49
Medium wage		–0.3		0.1		–0.1	0.5	70/0.49
Low wage					–0.3			35/0.69
Resource-intensive		–0.1						43/0.10
Labour-intensive				0.1				16/0.83
Specialised-supplier	–0.2							24/0.78
Scale-intensive						–0.3		46/0.50
Science-based	–0.5							24/0.56
Italy								
All man. industries							–0.4	134/0.32
High technology	–0.5						–0.9	35/0.71
Medium technology								45/0.40
Low technology					0.0	0.0	–0.3	60/0.64
High wage							–0.5	35/0.43
Medium wage							–0.2	74/0.41
Low wage							–0.4	40/0.51
Resource-intensive						0.2		27/0.51
Labour-intensive							–0.2	27/0.29
Specialised-supplier							–0.9	21/0.53
Scale-intensive						–0.3	–0.2	40/0.58
Science-based						–0.5		26/0.49
Canada								
All man. industries	–0.1						–0.4	175/0.23
High technology								40/0.12
Medium technology	–0.3							56/0.31
Low technology	–0.1	0.2	0.1		–0.2		–0.5	78/0.45
High wage								48/0.22
Medium wage		0.2	0.1		–0.2			72/0.36
Low wage	–0.2							52/0.22
Resource-intensive	–0.2	0.3			–0.2			43/0.43
Labour-intensive		0.3			–0.4		–0.7	27/0.87
Specialised-supplier			0.1					24/0.60
Scale-intensive	–0.2				0.1			49/0.49
Science-based								24/0.06

1. Elasticities are obtained from regression analysis of employment growth on the variables in the table (expressed in growth rates). Data are pooled over time for the period 1980-89. All variables are logarithmic transformations and expressed relative to the total manufacturing average. Only results significant at a 5 per cent or a 1 per cent level are reported. See text for more details.

Source: OECD STAN database; (DSTI/EAS Division).

A number of broad generalisations can be made from the table. The first is that the variable whose employment elasticity shows up in a significant way most often is that of relative compensation per employee. Typically, this elasticity is negative and between 0.5 and 1. Secondly, of the trade variables included in the analysis, import penetration seems to be the least important in determining growth in employment. In contrast, the employment elasticity of export market share growth is often significant and positive, and its value has a high variance between countries. Thus it seems that countries that succeed in increasing their export market shares are also successful in expanding employment. At the same time however, the employment elasticity with respect to changes in export coverage (the share of exports in production) is often negative, with a value of around 0.3. This suggests that employment declines as economies become more exposed to foreign competition through an increase in the export share of production. A third generalisation is that there is a great deal of country specificity in the results, with elasticities differing by country both in sign and magnitude.

Some of the most significant results by country are as follows. In the United States, import penetration growth does not seem to be associated with employment losses. On the contrary, the positive elasticities at the level of certain industry groupings suggest that import penetration increases during the period in question have been associated with a better than (total manufacturing) average employment performance. Relative employment growth is also (positively) sensitive to growth in relative export market shares and investment intensity, while inversely related to growth in relative R&D intensity and in export intensity. In Canada, in contrast, the elasticity of relative employment growth with respect to relative import penetration growth is negative for most industry groupings, as well as for all industries pooled together, even though its value tends to be low (in the –0.1 to –0.3 region). In Japan, relative employment growth has been most adversely affected by the relative growth in labour compensation, with elasticities in the –0.5 to –1 region for all industry groupings.

Employment elasticities in the four largest European countries exhibit a great deal of variance by industry grouping. There is no one variable which dominates in each country, except for the negative employment elasticity with respect to relative labour compensation growth in Italy. In Germany, employment elasticities with respect to relative export market share growth are positive but low for all industries pooled together as well as for the medium- and low-wage and the scale-intensive industry groups, while elasticities with respect to relative R&D intensity growth tend to be negative, for example in the high-technology, high-wage and science-based industries. In France, elasticities tend to be low, so that for all the industries pooled together the highest elasticity is –0.2 for the impact of relative increases of value added per employee on employment growth. Finally, in the United Kingdom, one noteworthy result is the strong and negative relationship

which exists between relative employment growth and the growth in relative import penetration in the science-based industries, with an elasticity of –0.5.

V. RELOCATION, FOREIGN INVESTMENT AND EMPLOYMENT

Section IV briefly looked at the analytical framework which determines the relationship between trade and employment and then examined some empirical evidence linking employment performance to international competition and trade. As the previous sections indicate however, globalisation cannot be reduced to trade relations. Foreign direct investment, the relocation of production or parts of production, and the optimisation of resources on a global scale through the international sourcing of inputs are some of the mechanisms and channels through which globalisation of economic activities emerges. In this environment, the impact of globalisation on employment can only be captured imperfectly by examining trade flows. Additional empirical work on the impact on jobs of the other aspects of this process is necessary. Such work is complicated, not least because of the lack of data and by the need to build models calculating, for example, the ripple effects associated with the displacement of workers due to foreign direct investment.

The location of industrial activities, international investment and sourcing

Relocation of industrial activities

At firm level industrial globalisation is characterised by the increasing share of foreign activities in the total activities of many industrial and commercial enterprises. Firms become more global as they organise operations along the chain from R&D and innovation, finance, through production and distribution to final sales in order to maximise returns on a regional or global scale. This requires spreading final sales and operations across many markets, and worldwide co-ordination of activities. This kind of firm strategy is being adopted increasingly as firms disperse their activities widely; it tends to predominate in high-technology industries, such as aerospace, computers, electronics and chemicals, and in some assembly industries such as automobiles, where development costs are high and there are economies of scale in worldwide operations (OECD, 1992*a*).

Not all international firms however operate with global strategies. Many large international enterprises differentiate between national and regional markets so that they can take advantage of local external economies in production and

distribution, while co-ordinating their core activities (R&D, technology, planning, finance and other key management functions) at a regional level (UNCTC, 1992). Many more firms, particularly smaller ones, only operate domestically (which may include limited exporting), conducting the overwhelming share of their activities in one national market; a market which is increasingly subject to global competition however. Final service and consumption industries strongly influenced by cultural and institutional traditions, such as retailing, deposit banking, food and beverages and other consumer goods, are of this type, as well as some process industries producing intermediate products.

Furthermore, not all of firms' activities are treated equally in the process of relocation. R&D activities tend to lag behind the transfer of production, but when they are transferred they also tend to remain concentrated in a limited number of countries, suggesting that a few countries are being used as important R&D bases. In the case of the United States, for example, expenditures on R&D as a share of gross output are higher for foreign manufacturing affiliates located in the United States than for the average for all manufacturing (7.6 per cent in foreign affiliates compared with the average of 6.5 per cent in 1987) (US Department of Commerce, 1991). This is explained by the high level of direct investment in R&D-intensive industries, and particularly by the acquisition of R&D-intensive firms by foreign investors. It also reflects the attractiveness of the United States as an R&D location, due to its stock of skilled manpower and large market.

The expansion and relocation strategies of many large multinational firms have increased the relative importance of foreign ownership in most OECD countries (Table 13). Wide differences remain however in the share of turnover and employment in foreign-controlled firms. The share of foreign-owned subsidiaries in manufacturing turnover is over 30 per cent in Australia, Belgium, Canada and Ireland; 20-30 per cent in Austria, France, Germany, Portugal and the United Kingdom; 10-20 per cent in Denmark, Italy, Norway, Sweden, Turkey and the United States; and less than 10 per cent in Finland and Japan.

Penetration of foreign firms has increased particularly rapidly in the United States, reflecting strong inflows of foreign investment in the 1980s, and in Sweden, both from a low base. In the European Community, it has increased rapidly in Portugal and Spain following large inflows of foreign investment and has continued to grow significantly in Ireland. With the boom in foreign investment from the second part of the 1980s, the relative importance of foreign ownership increased again in larger European countries (France, Germany, Italy, the United Kingdom) which already had 15-25 per cent of manufacturing output in foreign-owned subsidiaries in the 1970s but which showed low growth of foreign investment and penetration in the early 1980s. The share of foreign-controlled output has declined from previous high levels in Australia and Canada. These trends

Table 13. **Share of foreign enterprises in manufacturing production and employment**[1]

Percentages

	Production		Employment	
	1980	1988	1980	1988
United States[2]	5.1	14.9 (1989)	5.8	8.9
Canada	50.6	48.6 (1987)	34.0 (1986)	..
Japan	4.7	2.3 (1987)	1.6	1.0 (1989)
Denmark	..	13.3 (1986)	..	12.4 (1986)
France[2]	26.6	27.5	18.5	22.3
Germany[2]	23.2	20.5	16.6	15.4
Ireland	46.1	55.1	36.3 (1983)	44.2
Italy	19.2	22.3	15.8	17.2
Portugal[2]	23.6 (1984)	..	17.7 (1984)	..
United Kingdom	19.3	20.2	14.9 (1981)	13.0
Finland[2]	3.4	5.0	4.0[2]	5.5[2]
Norway[2]	..	..	11.2	9.7
Sweden	7.9	14.6 (1987)	6.4	13.5
Australia[2]	33.5 (1982)	32.0 (1986)	26.3 (1982)	23.8 (1986)

1. Includes minority holdings (equity holdings > 10 per cent 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.
2. Includes joint ventures and minority participation (< 50 per cent). Values for France are unweighted by share of minority ownership.

Source: OECD, from data supplied by national authorities and national sources.

indicate that while globalisation as measured here is an important overall tendency, it is not unequivocal in all countries and in all periods.

As mentioned earlier, globalisation has a particular sectoral incidence, and is most evident in high-technology industries. In most countries the computer, chemical, pharmaceutical, automobile, and electronics industries have had the largest flows of investment and the highest shares of foreign ownership. Table 14 shows that foreign enterprises account for a large share of production in five out of seven large OECD economies (the exceptions are the United States and Japan). Differences between countries remain, however, in the industries with the highest levels of foreign ownership, with for example resource-intensive process industries which need to be located near to markets (cement, glass, chemicals, metal refining) prominent amongst industries in the United States with extensive foreign ownership.

Overall, comparisons of foreign-owned and domestic firms yield mixed results (OECD, 1992*b*, 1994*b*). On average, the value added per employee by

Table 14. **Industrial sectors with the highest share of production by foreign enterprises**[1]

	Canada (1987)	France (1988)	Germany (1989)	Italy (1989)	United Kingdom (1989)	United States (1989)	Japan (1989)
1.	Motor vehicles 85%	Computers 71%	Computers 78%	Computers 63%	Computers 65%	Other 30%	Chemicals manuf. 11%
2.	Chemicals 76%	Chemicals 45%	Chemicals 39%	Electronics 55%	Motor vehicles 56%	Non-met. products 29%	Machinery/ equipment 2%
3.	Non.met. products 55%	Electronics 33%	Food/ beverages 21%	Chemicals 30%	Chemicals 37%	Chemicals 27%	Basic metals 1%
4.	Machinery/ equipment 44%	Non.met. products 27%	Motor vehicles 20%	Food/ beverages 15%	Electronics 30%	Basic metals 22%	Other manuf. 0.6%
5.	Other manuf. 35%	Machines 24%	Basic metals 17%	Machines 12%	Basic metals 22%	Electronics 19%	Paper/printing 0.5%

1. Production from foreign-owned enterprises and enterprises with foreign participation as a share of production in industry in each country. Values may be overestimated if small firms (< 20 employees) are excluded from the census on which figures are based, as small firms are predominantly domestic. Production refers to turnover, output or sales, depending on the source. For Japan, only 2-digit ISIC data available.

Source: OECD, Industry Division.

foreign subsidiaries appears to be as high or higher than that of domestic firms. A study of foreign affiliates and domestic companies in several manufacturing and service sectors in the United States concluded that there were neither significant nor systematic differences between the two kinds of firms, when account was taken of the tendency of foreign-owned companies to invest in capital-intensive and high-wage sectors. Similar studies in the United Kingdom, however, indicate that foreign-owned firms consistently generate a higher value added per head than their UK-owned counterparts. One study found a differential of nearly 50 per cent in 1987, with no more than half arising from sectoral differences (Davies and Lyons, 1991). Even greater differences are recorded in Ireland, where the net output per employee in foreign affiliates is some two to three times greater than in Irish enterprises. This disparity appears to arise mainly from the concentration of Irish companies in traditional sectors such as food and apparel, in contrast to the

concentration of foreign-owned companies in industries such as chemicals, engineering and information processing (Central Statistics Office of Ireland, 1991).

The growing presence of foreign investment

Although new forms of global expansion are probably increasingly important, the growth and structure of foreign direct investment gives the best-documented measure of globalisation. Aggregate foreign direct investment grew much more rapidly than either foreign trade (the traditional international "engine" of growth) or domestic product in the 1970s and 1980s. It showed particularly rapid growth from 1985-89, but slowed down in 1990 and declined in 1991 along with the global downturn in late-1990 and 1991. Between 1983 and 1989, world FDI outflows expanded at an average annual rate of 29 per cent, that is, three times faster than world merchandise exports (UNCTC, 1992).

After growing slightly faster that domestic OECD investment in the 1970s, international investment grew at more than double the rate of OECD GDP, domestic investment or trade flows during the 1980s, before slowing significantly in 1990. Between 1970 and 1990, foreign direct investment by OECD countries doubled in terms of flows as a share of total OECD GDP (from 0.5 per cent to 1.1 per cent), while exports increased from 13 per cent to 19 per cent and the share of domestic investment remained steady. Despite this relative growth, FDI flows were in 1990 only 5 per cent of domestic investment. Nevertheless, given the large part of trade that is FDI-related, this relatively low figure may understate the importance of foreign investment in increasing the interdependence of economies.

In addition to growing rapidly, new patterns of foreign investment developed from the mid-1980s as firms took advantage of regional integration in Europe, new trading arrangements in North America and growth prospects in the Dynamic Asian Economies (DAEs). This investment boom has different determinants from earlier investment, which largely originated in the United States and the United Kingdom and focused on resource industries, or was led by the technological and commercial strengths of US industrial firms. The second boom has been more "global", although many developing countries still have not participated. There is very substantial outward investment from many more countries (including France, Sweden, Canada, and the DAEs). More industries have set up foreign operations, including high-tech manufacturing and process industries which need to locate close to inputs and end-users. Only a few standard industries (textiles, clothing), industries which serve global markets from a few locations (aerospace), and heavy industries with large sunk costs and overcapacity have been less active foreign investors.

Table 15. **World stocks of inward direct investment**

	Amount (billion US$)			Distribution (per cent)		
	1967	1980	1989	1967	1980	1989
United States	9.9	83.0	400.8	9.4	16.5	28.6
Canada	19.2	51.6	103.0	18.2	10.2	7.3
Japan	0.6	3.3	9.2	0.6	0.7	0.7
European Community	24.8	186.9	483.9	23.3	37.0	34.5
Other Europe	6.6	25.4	56.0	6.3	5.0	4.0
Australia	4.9	28.1	69.3	4.6	5.6	4.9
South Africa	7.2	15.1	11.1	6.8	3.0	0.8
Developing countries	32.3	111.1	269.6	30.6	22.0	19.2
All countries	105.5	504.5	1 402.9	100.0	100.0	100.0

Source: Adapted from US Department of Commerce, *Foreign Direct Investment in the United States*, August 1991, Appendix Table 4-1.

The most important long-term development has been the expansion of the share of the total foreign investment stock held by OECD countries. At the end of the 1980s, two-thirds of the world total was in the United States and Europe (Table 15). The share of developing countries and regions in the total stock of foreign direct investment had fallen dramatically to less than 20 per cent of the total, due to instability and poor market prospects, although flows to Latin America have revived recently. The notable exceptions to this downward trend have been in South-East and East Asia, where market-oriented development policies, coupled with very high rates of economic growth have fed a foreign investment boom and an increasing share of total investment.

International sourcing of inputs

International sourcing of components and inputs into final products has increased along with greater international investment, particularly in high-technology industries (computers, electronics) and automobiles. Such international sourcing of parts and materials is not only a major feature of the global production systems that are rapidly emerging in numerous industrial sectors, but also accounts for a large part of the total trade between countries.

Recent OECD work which examined international sourcing in the manufacturing industries of six large OECD countries – Canada, France, Germany, Japan, the United Kingdom and the United States – points to the interdependence of

countries as their economies become increasingly merged and integrated (OECD, 1993*b*). These countries accounted for nearly half of total OECD imports in 1987 and over three-quarters of world foreign direct investment flows in 1988, 75 per cent of which was invested among each other. The study concluded that the direct import of manufactured intermediate inputs from abroad (which ranges from 50-70 per cent of all imports by the six countries) rose more rapidly than domestic sourcing in all countries, with the highest growth rates in the most recent years. The absolute growth was largest for Canada, France, and Germany followed by the United States and the United Kingdom. The smallest increase was recorded by Japan. As a result of these growth trends, the ratio of imported to domestic sourcing in the latest period reached 50 per cent for Canada and some 35-40 per cent for France, Germany and the United Kingdom. By comparison, the ratio was 13 per cent for the United States and 7 per cent for Japan.

The set of manufacturing products in which foreign sourcing was highest, relative to domestic sourcing, is generally similar across the countries. This set includes R&D-intensive products such as computer parts as well as mass produced goods such as ferrous metals and textiles. Large differences between countries remain, however, in the magnitudes of the foreign-domestic sourcing ratios for particular inputs. For example, Canada acquires nearly five times as many motor vehicle parts, and more than three times as many computer components, from foreign than from domestic sources. In contrast, the highest ratios for Japan and the United States rarely exceed 30-40 per cent for any product, while those of the European countries lie between these extremes.

To account for all the imported inputs used both directly and indirectly by firms, the OECD study developed an indicator of international linkages for each country's industries using input-output techniques. This is to take into account the fact that, given the chain of production through which a product normally flows, it is not uncommon for imports to enter the production process several stages before, unknown to "downstream" using industries. The ratio of an industry's foreign inter-industry links to its domestic links then provides an estimate of an industry's relative reliance on domestic or international suppliers. If the ratio is near one, it indicates that a unit of demand for that industry's product requires as much interaction with foreign firms as it does with domestic firms. A ratio of less than one means that industry's links tend to be with domestic rather than foreign industries; a ratio greater than one reflects that a unit of demand for that industry's product generates more economic activity abroad than it does domestically, indicating strong foreign links. Table 16 shows such an index in the mid-80s for the four high-technology industries which are most often mentioned in the context of globalisation: computers, communications and semiconductors, aerospace and motor vehicles.

Table 16. **International Linkage Index,[1] mid-1980s**

	Canada	France	Germany[2]	Japan	United Kingdom	United States
Motor vehicles	0.92	0.34	0.23	0.06	0.39	0.17
Aerospace	0.40	0.28	0.24	0.57	0.5	0.09
Communications/ semiconductors	0.46	0.2	0.22	0.08	0.37	0.13
Computers	0.68	0.43	0.28	0.1	0.42	0.13

1. Calculated taking into account both direct and indirect (upstream) inputs. For methodology, see OECD (1993*b*).
2. Electrical machinery includes communications and semiconductors.
Source: OECD, DSTI/EAS Division.

Foreign investment and employment

It is very difficult to quantify in any satisfactory way either the direct or the indirect impacts of FDI on employment. One of the difficulties that arises, similar to the case of trade, is that it is relatively easy to measure the immediate costs to a particular firm or workers who are displaced by foreign competitors, but it is generally not easy to measure the more widespread and dynamic effects which displacement brings to the economy as a whole (Henderson, 1986). In terms of outward foreign investment, while there is often an actual or potential loss of jobs when firms invest abroad, in some of these domestic jobs would have been lost even in the absence of investment abroad. Furthermore, it is often claimed that firms are able to maintain domestic employment in high-skill activities by transferring their labour-intensive activities abroad, while increased demand by foreign subsidiaries for domestically-produced intermediate products and capital goods may result in additional domestic employment (Baldwin, 1995). In an analogous fashion, it is not necessarily true that a particular inward investment creates *x* new jobs. Many of the workers employed in the new project may come from the ranks of those already employed. In addition, new jobs at the plant created by FDI may be at the expense of lost jobs in another plant, if the new competitor is more efficient and captures market share from established firms.

This section will review briefly two studies that examine the relationship between foreign direct investment and employment. The first is an OECD study which focuses on inward investment in a number of OECD countries. It examines the employment and wage characteristics of foreign affiliates and compares them with those of national firms. The second study is limited to the United States only but is more ambitious in nature, as it tries to quantify the number of jobs associated with both inward and outward direct investment.

Employment characteristics of foreign affiliates

The direct impact on employment, skills and wages associated with inward direct investment in OECD countries has been analysed in a recent OECD study (OECD, 1993*c*). The study seeks to quantify some of the effects of inward investment on employment, while taking no account of the influence of outward direct investment to the national economies and in particular of the transfer abroad of manufacturing units. The study concludes that the main trend which can be deduced from the available figures is that during the 1980s there was a more rapid increase in jobs in foreign affiliates than in domestically-owned companies.[10] An increase in the number of jobs in foreign affiliates, against a fall for domestic firms, was recorded in the United States, Austria, the United Kingdom, Sweden, Turkey, Portugal, Ireland, Finland and Norway. In Australia, Japan, France, Canada and Germany the growth in the number of jobs in foreign-owned subsidiaries slowed down. In France and Australia, unlike the other three countries, it was slower than employment growth in domestic firms. In two countries (Japan and Germany) domestic firms did continue to recruit. Finally, in Canada the number of jobs in foreign-owned subsidiaries fell more rapidly than in domestically-owned firms.

The sectors most affected by these changes and the geographical origin of the firms involved varied in the five largest OECD countries. In the United States, during the period 1980-89 employment in domestically-owned firms in most manufacturing sectors declined, while in foreign affiliates it rose. The only exception was the automobile industry. The foreign penetration rate has increased in that sector, but this is now in terms of capital; overall, few new jobs have been created. In Japan, between 1980 and 1989 foreign affiliates shed labour in every sector except "other manufacturing industry". The heaviest job losses in foreign affiliates were in the automobile, chemicals, paper, non-metallic minerals, textiles and basic metals sectors. By contrast, some jobs were created, especially in 1990, in the electrical-electronic machinery industry and, to a lesser extent, in the timber and food sectors.

In Germany, between 1980 and 1990 the number of foreign affiliates changed little, but they shed 162 000 jobs. The heaviest job losses were in the basic metals, chemicals and electrical-electronic machinery sectors. In France, between 1981 and 1989 foreign affiliates in the manufacturing industry shed some 25 000 jobs. As in Germany, the heaviest losses were in the basic metals sector and were ascribable to capacity cut-backs by European firms. Foreign affiliates in three other sectors (computers, electrical and electronic machinery and wood) also shed labour, mostly as a result of American affiliates cutting their workforce. In contrast, in the United Kingdom, between 1985 and 1990 the workforce in foreign affiliates in the manufacturing industry increased by 98 000. About 59 000 jobs were created by EC firms, 34 000 by Japanese companies and

18 000 by enterprises based in other countries. American affiliates, while they still accounted for half of employment in foreign-owned firms, shed 13 900 jobs. Employment increased most substantially in the automobile, computer, food and chemicals industries.

One criticism levelled at foreign investors is that they may downgrade jobs by offering, rather than skilled employment, more unskilled assembly-type jobs. This is not supported by the empirical findings of this study. In all countries, without exception, foreign firms offer wages which overall are higher than those paid by domestically-owned firms. This does not imply that in some sectors, and where certain regions are particularly hard hit by unemployment, such differentials cannot exist. It may happen, as is borne out by the available data which were used for this report. But it does not happen often, and then only when there are specific local or regional socio-economic reasons. Furthermore, between the beginning and end of the 1980s the wage differentials between foreign affiliates and domestically-owned firms widened still further.

Overall, this OECD study and other similar ones conclude that foreign firms tend to have a good employment record, higher average labour productivity and higher average wages, even though they have a higher share of output and value added in a given country than their share of employment. This can be traced to their technological and organisational advantages, to the advanced industries that they often operate in, and to their larger average size. They are also often more capital intensive than domestic firms. These differences between foreign firms and domestic ones generally hold across most OECD countries, and across most industries.

Finally, there is a widely-held view that MNEs are "footloose" and prone to uprooting their foreign branches and moving to other countries, making employment in foreign affiliates unstable. This view is not supported by the experience of the United Kingdom which has concluded that "branches of foreign-owned enterprises are no more likely to be subject to closure than those of UK companies. If anything, employment in foreign plants tends to be more stable over the economic cycle".[11] However, an earlier study in Ireland indicated a substantially higher percentage of foreign branch closures than of indigenous companies (O'Farrell and Crouchley, 1983).

Employment associated with foreign investment

A recent study has attempted to calculate the jobs which are directly and indirectly associated with both inward and outward investment in the case of the United States (Glickman and Woodward, 1989). The study estimates that between 1977 and 1986 there was a net total loss of 2.7 million US manufacturing jobs as a consequence of US investment abroad, the result of the displacement of

3.3 million jobs by investment abroad mitigated by nearly 600 000 jobs gained as the result of export expansion to US affiliates abroad. The industries most affected were the non-electrical machinery sector, primary and fabricated metals, food and chemicals. In terms of inward direct investment, it is estimated that the number of employees of US affiliates of foreign companies increased by an average of about 137 000 annually between 1982 an 1986 or just over half a million overall. The authors thus conclude that US investment abroad results in large US job losses, while foreign investment in the United States creates few jobs.

In estimating the displacement of jobs due to US investment abroad, the study uses a methodology based on input-output techniques and adapted from an earlier work by Frank and Freeman (1978). The methodology consists of several steps and is based on a model where US firms can supply foreign markets either by exporting from the home country or by producing the goods in foreign subsidiaries. First, substitution parameters are estimated which indicate the ratio of the quantity of goods each industry would supply in the foreign market if it only exported to this market compared with the quantity it would supply if it did not export but produced these goods in its lower cost foreign facilities. Then the export production that is displaced by foreign investment is calculated by multiplying the estimated volume of production of foreign subsidiaries in each industry (calculated by the annual investment expenditures of the industry's foreign subsidiaries and a capital/output ratio) by the estimated substitution parameters. Finally, the direct and indirect number of jobs is calculated from input-output tables and the associated labour coefficients.[12]

The employment impact of foreign direct investment in the United States is estimated using a different methodology, thus making direct comparisons with the jobs impact of US investment abroad difficult. This consists of using survey data from the Bureau of Economic Analysis (BEA) of the US Department of Commerce on changes in the numbers of employees of US affiliates of foreign companies. The total change is broken down by BEA into five components: new investments, expansions, sales or liquidations, cutbacks, and combinations of new investments and sales or liquidations. Under various assumptions, these components are rearranged by Glickman and Woodward into the employment changes during 1982-86 due to: new plants (+45 151), expansions (+341 281), acquisitions (+1 381 690), cutbacks (–442 295), and sales and liquidations (–777 900). The sum of these components yields a net job addition of just over half a million jobs for the 1982-86 period. However, the authors note that most of the job gains under the acquisitions category represent the transfer of existing jobs. The inability to separate between job creations and job transfers makes the final figure difficult to interpret.[13]

VI. CONCLUSIONS

The starting point of the paper was the fact that in policy discussions and in much of the ongoing analytical work, increasing attention is being paid to the role of globalisation, international competition and technology as being key elements of change affecting the way the global economy operates, and explaining the patterns of employment in the OECD area. In the current economic environment, intensified international competition and the relocation of activities of firms are often blamed, together with rapid technological progress, for the poor employment performance of OECD countries.

This paper has attempted to contribute to this debate by examining some of the characteristics of the globalisation process, and confronting the evidence on the changing structure of OECD employment with shifts in trade and patterns of foreign investment and relocation of industrial activities. Globalisation was defined as a process of broadening geographical inter-linkages of products, markets, firms and production factors, with a growing component of each derived, generated or available in more countries and regions. It is a process that was described by a number of characteristics: the relocation of industrial activities; shifts in world trade, with a larger component of intra-industry and intra-firm trade; the central role of foreign direct investment, and its new geographical and sectoral patterns; and growing international sourcing of production inputs.

The paper has argued that this process of growing interconnection between national economies and their increasing integration through market relationships has been driven by a number of factors. Technological change has led to falling communication, transport and co-ordination costs and enabled firms to take advantage of market opportunities, reorganise their technical activities on a regional or global basis, and to build on local industrial specialisation in order to service new markets, while also forcing alignment on international best-practices. At the same time, the high fixed costs of production and shorter product cycles associated with new products have put pressure on monopoly rents and led to efforts to optimise resources on a regional or global scale.

Institutional changes such as the liberalisation of financial and product markets, either unilaterally or as a result of successive rounds of trade negotiations, and the gradual acceptance of foreign ownership of factors of production by OECD countries has been another driving force of industrial globalisation. Alongside trade, investment relations between nations have thus increasingly acted as the organising principle of the system. The strategies of firms have also evolved in response to regional bloc formation and to potential protectionist tendencies, often leading multinational firms to establish a presence or forge strong links with other firms in all major trading areas in order to share risks and opportunities.

The implications for employment and unemployment in OECD countries follow from the characteristics of the globalisation process. Intensified worldwide competition erodes monopoly rents and puts pressure on industrial structures by affecting both declining and growing industries. The premium put in this environment on the role of knowledge and on the acquisition of skills implies that patterns of employment and unemployment depend to a large extent on the capacity of individual countries for absorbing structural shifts (sectoral, occupational, and regional) and on the extent to which employment creation in the non-tradeables sector has been able to compensate for job losses in tradeables.

Analysis of globalisation has tended to focus mostly on defining its characteristics and driving forces, or examining its consequences for the structure of world production or for government policies, with relatively little empirical analysis focussing directly on the implications on the level and type of employment. Furthermore, when the employment implications of the various aspects of globalisation have been considered, formal analysis has tended to concentrate almost exclusively on the impact of trade patterns on the level or structure of employment, to the exclusion of other characteristics of globalisation.

In this respect, empirical evidence reviewed in the paper has tended to conclude that the overall effects of trade on employment, if any, are small, but that there is an impact on the structure of OECD employment. Research in this area has generally reported that increased trade in goods tends to intensify the process of structural change in OECD economies, especially with respect to trade with non-OECD countries, which has a labour-saving effect and affects the structure of demand for labour.

The available evidence suggests that trade is not important for changes in aggregate employment. Factors other than trade such as compensation per employee are more important in determining employment growth. Looking at the relationship between employment patterns and trade variables for a number of OECD countries together, there appears to exist no overall systematic relationship between openness to trade, as this is reflected in import penetration rates, or their change over time, and employment growth. Thus neither the degree of openness nor trade liberalisation leading to a greater part of domestic demand being satisfied by imports seem to be associated with overall employment losses.

At the same time however, trade can be an important factor in determining employment losses or gains in some individual industrial sectors. A negative (but weak) relationship between employment growth and import penetration is evident for low-wage industries of OECD countries, while for high-wage industries, openness to trade is often associated with employment gains, as industries respond to competitive pressures from an open international environment. At the same time, for a number of individual countries a positive relationship is often present between gains in export market shares and employment gains. Overall however,

results are not very robust and vary widely for individual countries, so that generalisations are hard to make.

The paper stressed the fact that trade is only one facet of the process of industrial globalisation. The impact on employment of foreign direct investment and of new patterns of relocation of firms, of international sourcing of inputs, or of the creation of international networks of co-operation between firms have all been studied very little, partly because of the paucity of data and partly because of the difficulty in formulating clear testable hypotheses. Calculating the effect of relocation and of foreign direct investment for a particular country, for example, is a more complicated matter than simply measuring direct job losses associated with outward investment and setting these against job gains from inward investment. In the absence of relocation, it is not clear what the level of domestic employment would have been; similarly, outward investments are undertaken in order to increase firms' competitiveness, a benefit that cannot be easily translated empirically in terms of jobs.

At its simplest level, evidence on the direct employment impact of inward direct investment (which represents only one aspect of the relationship between foreign direct investments, relocations, and employment), shows that during the 1980s it is possible to observe a more rapid increase in jobs in foreign affiliates than in domestically-owned companies in the manufacturing industry of most OECD countries. In terms of wages, compensation offered by foreign affiliates in OECD countries is higher than that paid by domestically-owned firms. In terms of labour productivity, both its level and rate of increase tend to be higher in foreign affiliates than in domestic firms; furthermore, while in foreign firms productivity increases can be traced to higher output, in domestic firms they are ascribable more to job reductions.

NOTES AND REFERENCES

1. For a more detailed discussion of the process of globalisation, see the contributions in the issue of *STI Review* (No. 13, Fall 1993) devoted to this topic.
2. Foreign output of home-based MNEs is estimated from the sales of MNEs or their foreign affiliates. The contribution to the domestic economy is calculated as a share of private (*i.e.* excluding government expenditures) GNP.
3. In the case of France and Italy, lack of industry detail for sectors in the ISIC 38 group (fabricated metal products and machinery) does not allow the calculation of the indicator for the late 1980s.
4. Not all studies identify a serious impact of imports on employment in these industries. Grossman (1987) measures competitive pressure from imports in nine United States manufacturing industries during the 1967-79 period by the relative behaviour of import prices in these industries. He finds that price pressure from imports reduced employment greatly in only one industry (radios and televisions), while no import-induced loss in employment is detected in two other industries (although pressures from imports appeared to have reduced wages).
5. The assumption of "non-competing" imports has been criticised as being irrelevant to the issue of the impact of trade on jobs in industrial countries today. The issue is the estimation of potential or actual job losses associated with the increase in imports of goods currently produced in OECD countries. In estimating the jobs lost from such shifts, the relevant labour coefficients are those that exist at the time in the industrial countries, not those in developing countries (Baldwin, 1995).
6. The results from this OECD study are presented in detail in another paper included in this volume and are thus only summarised here. It should be noted however that the methodology used achieves what is essentially a mechanical decomposition, and that for example, the negative effect on employment growth of labour productivity does not take into account any compensatory effects on employment through higher incomes or lower prices.
7. These estimates are based on rather strong assumptions. The influence of trade on the demand for labour in manufacturing is estimated by comparing the actual use of labour per unit of output with what labour use would have been if productivity in manufacturing, relative to productivity in non-traded sectors, had continued to grow at the slower rate of the 1950s, a period before manufactured exports from developing countries began to take off. Faster productivity growth in manufacturing may, however,

have been due at least in part to other causes, such as new technology. Furthermore, even if the acceleration is due to trade, it is not necessarily ascribable to North-South trade, given the importance of trade within industrial countries.

8. Graph 3 is based on pair-wise correlations between average import penetration rates for the 1980-89 period and average annual employment growth for the same period in 22 manufacturing industries and the 13 OECD countries included in the STAN database (the G7 group, Australia, Denmark, Finland, Netherlands, Sweden, Norway). The reader is alerted to the limitations of univariate relationships.

9. Variables are logarithmic transformations in nominal terms and are expressed relative to the manufacturing average. There is no behavioural model underlying the estimation, so that the estimated elasticities should be interpreted as providing information about the variance of employment growth with respect to each variable. Only estimates significant at the 5 per cent or the 1 per cent level are reported in the table. For each of the G7 countries in the table, these elasticities have been estimated for all manufacturing industries pooled together, as well as for the three industry groupings based on technology, wages and orientation. The elasticities are interpreted as follows: an estimated elasticity of employment with respect to, for example, import penetration equal to –1 implies that a 1 per cent increase in the import penetration rate for a particular industry grouping relative to the growth in import penetration for manufacturing as a whole during the 1980-89 period was associated with a 1 per cent fall in employment in that industry grouping relative to employment change for manufacturing as a whole. The elasticities therefore relate to the responsiveness of the *relative* employment performance of industries with respect to trade and other variables.

10. A number of methodological problems complicate the interpretation of results. They arise from the fact that the effects of foreign investment on employment depend on the type of investment concerned. Three investment categories could be distinguished: *i)* new investment; *ii)* disinvestment; and *iii)* combination of new investment and disinvestment in one and the same operation. In the first of the three sub-categories of new investment, new jobs are created, though it still has to be seen whether this may not entail the closing of other existing establishments. In the second, jobs are transferred from a domestically-owned company to one which now becomes a foreign affiliate. Evaluating the effects on employment of mergers and buy-outs raises further problems in that the jobs concerned are considered to be new jobs. In the absence of a buy-out some of those jobs would probably have gone, but it is impossible to say exactly how many would simply have been transferred under the new ownership.

11. United Kingdom submission for the theme discussion of the OECD Industry Committee on: "Globalisation, Firm Citizenship and Industrial Policy".

12. This description of the methodology is based on Baldwin (1995). He criticises the results obtained on the basis that the estimates of job losses are very sensitive to the estimates of foreign demand elasticities and of cost differentials between domestic and affiliate production that are necessary in order to obtain the substitution parameters. He argues that under more realistic cost assumptions, the export displacement effect can be more than offset by the employment stimulus arising from increased exports of intermediate goods to the subsidiaries.

13. The authors in fact note that if one looks only at new plants, expansions and cutbacks, there is actually a net loss of jobs amounting to just over 55 000. Alternatively, Baldwin (1995) argues that one could also regard the cutbacks as representing jobs that would have been lost even in the absence of foreign investment, and that therefore the net change in employment from foreign investment should be regarded as the almost 400 000 jobs created through new plants and expansions. In a more general vein, when comparing the effects of outward and inward investment, Baldwin criticises the different methodology used in estimating the job displacement of US investment abroad and the job effect of foreign investment. He argues that the inconsistency in the methodologies invalidates any overall assessment of the net impact of foreign investment on employment.

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STRUCTURAL CHANGE AND EMPLOYMENT GROWTH: THE CHALLENGES AHEAD

CONTENTS

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It uses material collected within the framework of a report prepared with Christopher Freeman for IBM Europe (Freeman and Soete, 1993)

I. INTRODUCTION

While the last decade has undoubtedly been the period of the growth and emergence of modern information and communication technologies, it has also been a period of significant international structural change, particularly in terms of employment growth and displacement in the world economy. From a vision in the early to mid-1970s which held that, after the first oil shock, OECD economies would quickly return to full employment (see *e.g.* the so-called "McCracken" OECD Report, 1975), there is now a broad consensus amongst policy-makers that various facets of "structural change" have had and are still having a major impact on the structure of unemployment (long-term, youth, excluded workers, etc.) and on different countries' capacities to generate new employment opportunities.

That economists and policy-makers are waking up to the importance of structural change, even in a recessive period with substantial growth in cyclical unemployment, is not really surprising. The last five to ten years can probably best be described as a period of historically major political and structural change: the end of the cold war and the collapse of the former socialist countries; the shift in world market growth from the North Atlantic OECD area (United States, EC, EFTA) to the Pacific basin area with new countries such as Mexico and South Korea now joining the club of OECD developed countries, and possibly others in a position to do so in a near future; the creation of regional trading blocks with as a result much more rapid growth within than between such integrating trade areas; the surge in foreign direct investment in these trade blocks with large firms aiming at presence in each of these markets; the growing impression of a dramatic reduction in physical distances – the world as a village – be it in terms of communications (with as typical examples financial services, or world information) or the decline in the relative cost of migration.

These processes of structural change have made policy-makers, economists and businessmen much more aware of the increased international implications of their policy actions. Policies which might appear "sustainable" within a national context, might increasingly not be so in an international or regional trade block context. This opening up to international restructuring processes has probably only just started, but it brings to the forefront how freedom of policy actions in a wide variety of different fields has been reduced in many developed countries.[1] This holds not only for monetary policy[2] but also for social policy, environmental policy, security policy, and even traditionally national policies such as open attitudes to refugees, drugs or even ethical considerations such as euthanasia.

Combined with the more traditional processes of structural change associated directly with technical change as described by Petit in his contribution to this

issue – changes in the industrial and service composition of employment, changes in demand for new commodities and services – these new features of international structural change question increasingly the automaticities of "employment compensation" and the employment creation capacities of high-wage and high-labour cost economies. While the international structural change features described above are taken as a starting point, they will not be further elaborated upon here, but rather some of the trends in employment, both at the aggregate and disaggregate level, and in international trade and competitiveness, both at the aggregate level and with respect to information and communication technologies (ICT), will be described. To take these features into account, such trends need, however, to be looked at in a broader world economy framework. However, the focus of the analysis, in the next four sections, will be on the situation in Europe and the OECD countries. Then in Section VI some of the major new policy challenges will be examined.

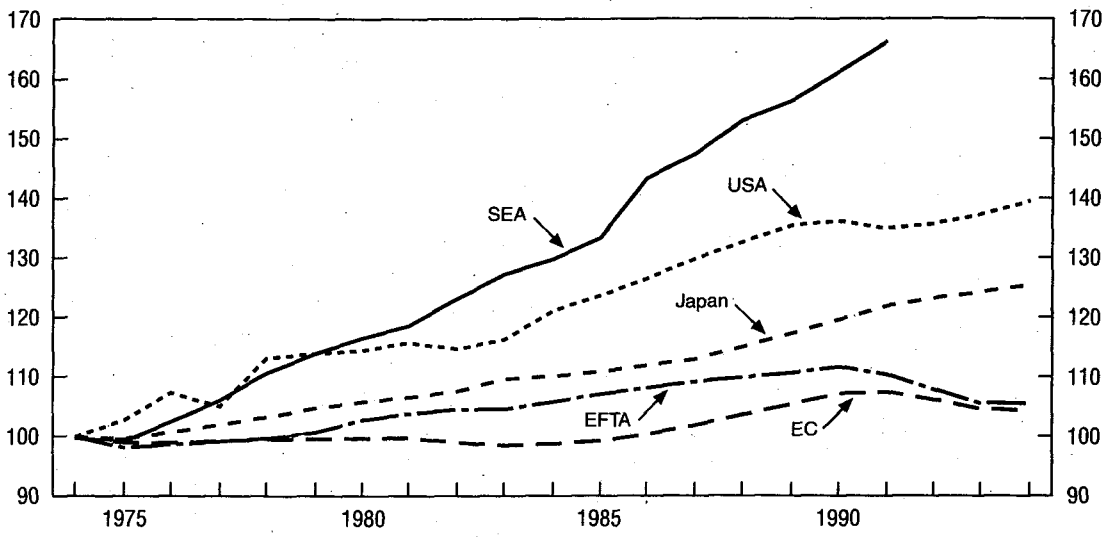
II. TRENDS IN EMPLOYMENT

Starting from the trends in employment, Figure 1 illustrates how employment creation capacities have varied between different OECD countries (the United States, Japan, the EC and EFTA countries) and the South and East Asian countries (SEA consisting of Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Taiwan, Thailand) over the last twenty years. The figures for 1993 and 1994 are estimates.

The United States as technological leader and most developed country has witnessed a remarkable employment growth pattern over the last twenty years. Over the last ten years some 18 million jobs have been created in the United States. Since 1960 total employment nearly doubled. Much has been written about the US pattern of employment growth. What appears from Figure 1 is that the popular notion in the United States of "jobless growth" is, if anything, only a recent, not very pronounced, phenomenon. The Japanese economy has also been characterised by substantial employment growth over the 1980s. This is to some extent even more remarkable given the continuous rapid growth in productivity in Japan. Despite average productivity growth rates in Japan of some 3.4 per cent a year, employment grew at some 1.2 per cent a year.

By contrast, the EC countries, and since the 1990s the EFTA countries, have been witnessing "jobless growth" for a very long time. There has barely been any growth in employment over the last 20 years. Surprisingly, however, the EC countries' most rapid employment growth occurred in the most recent period

Figure 1. **Development of employment (1974-94)**
1974 = 100, 1 000s workers



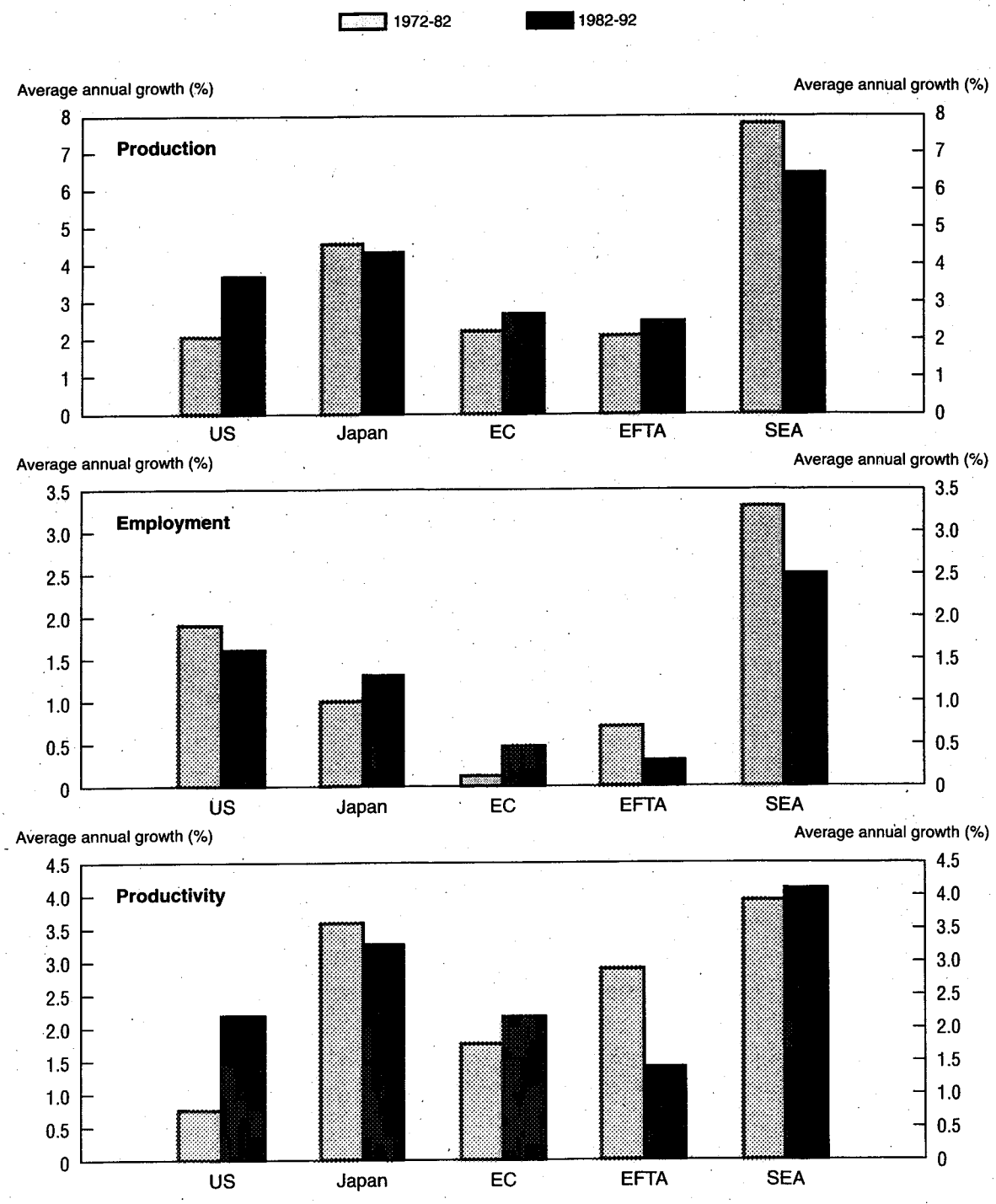
Source: ILO/OECD.

1985-90. Employment grew at the historically unprecedented rate of 1.3 per cent a year, creating some nine million jobs. However, the shedding of employment since then has been so large that all the gains in employment over the exceptional period 1985-90 have been lost. As Figure 1 points out, compared to other OECD countries, European countries, both EC and EFTA, have been characterised by low employment growth over the last two decades which turned negative in 1991.

In contrast to these trends in employment growth, the South and East Asian countries have been characterised by extremely rapid employment growth, on average some 2.5 per cent a year. Whereas the United States nearly doubled its employment in thirty years, the Asian economies did so in twenty years. This rapid growth in employment has gone hand in hand with rapid output and productivity growth. This overall pattern of growth in output, productivity and employment, illustrated in Figure 2, can be best described as a new process of "catching-up" to productivity levels and consumer demand of the OECD developed countries. The catching-up process still has a long way to go, but the self-reinforcing dynamics of the process combined with the high concentration of world population in this area of the world, have made East and South Asia the new growth pole of the world.

Figure 2. **Production, employment and productivity growth (1972-92)**

Productivity growth = output growth per manhour



Source: ILO, *Yearbook of Labour Statistics*; OECD, CRONOS database.

As also illustrated in Figure 2, Japan has traditionally been the developed OECD country which compared most favourably with this successful "catching-up" growth pattern. Over the 1970s and 1980s Japan witnessed an impressive output growth (on average 4.5 per cent), higher than the substantial productivity growth of 3.4 per cent a year, with as a result a small, but steady employment growth just above 1 per cent a year. Whether Japan will be able to maintain such high, "full employment" output growth in the 1990s given the increased competition from other low cost based East Asian economies, or whether its unemployment rate will start to approach European levels, will depend on its capacity to keep ahead of other East Asian economies, benefit from the new growth opportunities in Asia, and successfully adjust its industrial structure towards a more service oriented structure.

By contrast, the United States with *absolute levels* of productivity still higher in most industrial and in all service sectors than in Japan and Europe (the exception with respect to Japan being steel, motor vehicles and parts, see *e.g.* the recent McKinsey study), has not surprisingly witnessed a lower *growth* in productivity than Japan or Europe, so that most of its output growth has been accompanied by employment growth. This high "employment intensity" of US output growth has been accompanied by the creation of many low-skill jobs in service sectors.

Finally the EC and also the EFTA countries, have been witnessing relatively low output growth with a relatively high productivity growth so that employment growth has been very low. Nevertheless for the period 1982-92 the EC and particularly EFTA countries had, with the United States, the lowest labour productivity growth.

The variety of trends in employment, output or productivity growth, as summarised in Figure 2, in other words hide some crucial structural change features, which appear to have had a much stronger impact in some countries than in others. To draw policy conclusions from aggregate trends is thus difficult because no insight is given about the underlying structural causes for productivity growth. The latter might indeed be the result of changes between sectors, and in particular between manufacturing and services; or even changes between occupations and skills; changes in competitiveness and in growth opportunities. Where employment is being created: in old, mature industries or new, high-tech services, some of which might be internationally traded whereas others might not (yet) be; what sort of employment is being created: low-wage, unskilled jobs or high-wage multi-skilled jobs; and where in the world such employment is created, matter a great deal in any debate on future employment growth.

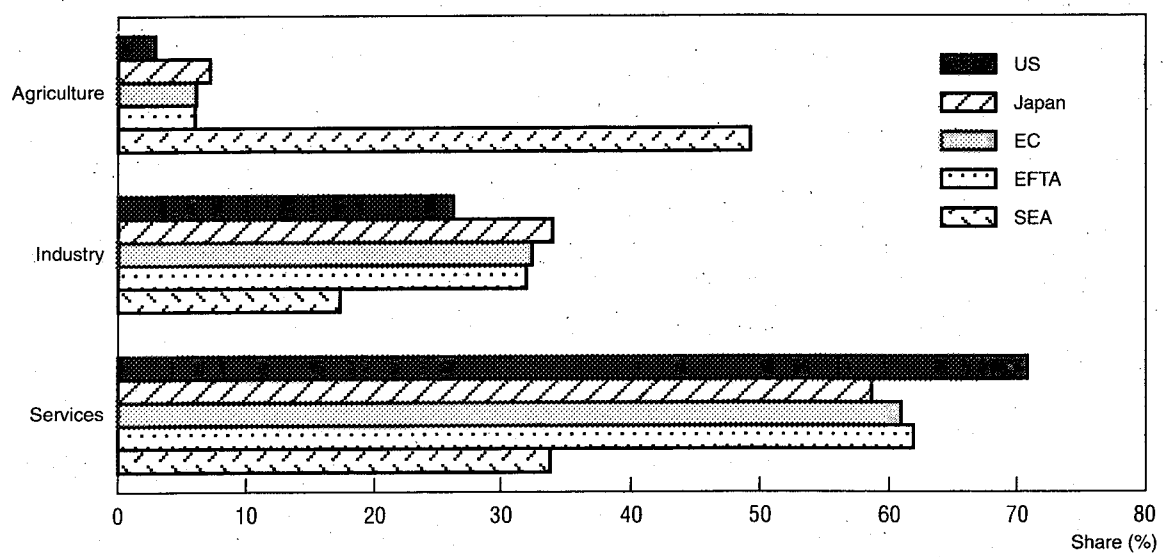
This explains why even in countries with high employment growth such as the United States, and economies with low unemployment such as Japan, there is as much public debate on structural change and employment as in regions with

very high unemployment such as Europe. It also explains why simplistic macro-economic visions about creating more employment through slowing down productivity growth – increasing *e.g.* the so-called "employment intensity" of growth – will not lead the policy debate on employment growth very far. To do so requires a much more in-depth look at the major structural changes occurring in the economy, most of which will be associated with technical change. This is something to which we turn in the next sub-sections: sectoral changes; occupational changes; and international changes in competitiveness and growth.

III. SECTORAL SHIFTS IN EMPLOYMENT

In Figure 3 the distribution of employment in the primary, secondary and tertiary sectors for the OECD countries and the same East and South Asian industrialising countries as in Figure 1 are represented. The data for the OECD countries illustrates the well-known general shift away from agriculture *and* industry into services. The service sector now accounts for between 60 and 70 per cent

Figure 3. **Sectoral employment shares**
1990



Source: ILO, *Yearbook of Labour Statistics.*

of total employment in most OECD countries. Accompanying this steady increase in service employment share, both the United States and Europe have witnessed a steady decline in their manufacturing employment share. The most recent US figure (June 1993) indicates that no more than 18 per cent of the total US labour force is now employed in manufacturing.

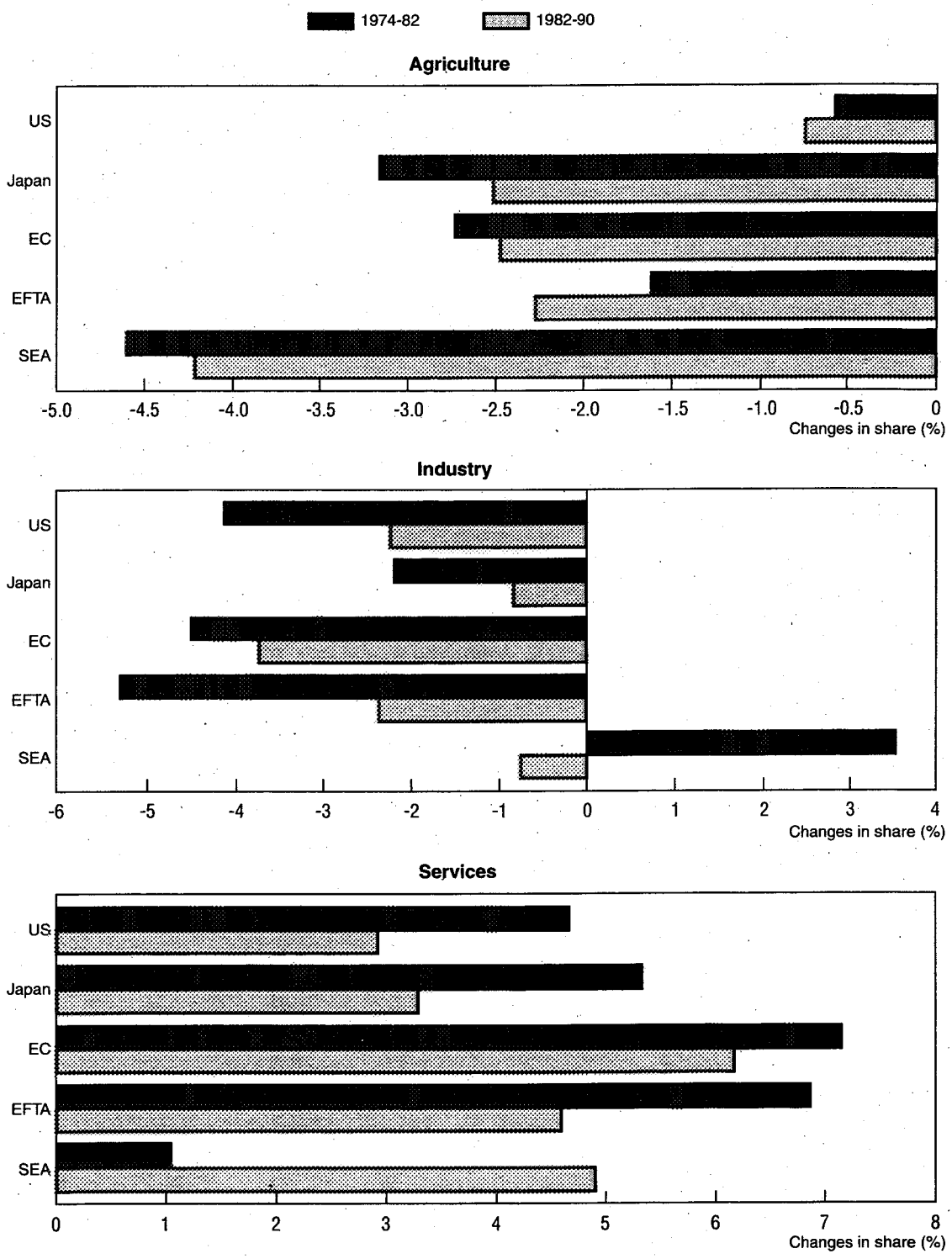
But the contrast between the OECD and the East and South Asian economies relates in the first instance to the size of the agriculture sector. Whereas all countries saw their share of employment in agriculture decline, the difference between the absolute levels remains striking, with, however, substantial variation between both the OECD and Asian economies. Turkey, Greece, and to a lesser extent Portugal, resemble much more the developing economy pattern than Hong Kong, Singapore, Taiwan or South Korea. In industry the picture is less strikingly different between the OECD and Asian economies. All OECD countries, with the exception of Turkey, have seen their employment in industry decline. However, and in line with the evidence for Hong Kong and Singapore, the decline in manufacturing employment has been smallest in Japan and the Southern "industrialising" European countries: Portugal, Spain and Greece. By contrast South Korea, Malaysia and the Philippines still saw their industrial employment share rise.

With respect to services it is obvious that this sector is now by far the dominant employment provider in most developed countries. However, as Figure 4 illustrates, the growth in the employment share of services is in no way confined to the OECD area. As a matter of fact, the growth in the service employment share has been most rapid in the EC, EFTA *and* South and East Asian economies, illustrating again that the catching-up process in these countries includes a structural shift towards service activities.

These broad structural shifts are to some extent typical of economic development. They illustrate nevertheless the significance of the structural "transitions" occurring during any process of growth. Behind growth one observes, in other words, continuous shifts in employment growth between sectors, caused by the complex interplay between technology and demand. Technology will indeed lead to efficiency improvements in production, *e.g.* in agriculture and industry, resulting in declines in employment, if growth in output does not compensate sufficiently for such productivity gains (something which will depend on price and income elasticities – the most well known cases where such compensating effects will be insufficient relate to food and basic commodities, known as Engel's law) and to the emergence of new products and/or services.

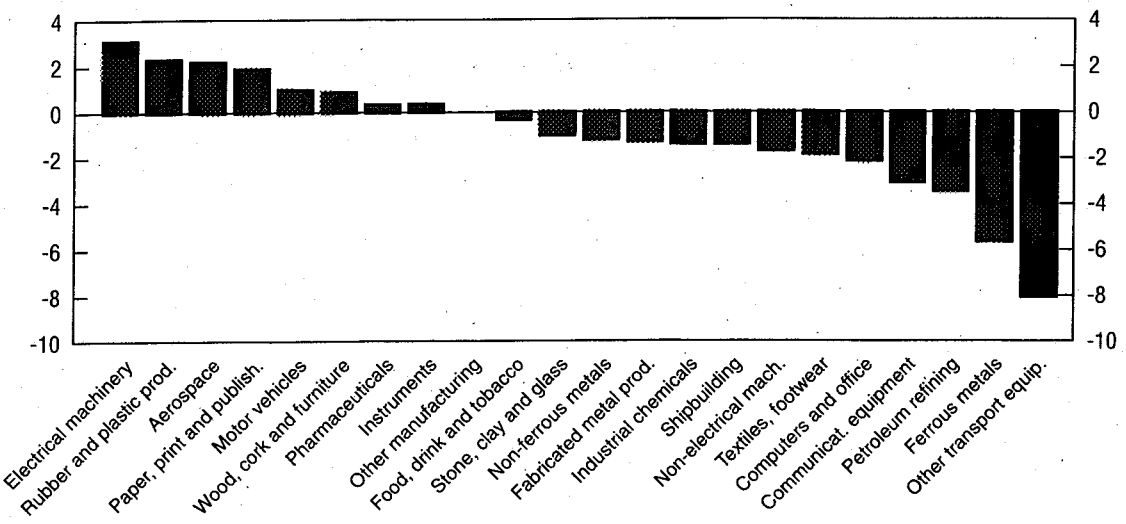
Similar changes, induced by changes in technology and demand, are of course occurring at a more disaggregated level, between industrial sectors. At the level of the United States, Japan and the EC, Figure 5 illustrates the changes in industrial employment in the 1980s. Both in the case of the EC and Japan, sectors

Figure 4. **Change in employment shares**



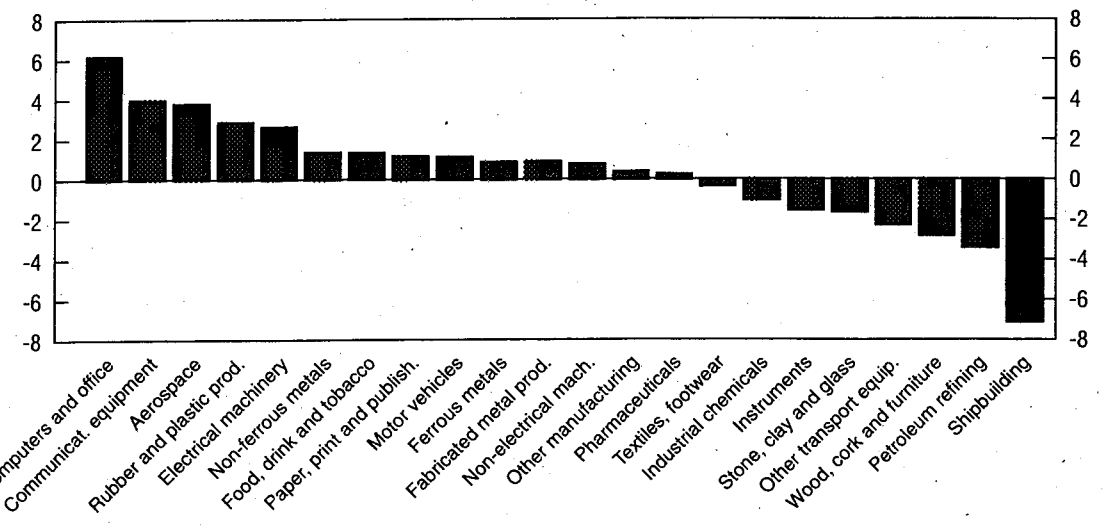
Source: ILO, *Yearbook of Labour Statistics.*

Figure 5*a*. **Average annual employment growth 1980-90 in the United States**



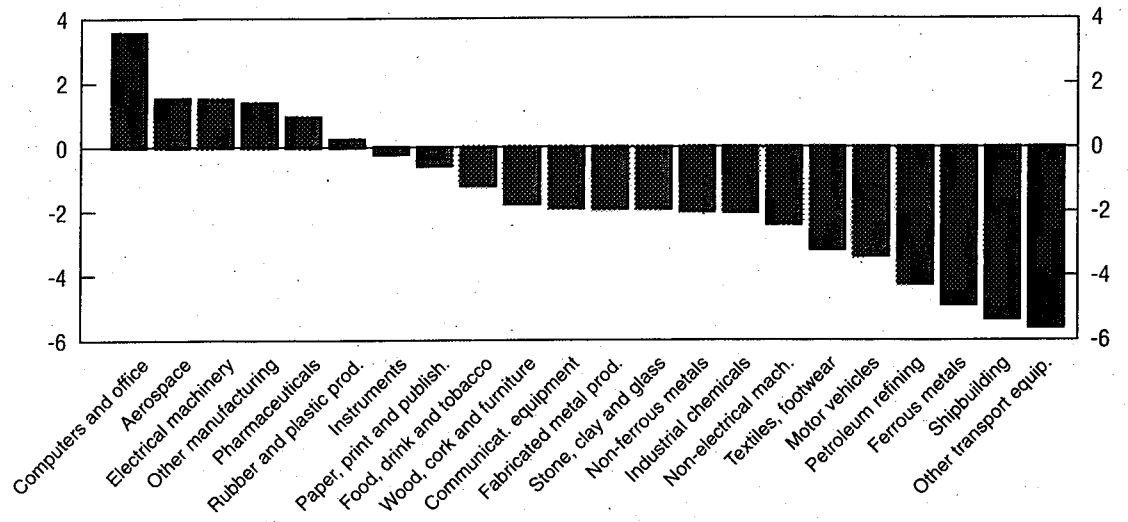
Source: OECD STAN database.

Figure 5*b*. **Average annual employment growth 1980-90 in Japan**



Source: OECD STAN database.

Figure 5c. **Average annual employment growth 1980-90 in the EC**

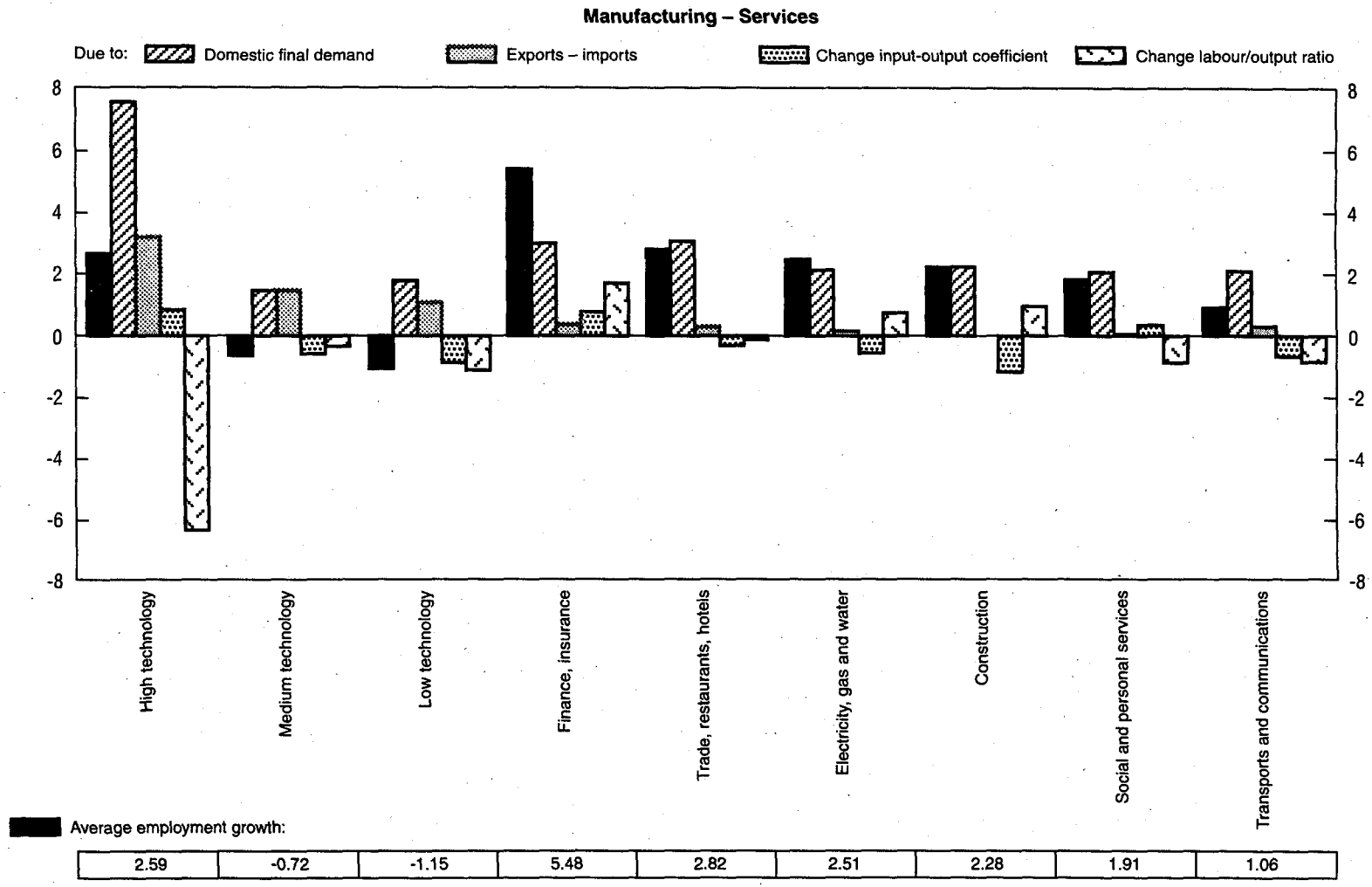


Source: OECD STAN database.

with the highest employment growth are typically high-technology sectors, particularly in ICT.

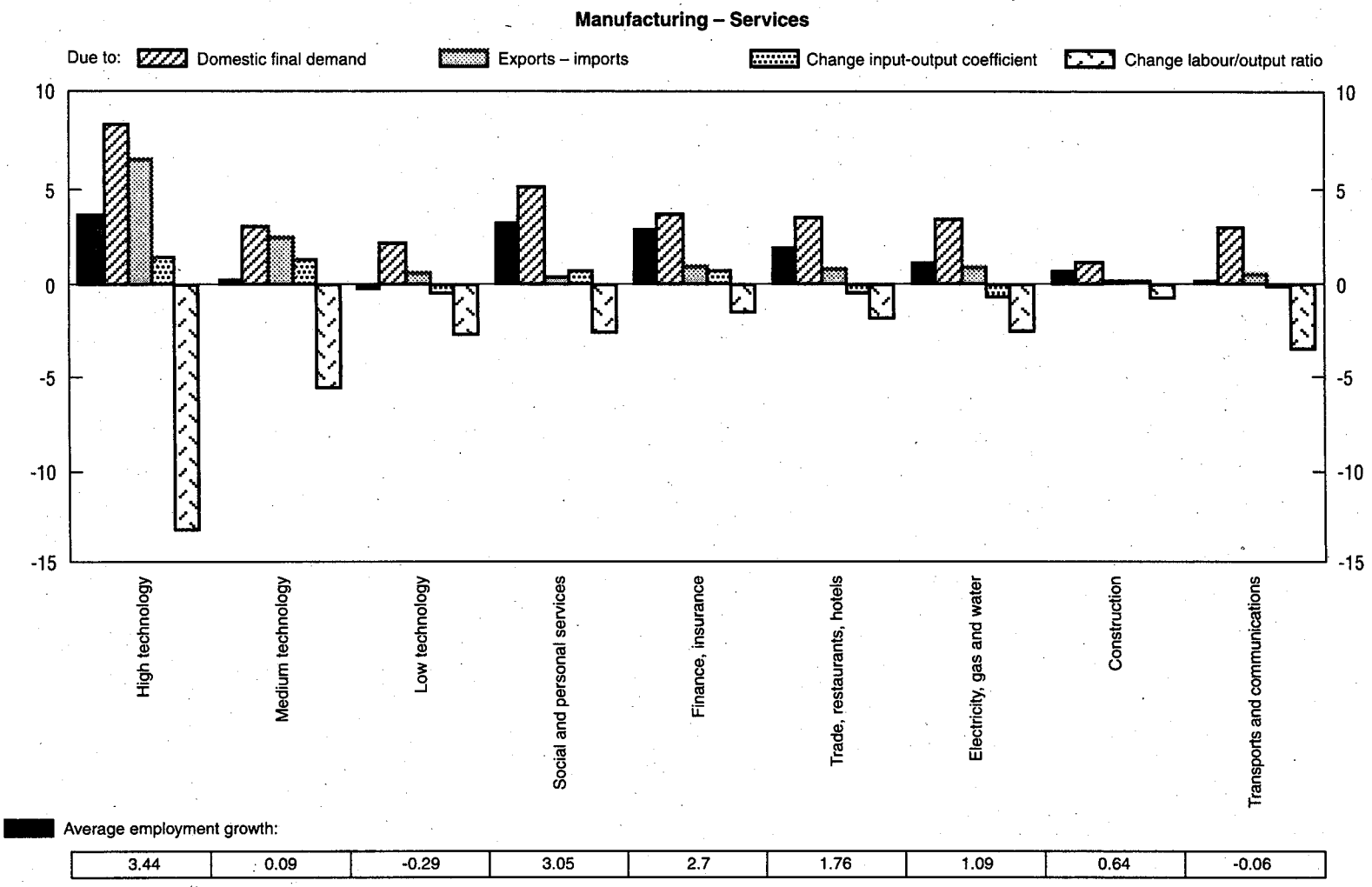
On the basis of some recent OECD work by Sakurai (Sakurai, 1993) attempting to "decompose" changes in employment, Figure 6 illustrates for the United States, Japan and the EC the "decomposition" in employment growth between output growth [sub-divided into domestic (final) demand and exports minus imports], and changes in technology (changes in input-output coefficients and labour productivity). While many questions can be raised about the assumed independence of each of those "decomposed" factors, the figure illustrates quite neatly how the employment growth in the high-wage or high-tech industrial sectors observed already in Figure 5 in the United States, Japan and to a lesser extent Europe is primarily the result of rapid output growth (both of domestic and foreign origin) which more than compensates for the very rapid growth in labour productivity in this sector. By contrast, the employment growth in financial and personal service sectors has gone hand in hand with only minuscule gains in labour productivity. Employment growth in these sectors has primarily been the result of rapid domestic output growth. Whether such employment growth is "sustainable" or is simply the result of the failure of those sectors to use efficiently new ICT technology remains of course to be seen. Studies of the financial sector

Figure 6*a*. **Growth in employment and its composition in the United States**



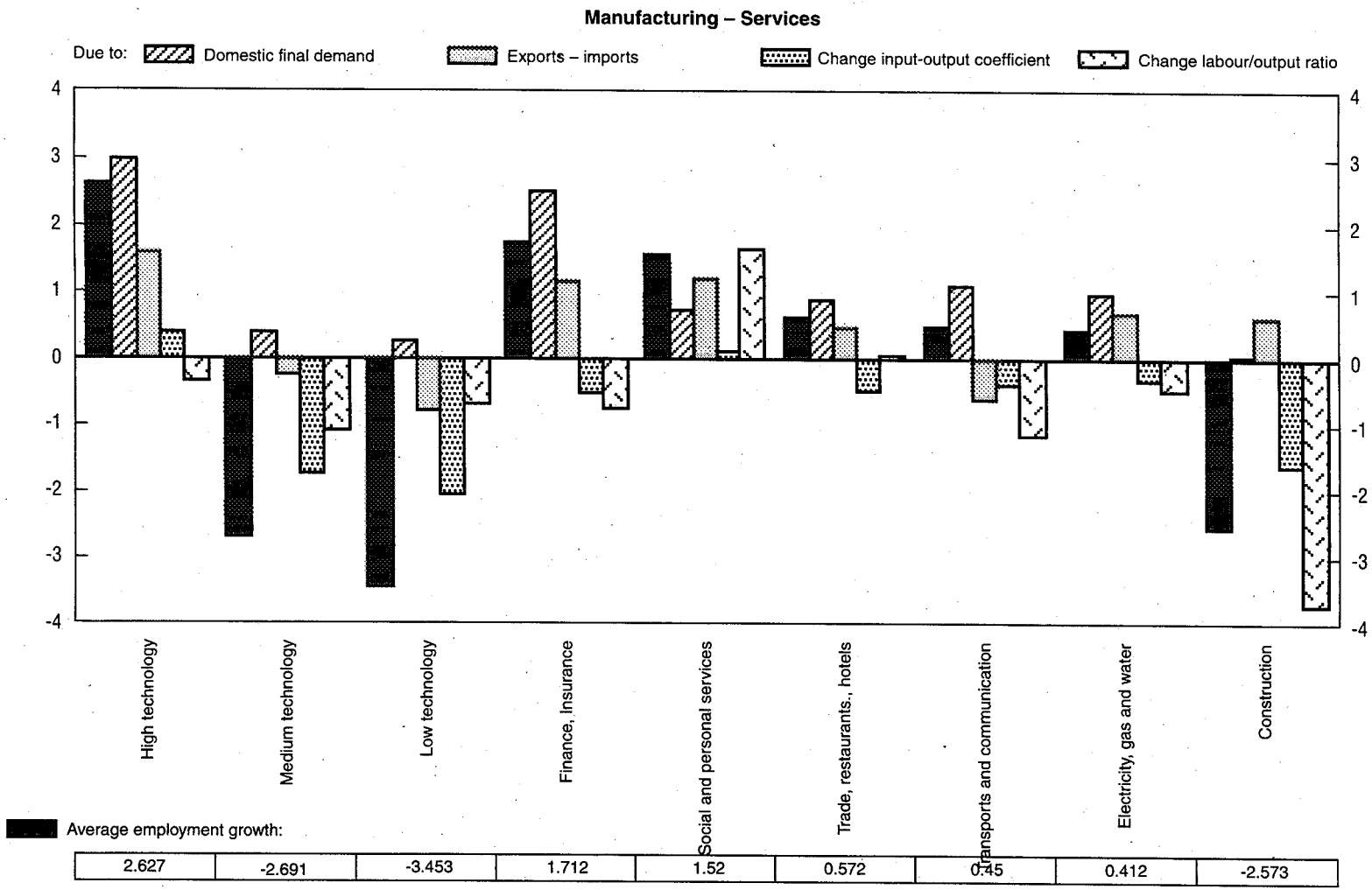
Source: OECD (1992), *Structural Change and Industrial Performance*, OECD Document Series.

Figure 6*b*. **Growth in employment and its composition in Japan**



Source: OECD (1992), *Structural Change and Industrial Performance,* OECD Document Series.

Figure 6*c*. **Growth in employment and its composition in the EC**



Source: OECD (1992), *Structural Change and Industrial Performance,* OECD Document Series.

forecast that efficiency improvements and the increased tradeability of such services will reduce EC employment in financial services by more than 10 per cent.

The variety of sources of employment growth in different sectors of the OECD countries considered in Figure 6, suggests that one has to be very careful in drawing general policy conclusions in the area of employment creation. Clearly, new demand and output growth associated with high-tech industries can be a major provider of employment growth. However, and as illustrated in the case of France, the United Kingdom or the Netherlands, the growth in productivity in order to stay competitive might be so high that there is actually a decline in employment in these high-tech sectors. Similarly in services, old, traditional and above all "non-tradeable" demand for personal care services, will generate many employment opportunities, given the low, sometimes negative, labour productivity growth in such sectors. At the same time though, new, increasingly tradeable demand for finance and other business services, where the productivity growth pattern has varied between the United States, Japan and the EC, might cause major employment reductions in those sectors.

While the data reported in Figures 5 and 6 describe some of the structural changes in employment creation in the 1970s and 1980s, very little evidence exists for the most recent period. However, there is little doubt that the intensity of structural change has accelerated in the present recession, and that the variety in employment growth and decline patterns between countries and sectors has, if anything, increased.

IV. OCCUPATIONAL CHANGES IN (UN)EMPLOYMENT GROWTH

The growth and decline of employment opportunities is not limited to the growth and decline of sectors. A particular feature of the rise in structural unemployment over the last two decades is the growing educational and occupational "mismatch" resulting from the combination of job losses and new employment opportunities. As Sherman and Jenkins (1979) put it: "how to tell a redundant Scottish steel worker that there is a job opportunity as a secretary in London?" The labour market is from this perspective an extremely heterogenous "market" which does not adjust to incentives in the same immediate way as financial markets would. Many of the structural changes associated with changes in the demand for new skills and qualifications are directly the result of technological change.

The broad description of the structure in occupations and educational levels is limited to the EC. Figures 7 and 8 illustrate the distribution of employment

Figure 7*a*. **Educational employment shares**
European Community, 1991

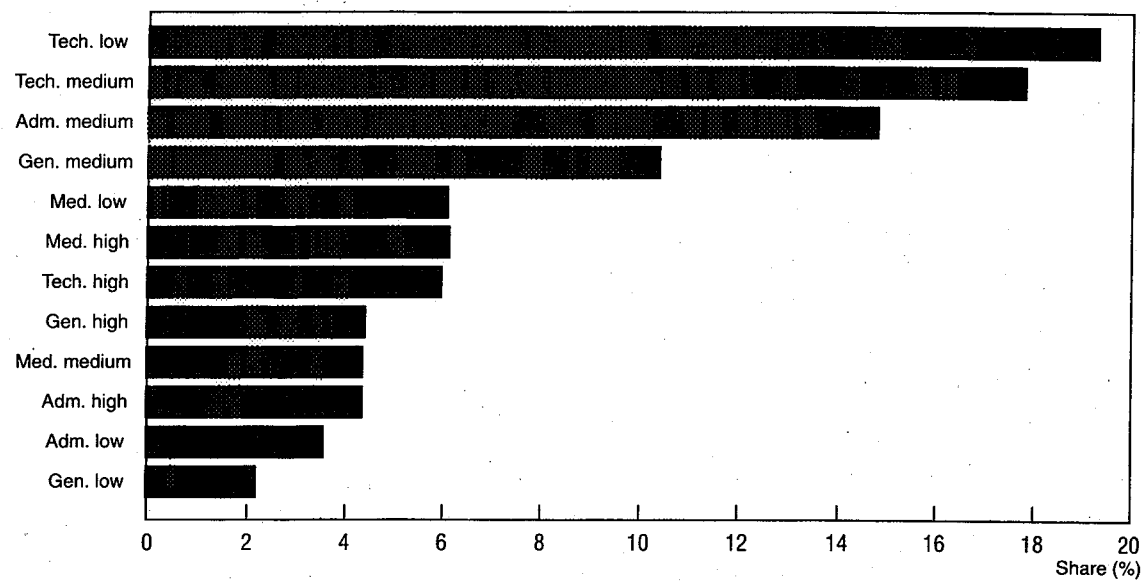
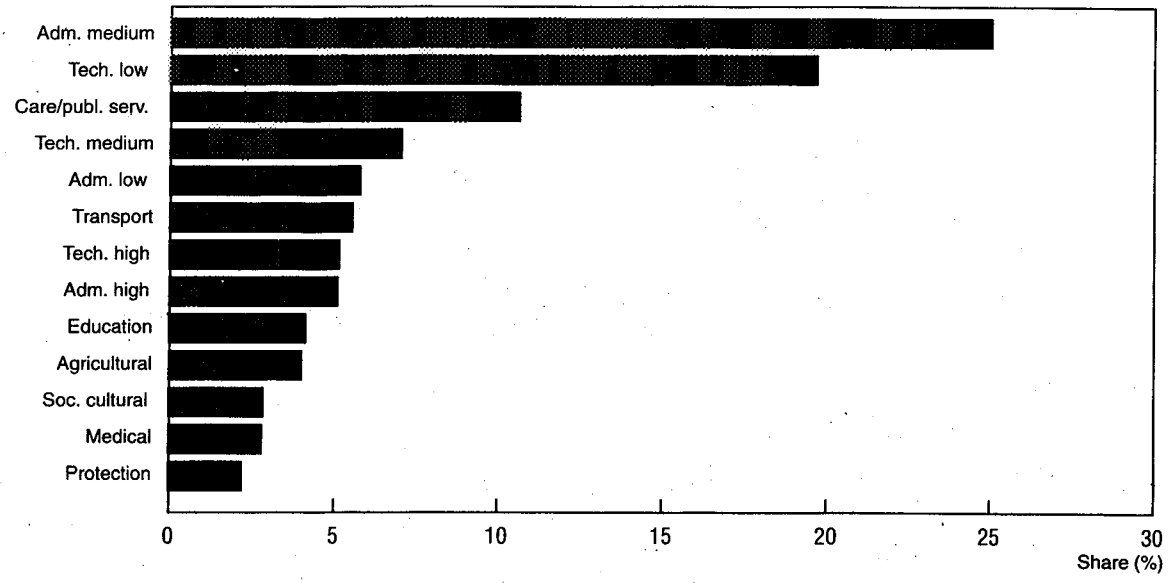


Figure 7*b*. **Occupational employment shares**
European Community



Source: MERIT, MASTER database.

Figure 8*a*. **Educational unemployment shares**
European Community, 1991

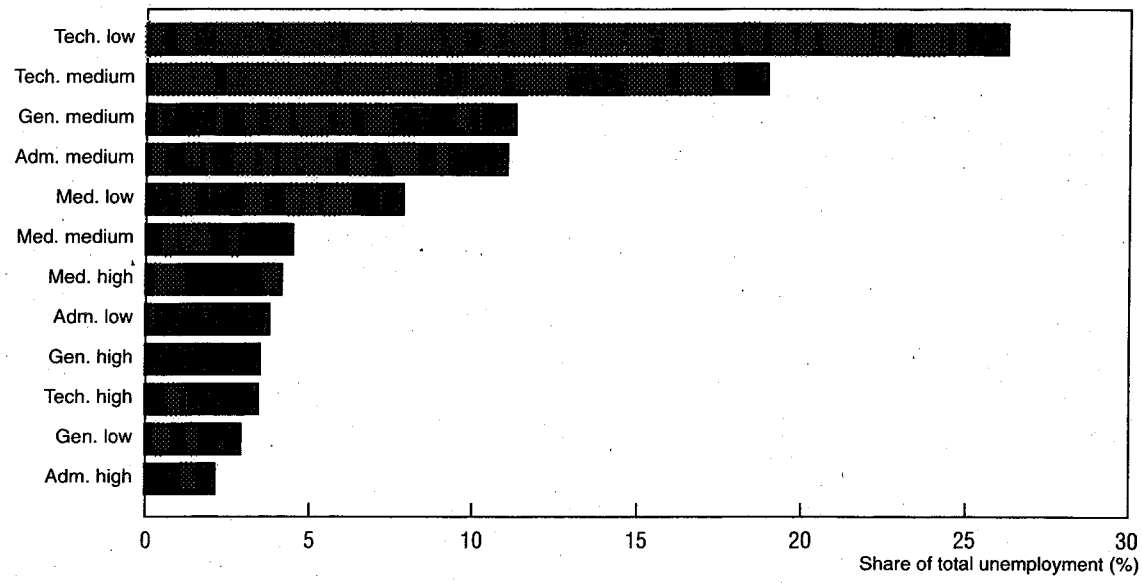
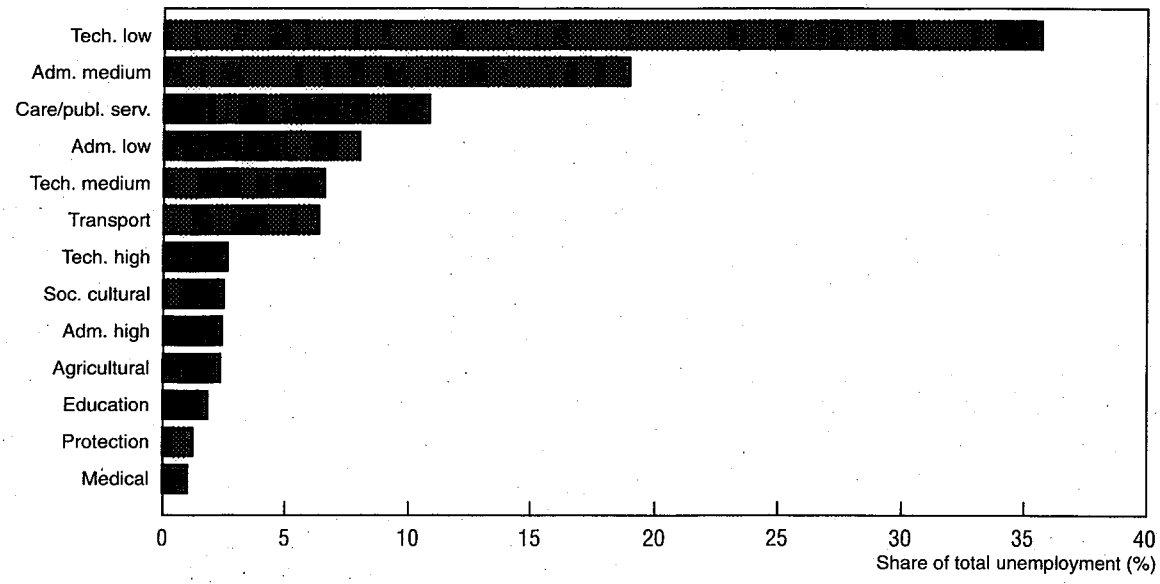


Figure 8*b*. **Occupational unemployment shares**
European Community



Source: MERIT, MASTER database.

(Figure 7) and unemployment (Figure 8) in the EC for thirteen broad occupational and twelve educational classes. Figure 7*a* illustrates the importance of low and medium technical qualifications for employment. Workers and employees with such qualifications represent nearly 40 per cent of total employment in the EC. At the same time though, as Figure 8*a* illustrates, unemployment is highest amongst those workers. Workers with these qualifications represent 45 per cent of total unemployment. High technical, administrative, medical levels and general qualified people by contrast, while representing some 20 per cent of total employment, only represent some 12 per cent of total unemployment. A similar but somewhat more varied picture emerges from Figures 7*b* and 8*b*. The extremely high share in total unemployment of workers with low technical skills (more than 35 per cent of total unemployment in Figure 8*b*) is much higher than the share in total employment of such low-technical jobs. Medium administrative jobs by contrast represent more than 25 per cent of total employment (Figure 7*b*) and their share in total unemployment is, not surprisingly, also high. The high-technical jobs appear again much more present in the employment share bars in Figure 7*b* than in the unemployment share bars in Figure 8*b*.

In Figures 9 and 10 the interaction between educational qualifications and occupational job distribution is illustrated for two extreme, but typical cases: administrative qualifications and jobs (Figures 9*a* and *b*) and technical qualifications and jobs (Figures 10*a* and *b*) each time at the low, medium and high level.

In Figure 9*a* one can observe the distribution of workers/employees with an administrative educational background over different occupations. Thus 65 per cent of those holding medium administrative degrees have an employment in medium administrative jobs. For those with high administrative qualifications, 45 per cent found employment in medium administrative and 32 per cent in high administrative jobs. Figure 9*b* by contrast depicts the *educational* background of workers with an administrative job. Here only 45 per cent of those employed in medium administrative jobs appear to have such a qualification. In the case of high administrative jobs this is even lower, only 31 per cent of those holding high administrative jobs had a corresponding educational background. Nearly 10 per cent of those holding such jobs had high technical, medical or general educational qualifications. Figures 9*a* and 9*b* illustrate in other words, that the educational background of workers or employees with an administrative job is not that important, whereas workers with an administrative training normally get an administrative job.

The opposite can be found for workers with technical qualifications. Figure 10*a* depicts the distribution of those holding technical degrees over various job categories. Contrary to Figure 9*a*, less than half (48 per cent) of those with low-technical degrees are also employed in low-technical jobs. Similarly, of all those with medium-technical degrees, only 17 per cent are employed in medium-

Figure 9*a*. **Occupational distribution in the EC**
Of those holding administrative degrees

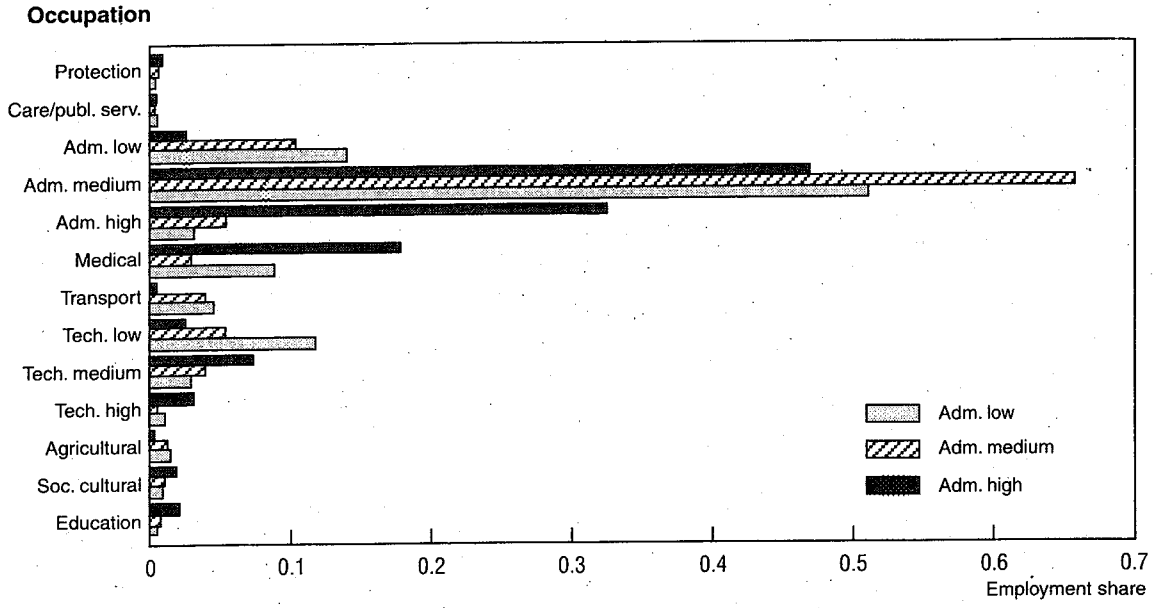
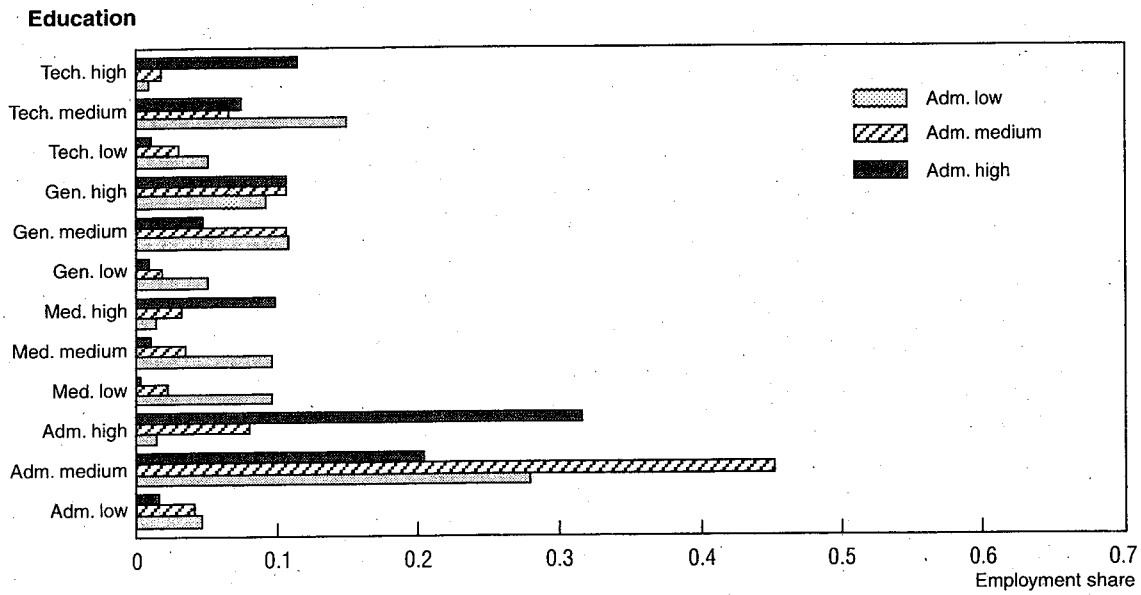


Figure 9*b*. **Educational distribution in the EC**
Of those holding administrative jobs



Source: MERIT, MASTER database.

Figure 10*a*. **Occupational distribution in the EC**
Of those holding technical degrees

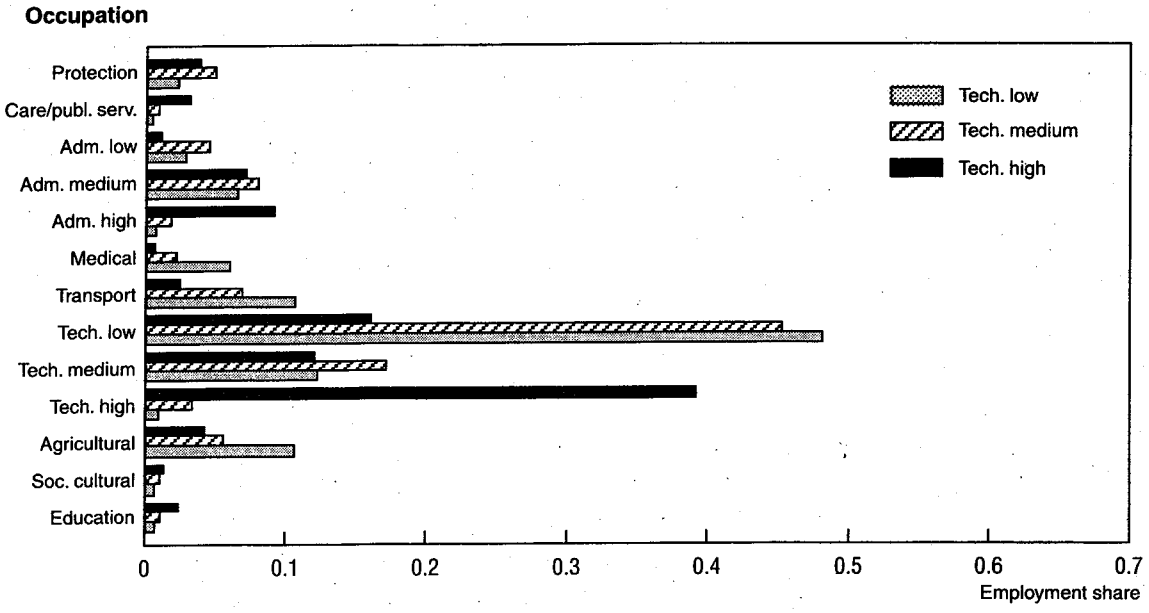
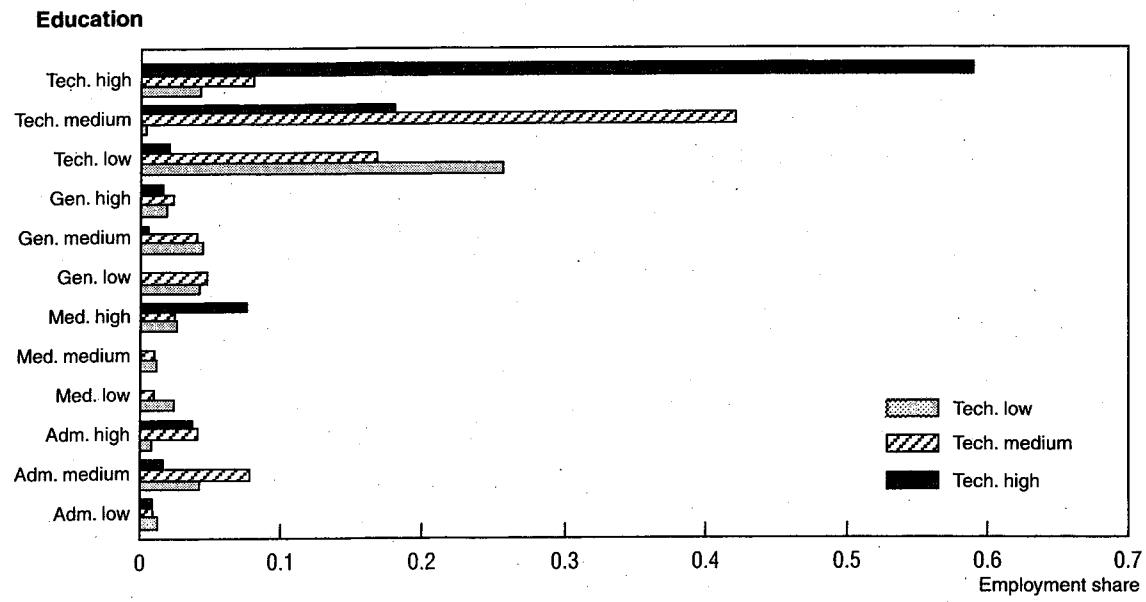


Figure 10*b*. **Educational distribution in the EC**
Of those holding technical jobs



Source: MERIT, MASTER database.

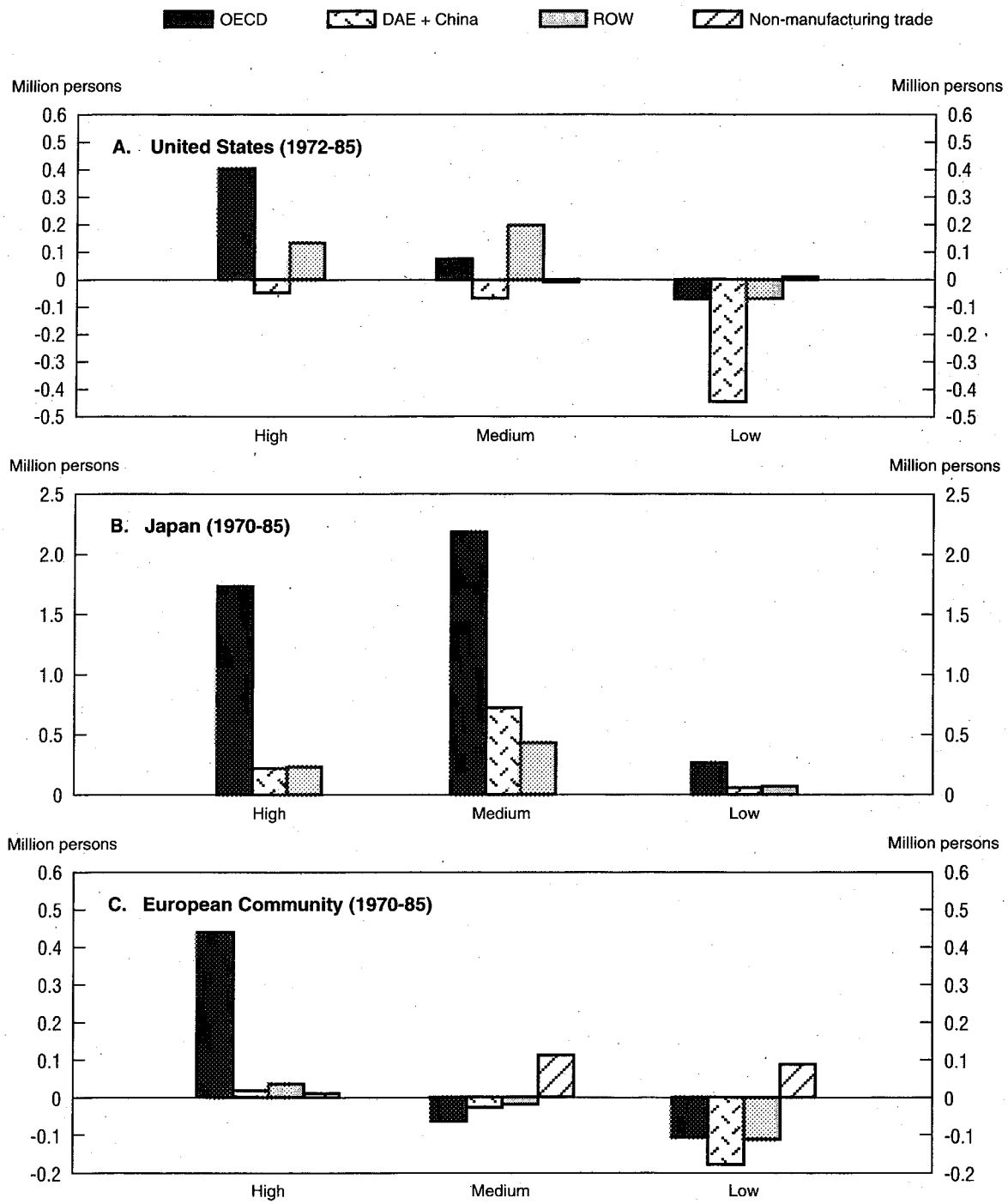
tech jobs, and more than 44 per cent in low-tech jobs. More generally stated, it appears that the distribution of those with technical qualifications is more dispersed over job categories than in the case of administratively qualified workers or employees. Similarly, Figure 10*b* illustrates the educational background of workers with a technical job. In contrast to Figure 9*b*, those holding high-technical jobs need high-technical qualifications. Nearly two-thirds (63 per cent) of those holding such positions have such qualifications. In other words, technically-qualified workers can occupy different types of jobs, whereas the pure technical jobs have to be occupied by technically-qualified workers.

In so far as the category "high-technical" includes such relevant ICT educational or occupational categories as software engineers or computer analysts, a more disaggregated analysis focusing on relevant ICT qualifications and occupations would undoubtedly resemble the distribution chart illustrated in Figure 10. There are in other words some *key* skills, which have an importance way beyond their particular occupational fit.

V. INTERNATIONAL TRADE AND COMPETITIVENESS

As highlighted already in Figures 5 and 6, an important source of employment creation and also employment displacement is directly associated with foreign trade and international competitiveness. Based on the OECD methodology used above, Figure 11 illustrates the employment impact of trade for three categories of manufactured commodities: high-, medium- and low-wage goods, for the United States (Figure 11*a*), Japan (Figure 11*b*) and the EC (Figure 11*c*). The figure illustrates the crucial importance of foreign trade to employment growth in Japan. More than 5.6 million jobs in manufacturing have been created in Japan over the period 1970-85 directly as a result of foreign trade.[3] That is about three-quarters of the total gains in employment in Japan over this period (Sakurai, 1993). The "full employment" output growth pattern Japan has enjoyed over the 1970s and 1980s has in other words been primarily based on foreign output growth and foreign market penetration. The employment gains have been realised both with respect to high-, medium- and even low-wage sectors, and with respect to trade with the OECD, the so-called Dynamic Asian Economies (DAEs: Hong Kong, Singapore, South Korea and Taiwan) and China, and the Rest Of the World (ROW). While trade with the OECD area has remained over the period considered in Figure 11*b* (1970-85) the most important employment growth contributing factor in Japan, it is likely that over the more recent period trade with the

Figure 11. **Trade impacts on employment**



DAE = Dynamic Asian Economies: Hong Kong, Singapore, South Korea and Taiwan.
ROW = Rest of the World.
Source: *Sakurai*, 1993.

DAEs and the other SEA countries has become as important, if not more important for employment growth in Japan.

The United States by contrast, and as illustrated in Figure 11*a*, has barely relied on foreign markets for its output and employment growth. Only in the area of high-wage commodities and non-manufacturing trade has employment growth been realised on the basis of foreign trade. Overall the United States lost about half a million jobs as a result of trade. These employment losses were in the first instance the result of trade with the DAEs and China, particularly in low-wage commodities.[4] Trade with the rest of the OECD particularly in high-wage commodities still generated substantial employment growth.

Finally in the case of the EC (Figure 11*c*), while the overall employment gains and losses of trade appear to cancel each other more or less, nearly all the employment gains in manufacturing appear to be the result of trade in high-wage commodities with the rest of the OECD. The other gains appear related to non-manufacturing trade.

Given the importance of trade in high-wage/high-tech sectors for employment growth and the particular contribution therein of ICT commodities, we now turn to some more detailed data on the trade performance of the United States, Japan and the EC in ICT commodities.

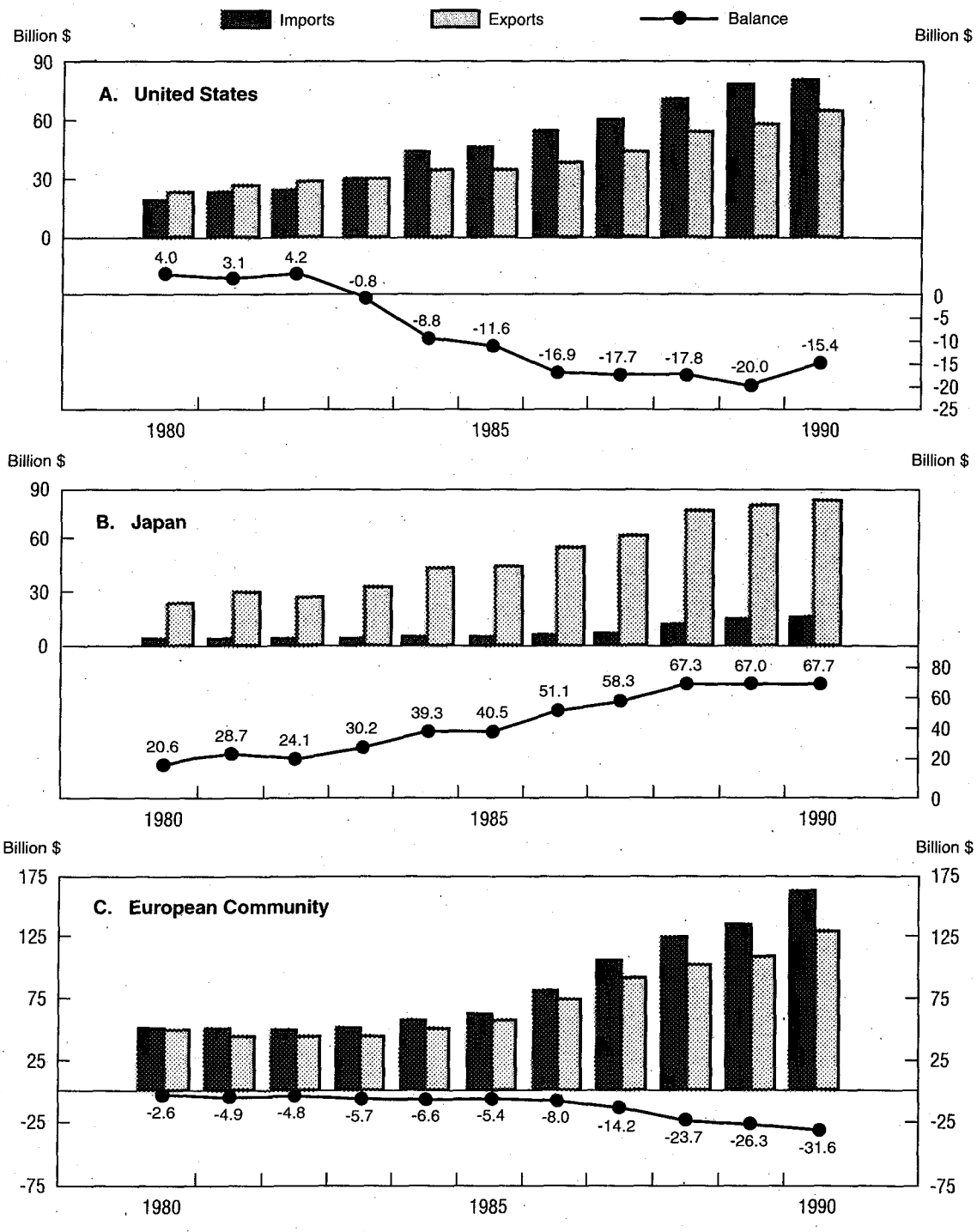
In Figures 12*a*, *b* and *c*, the trend in the absolute trade balance of the United States, Japan and the EC in ICT commodities over the 1980s is represented. The figures illustrate the dramatic trade surplus of Japan in ICT goods, which seems only to have come to stabilisation in 1987 at a staggering trade surplus level of about $67 billion. They also illustrate the rapidly declining trade balance of the EC. Its trade deficit of $32 billion is now more than twice the deficit of the United States in ICT goods.

Another less absolute and more comparative way to look at the trade performance of the ICT sectors is provided by indicators of international competitiveness such as the "Revealed Comparative Advantage (RCA)" index which normalises the export performance of the ICT sector, relative to the trade performance of all manufactured goods. Indices[5] above zero indicate comparative advantage in the particular sector, indices below zero, comparative disadvantage.

Figure 13 presents such normalised "revealed comparative advantage" (RCA) indices for the United States, Japan and the various EC countries for the office equipment and computers sector (Figure 13*a*) and for the communication equipment sector (Figure 13*b*) over the last 20 years (3-year averages for the periods 1970-73 and 1988-90).

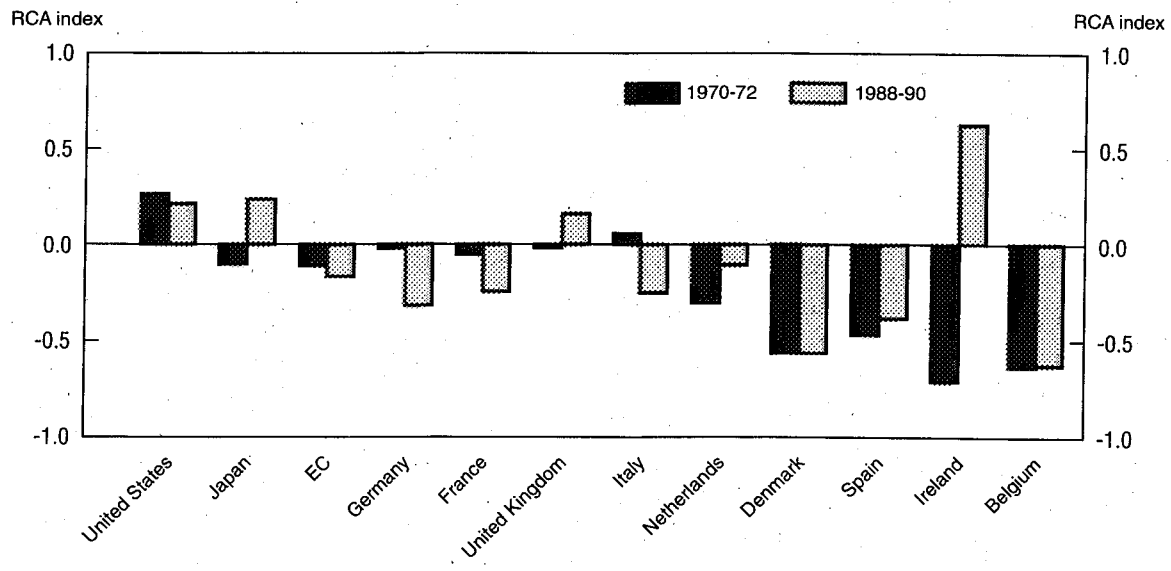
Figure 13*a* illustrates in the first instance the emergence of a significant comparative advantage in Japan in office equipment and computers over the last 20 years. In the case of the United States it points to a weakening but continuing

Figure 12. **Imports and exports of information technology (IT) sectors**



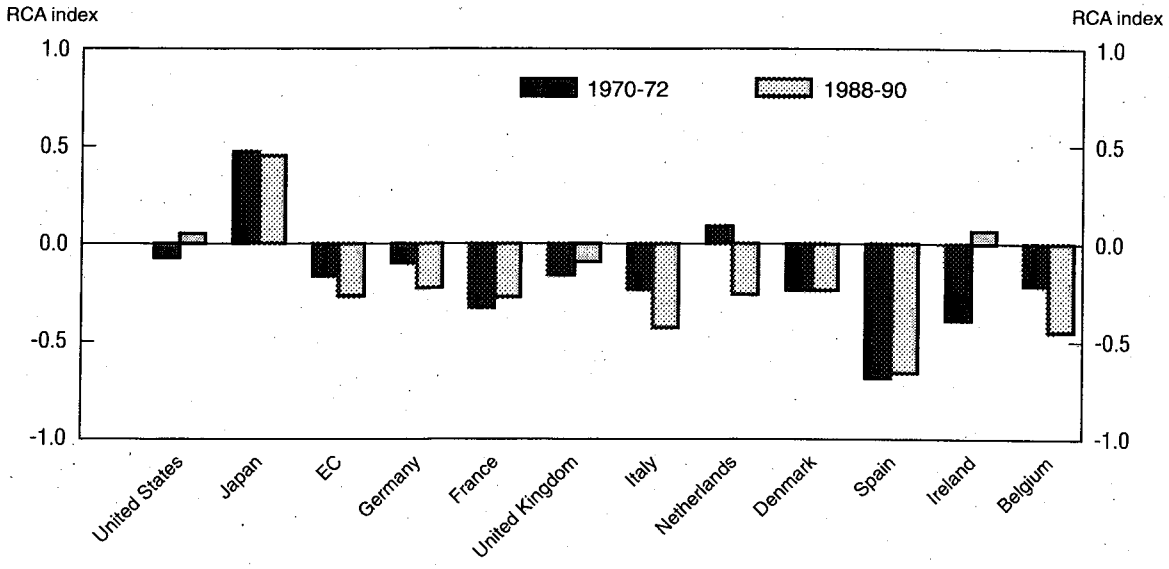
Source: OECD.

Figure 13*a*. **Revealed Comparative Advantage index**
Office machines and computers



Source: MERIT.

Figure 13*b*. **Revealed Comparative Advantage index**
Communications equipment



Source: MERIT.

comparative advantage in office equipment and computers. With respect to the EC, and possibly most strikingly, Figure 13*a* illustrates how Europe has further fallen behind and does not have a comparative advantage in office equipment and computers.

Finally, with respect to the individual EC countries, apart from the extraordinary but special case of Ireland with a dramatic, but primarily "foreign assembly" comparative advantage in office equipment and computers, Figure 13*a* illustrates how each of the large European countries, with the exception of the United Kingdom, has lost its comparative advantage in this ICT sector. This is particularly the case for those EC countries with large domestic producers in office equipment and computers: Germany, France and Italy. Only in the case of the United Kingdom and apparently since Fujitsu bought ICL has there been a strengthening of the UK's international competitiveness in this sector.

In communication equipment (Figure 13*b*), the Japanese comparative advantage is dramatic. Only the United States and Ireland have, today, indices just above zero. Germany, the Netherlands and Italy, again all countries with large domestic firms in this ICT area have seen their relative competitiveness decline significantly over the last 20 years.

In other words and as illustrated by both Figures 13*a* and 13*b*, the only areas where Europe seems to have increased and built up a comparative advantage in ICT have been dominated by the activities of foreign, non-European firms. The large European countries with strong domestic firms appear all to have lost much of their competitive strength over the last 20 years in the two broad ICT sectors considered above.

The employment implications of this pattern are, as highlighted amongst others in Papaconstantinou's contribution to this issue, not easy to measure. The presence of many foreign firms in the ICT area in Europe has certainly generated much new employment in the ICT area which would otherwise not have been generated (see amongst other the evidence presented in Figure 6*c*). At the same time those firms have been much more active in reaping fairly early the advantages of European integration. Compared with the United States, Japan or South-East Asia, growth in Europe in ICT has lagged behind and Europe's world market share has steadily declined.

The shift in comparative advantage away from high-tech commodities, towards more traditional commodities has, in our view, had a major negative impact on European growth and employment. The results are: a much slower pattern of diffusion of ICT equipment to the rest of the economy, a much lower birth rate of new product or service activities in the ICT area, much higher prices for ICT commodities and a far less dynamic and competitive ICT industry.

VI. STRUCTURAL CHANGE AND EMPLOYMENT: THE POLICY CHALLENGE

We turn now, albeit briefly, to some of the major policy challenges. For simplicity these have been grouped under the headings: the rising trend in long-term unemployment resulting from structural change and labour market rigidities (Sub-section VI.1); and the increased international competition and fear of delocalisation (Sub-section VI.2).

VI.1. Rising long-term unemployment and labour market rigidities

The growing policy concern about structural unemployment, and in particular that related to long-term and youth unemployment, is not only inspired by the economic waste of these large unused human resources or the rising financial burden on government budgets of unemployment payments and other social security benefits. The policy concerns in Europe relate today probably as much to the fear of social destabilisation and insecurity which such levels of more or less permanent "unemployment" might bring about in society at large. Typically, the official downward revisions in unemployment numbers to correct for early retirement – excluding unemployed above 50 –, workers on job creation schemes or on other training schemes, no longer appear to serve their purpose. Indicators of disguised unemployment appear today again of relevance, not just to trade unions, but to policy-makers as well. In many European countries the unemployment rate, including such disguised unemployment, is now nearly twice as high as the official one.

The hidden costs of such high *real* levels of unemployment are slowly coming to the surface: social tensions; growing dualism between those included and excluded from work and jobs; social selfishness alongside growing income inequality; growth in crime, drug dependence and alcoholism, most of which must be associated with the extraordinarily high unemployment rate amongst unskilled, urban youngsters and school dropouts; xenophobia and a rise in racial conflicts and tensions associated with immigrants and anything that is "foreign", etc. It is notable that the work of social psychologists and sociologists on such adverse effects led both economists and policy-makers to a more intense concern with *long-term* unemployment. As the OECD's *Employment Outlook* (1993) points out, nearly half of the EC unemployed have been out of work for more than a year. Not surprisingly the policy emphasis has shifted towards more active labour market policies: policies aimed at counteracting the dangers of a "culture of dependence" developing over time as a result of long-term unemployment. To break such

"vicious circle" phenomena appears to require much more inter-connected active measures with increasingly an obligation to accept work or training combined with financial pressures and inducements, both for employers and for the unemployed.

At the same time many labour market economists also put the emphasis on the need to reduce relative wages (and social benefits) for less skilled workers and for young workers. In this, more traditional, vision much of the blame for the rise in unemployment, particularly in Europe, is put on labour market rigidities and on the lack of incentives to seek work. Labour market flexibility and in particular downward wage flexibility is then expected to enlarge the employment creation potential at the low-skill/low-wage end. The combination of existing income tax structures[6] and minimum wage legislation is assumed to discourage the supply of low-paid work, and the amount of unemployment and social assistance benefits might have removed incentives for unemployed workers to seek actively for work.

The wage flexibility argument while attractive cannot, however, be discussed purely in static economic terms. As already argued above the issue is not just an economic one. For example, how should we deal with the fact that downward wage adjustment puts most of the burden of the adjustment on the economically-weakest groups in society? How can we avoid the employment generated by wage flexibility leading to "work in poverty"? Minimum wages and many other social achievements at the low end of the labour market have been created because they corresponded, often in an absolute sense, to minimum remuneration levels, where life in work meant life with an income which would allow somebody to survive, given relative costs of living. Over time, these minimum wage levels could well have exceeded such "survival" levels in some OECD countries, such as the Netherlands, but minimum wages, if calculated in "purchasing power parities", are generally not high enough to offer much room for downward adjustment in many European countries without generating work in poverty. The focus must be much more on the double gap between before- and after-tax minimum wage levels and the official and effective minimum wage levels. In many OECD countries that gap appears to be substantial.

Second, the question can be raised as to what extent such immediate wage adjustments would not have severe, long-term negative consequences for both labour productivity growth and competitiveness. Whereas from a static, short-term point of view such policies might well generate low-skill employment possibilities in the non-tradeable service sector – the so-called "hamburger economy" – and thus reduce some of the structural long-term, low-skill unemployment, there exists a real danger that these measures could also lead to downward pressure on labour productivity with spillovers to the tradeable sectors, such as sweatshops in clothing and textiles, and a move towards long-term specialisation in low-skill activities. As suggested above in Section V, it is precisely the low-wage sector

which has, because of increased import penetration, suffered most employment losses.

The wage flexibility argument appears, from this perspective, rather similar to the argument for full protectionism. If there were full protectionism, for instance, at the broad level of the EC trade block (or even better the new European economic space), low-skill employment is likely to be generated in many of the labour-intensive, low-wage sectors which would now substitute for previous imports of such commodities. The new employment created would be substantially bigger than the employment decline in the EC's world export sectors and full employment would probably be quickly reinstalled. Apart from the obvious welfare losses from EC autarchy, the loss of the dynamic competitive impact of foreign imports would, however, in the long term, severely undermine the EC's growth and competitiveness.

In an open world, downward wage adjustment appears to be a similar type of escape from adjustment as protectionism. Introducing it as the main policy device could, from this perspective, lead to the "import of underdevelopment": a process of a more *lateral international division of labour*, where wage differentials within the developed countries increasingly resemble wage differentials between countries. There is in other words a danger of being caught up in a low-wage trap on a long-term basis. To avoid this danger of a permanent large low-wage, low-skill underclass it is essential to press forward with policies for training and high quality services, so that high-skill jobs become a steadily higher proportion of the total.

VI.2. International competitiveness and delocalisation

This last trend points to some of the new features emerging in the technology employment policy debate: the growing role played by increased international competition and international location of manufacturing and, increasingly, service activities. The policy argument is here one of "fear of delocalisation" and is directly influenced by the rapidly growing possibilities for such delocalisation because of ICT.

An important factor in the discussion about the scope for downward wage flexibility is the size of the *non-tradeable* sector, given its particular role in absorbing low-skilled, low-wage employment. It has often been claimed that the non-tradeable service sector in Japan acted as an employment "reservoir" in times of slack demand, both within large firms, organised along lifelong employment, and in the economy at large with many relatively low-skilled service activities. The steady low levels of unemployment in Japan are thus also explained by the cushioning effect of the non-tradeable sector. There are, however, good argu-

ments that the non-tradeable service sector has been shrinking significantly over the last ten years in all OECD countries, and in the EC in particular.

First and foremost, it is obvious that ICT has significantly increased the tradeability and geographical mobility of many service activities. The present trend in many service sectors towards the relocation of service activities, such as programming, simple clerical functions, and reservations and bookings, illustrates the fact that information and communication technology has brought about a rapid and cheap flow of information across the world, creating to some extent the global service village. Labour cost differences in such service activities are the major cost variable. Firms, even those which had little international experience, are "(re)discovering" the basic principles of the international division of labour.

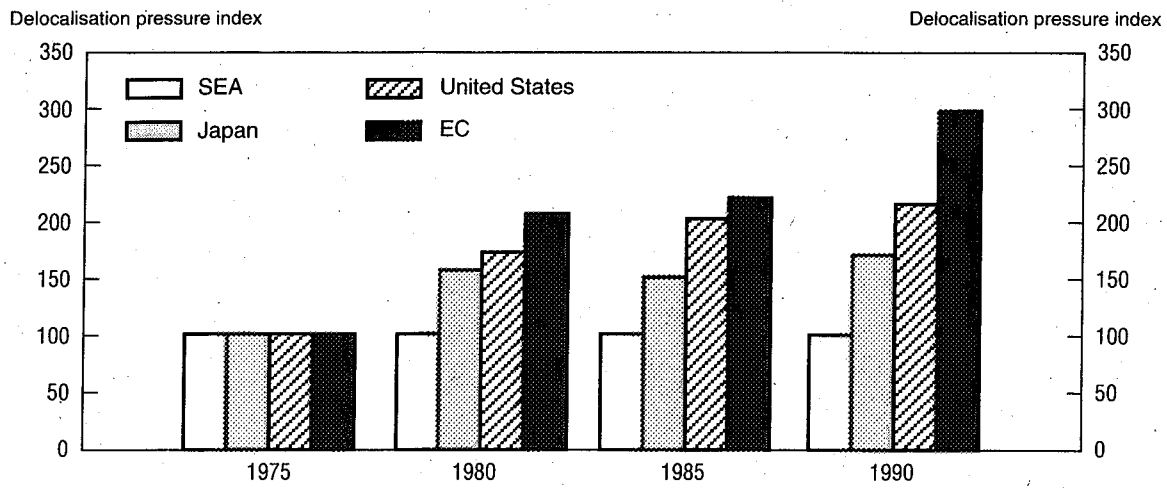
But there might well be a far more fundamental trend underlying such international relocation shifts in services. Many Western firms are also discovering the relatively high levels of human capital in many Asian countries. The latter, after years of heavy investment in education, particularly in the science, technical and engineering fields, are starting to reap some of the benefits of these investments and attract some of the complementary physical capital. Whether this is a reflection of a more lateral division of labour or whether this is the result of a much more straightforward process of catching-up, is an open question. What is certain though, is that an increasing number of jobs in OECD countries, even in high-skilled activities, that were previously protected because they were essentially non-tradeable, are becoming subject to international competition. It is this new pressure across the occupational spectrum which probably gives rise to some of the most outspoken fears of low-wage competition and rapid growth in structural unemployment in the OECD economies.

Figure 14 illustrates this growing concern using a relative unit labour cost indicator which we have called *delocalisation pressure*. It is based on the gap in labour costs between the low-wage and high-wage country, corrected for the gap in labour productivity between the two countries. The indicator illustrates how over the last ten years the delocalisation pressure has increased dramatically between Europe (and in particular Germany) and the South and East Asian economies. For the United States and Japan the rise in delocalisation pressure has been less pronounced.

Not surprisingly, there is growing concern that the international flexibility initiated by multinational corporations "delocalising" production activity towards regions/countries with lower labour costs, will lead to severe employment losses. This concern is not just expressed with respect to delocalisation to South and East Asia, as illustrated in Figure 14, but is also expressed more and more within Europe, because of the geographical proximity of new, low-labour-cost regions in the ex-socialist East European countries, and because of the lack of a "social

Figure 14. **Delocalisation pressure**[1]

Manufacturing, SEA = 100



1. Delocalisation pressure = labour cost (constant prices, per manhour) divided by labour productivity (= output per manhour) (1975 = 100).

Source: MERIT; ILO; OECD.

charter" in the Maastricht Treaty of European Union which might prevent convergence in the social sphere, at least in the short run.

Such trends towards delocalisation are to some extent within the logic of international competition and the free movement of international capital flows. While national governments might be unable to do much about such delocalisation trends, local government authorities have, in our view, a much more active role to play in "keeping" such firms within their region. Indeed, local government authorities have a prime responsibility in creating economic conditions to ensure that subsidiaries of foreign firms become embedded in the domestic economy, so that the region in which they are located becomes essential to the subsidiary's competitiveness. From this perspective, local authorities might well have to focus less on attracting foreign firms with subsidies, and switch their attention more to creating favourable infrastructural conditions that will strongly link foreign subsidiaries to the local region. These infrastructural conditions include education and training, networking with small and medium-sized local sub-contracting firms, and collaboration with local universities and technical institutes or other research organisations.

VII. CONCLUSIONS

Probably to the frustration of many policy-makers, the problems of structural unemployment remain complex and are unlikely to be solved by immediate policy reactions. What is clear though is that the subject represents a major challenge to the OECD as an international economic advisory "think thank" organisation. If the OECD is not capable of coming up with long-term, lasting solutions to the steady growth in (structural) unemployment, countries will start to act by themselves, ignoring each others experience and commencing a difficult process of institutional and policy learning. This process is already occurring in many OECD countries, with the Scandinavian countries taking the lead.

The breakdown of the Scandinavian "social system" (in particular Sweden and Finland) is indeed one of the most dramatic, new features of present day high unemployment in the OECD area. It is obviously linked to some specific geographical factors, such as the periphery position *vis-à-vis* the EC or the proximity to the ex-Soviet Union and eastern European ex-socialist countries. But it is also related to a rag-bag of very different structural factors: the unsuccessful attempts at monetary convergence with Germany and EMU, the possible overstretching of the social system, the structural adjustments and changes in specialisation pattern towards less-technology-intensive commodities, the globalisation of large domestic firms, etc. These countries, while having been confronted with such structural problems much earlier and much more profoundly than most other OECD countries, might well show the way on how institutional change can be introduced in a democratic fashion and without paying too high a price. Not surprisingly, the conference on which this issue reports was organised on the initiative of the Finnish Government. The present Finnish, Swedish and Danish experiments might bear particular relevance to many other OECD countries both in Europe and outside Europe. And while the OECD report on employment/unemployment might well come too late to be of much practical assistance for these countries in their confrontation with structural unemployment, it will nevertheless be of influence in assessing the likelihood of success of the policies currently being implemented.

More disturbing though are individual "beggar-thy-neighbour" countries' responses to unemployment. Such policy responses are not confined to traditional protectionist policy proposals. They also include various other attempts at reducing domestic labour costs relative to major competitors, *e.g.* through devaluations, reductions in, or even abolition of, minimum social legislation, including minimum wages, child labour legislation, environmental rules and regulation, etc. "Flexibility" in this social deregulation sense has a far more negative connotation. The role of the OECD in setting out rather early on what the rules of the game

should be in this area of "flexibility", is of the utmost importance. No doubt there is scope for employment creation and increases in labour force participation in many European OECD countries by eliminating some of the labour market rigidities. However, the point should not be overstretched: labour markets, contrary to financial markets, will never adjust to prices in a fraction of a second. The OECD should probably bring more clearly to the forefront the scope for "positive flexibility", to be defined just like "positive" adjustment, or "positive" economic integration in terms of common policies likely to strengthen both the adaptive and innovative strength of the OECD economies.

Finally, and with respect to the possibly much more competitive international environment, it is important to recognise that the OECD economies do not operate in a vacuum. The world economy, particularly in the Asian Pacific area and by and large outside of the OECD, has grown much more rapidly than the old North Atlantic OECD core base. The fact that most of the employment concerns are being voiced in Europe is, from this perspective, not surprising. It is, whether one likes it or not, part of a more general structural shift in the growth and employment pole from Europe-United States to United States-Asia. How Europe will respond to this shift is an open question, but one with many implications for Europe's employment future.

NOTES AND REFERENCES

1. We say developed countries because those degrees of freedom have of course always been far more restricted in developing countries. One has only to think of the IMF or World Bank conditions with respect to new loans.
2. It might even have been overstretched in this area. What is obvious though is that in the monetary area, given the large amounts of money which have become internationally mobile, the "independent" actions of central banks have become increasingly dependent on the financial markets' reactions.
3. It should be emphasised that the "decomposition" method used by Sakurai (1993) and illustrated in Figure 6 only allows for directly attributable employment gains/losses due to foreign trade. Indirect effects, *e.g.* through increased competition, are not taken into account.
4. Again this statement needs to be interpreted with care given the "partial" nature of the methodology used. The welfare gains, *e.g.* in terms of lower priced imported goods, are of course left out of the mechanical employment decomposition methodology used in Figure 6.
5. The RCA index has been normalised as (RCA – 1)/(RCA + 1).
6. We do not discuss here the various policy proposals directed at reductions in labour costs while leaving wages intact. Proposals aimed at shifting the the tax burden away from labour towards other inputs such as materials or energy are undisputed. However, their unco-ordinated implementation in individual European countries appears difficult, because of fears of losing international competitiveness.

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