B. SCIENCE AND TECHNOLOGY LABOUR MARKETS: RELEVANT ASPECTS OF SUPPLY AND DEMAND

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Abstract

The strategic importance of a deep and solid culture in science and technology is generally accepted for sustaining the growth of future socio-economic systems. Consequently, great efforts have been made by the most advanced countries to develop education and training in S&T and a high-tech culture as strategic tools for future wealthy economy.

This general approach appeared very successful up until the end of the 1980s, but recently evidence of differences in labour market outcomes in various OECD countries have emerged. Differences in the match between the supply and demand for science and technology skills in the labour market are evident among very high-tech and strong economies such as the United States and other advanced countries but also in weaker advanced economies such as Italy.

In fact, although recent statistics are lacking, it appears the unfavourable economic situation that originated from the crisis in the large high-tech companies in Italy is having a negative effect on the labour market and is resulting in a considerable reduction in the hiring of highly skilled employees. This is happening especially in large industries operating in markets showing various, although different, signals of structural crisis (military production, hardware electronics, etc.), but it is also limiting the potential of newer high-tech sectors such as biotechnology.

Surely, a compensating trend has been the movement of personnel with high-tech skills towards advanced "tertiary" sectors such as multimedia services, office automation, etc as well as the higher education sector. In conclusion, although the high-tech sector is among the most promising for the future, it has not generated that many new jobs, especially for workers with science and technology skills. In addition, the development of personnel with high-tech skills appears to be geared towards improving the quality of labour in sectors dominated by more mature technologies.

Background

Given the strategic importance of science and technology to future socio-economic systems, the most advanced countries are investing a great deal in sustaining the growth of S&T especially technological innovation. There are many complex phenomena involved in this process and it is not only difficult to clearly define the objectives, but also to establish and quantify the results of investments in S&T.

This is particularly true with regard to the impact on the labour market for human resources in science and technology. First, some general considerations are needed in order to carry out an analysis based on the scientific approach.

BACKGROUND SCENARIO

- The strategic importance of science and technology is evident and generally accepted for sustaining the growth of future socio-economic systems.
- Government interventions have resulted in large amounts of money being invested at national and international level (e.g. European Union Framework Programme).
- During the 1970s, most of these efforts were dedicated and oriented towards R&D. In subsequent years, the focus has shifted towards innovation development and technology transfer.
- Governments have identified various measures and compared them across countries quite satisfactorily. However, the quantification of results remains a difficult task.

Globalisation is influencing and sometimes imposing new rules in socio-economic spheres worldwide, especially in advanced countries. This means that the objectives and rules guiding developments in science and technology, especially innovation-based technologies, are strongly conditioned by globalisation. This process highlights the importance of national competitiveness in science and technology for success in global markets. At the same time, there is a strong influence on the labour market in those strategic activities that depend on the application of R&D results. Thus at the international level, the scope for acting and *working* in science and innovation is more and more conditioned by the possibility of applying the R&D results to product development and commercialisation in the global market.

Objectives of government policy and results

The main objectives of government policies for sustaining research and innovation have been the improvement of technical, industrial and economical aspects, including employment. This was generally true at the time when economies were operating in well-defined territories, mainly within national borders, and when international co-operation in technology was strongly conditioned by the prominence of manufacturing in the country importing knowledge. This is generally no longer the case mainly because of globalisation. Increasingly products are manufactured where the ratio between cost and performance is at a minimum and where there is also a strong knowledge-based infrastructure.

This is particularly true in high technology, especially in scientific fields, where the gap for “followers”, not only third countries, but even “second countries”, is increasingly widening. Moreover, insofar as science and technology are first level activities (i.e. fields where either “one is first or nothing”), it is clear that the relevance of what, how and where science and technology is carried out is conditioning the labour market in high technology. The complex and often unfavourable situation of the labour market in OECD countries has raised greater attention to the outcomes of the relations between technology innovation and the creation of new business and jobs.

For reasons mentioned above, a tentative analysis of the present situation and even more of future trends is not easy and surely depends on complex phenomena such as globalisation, technological culture and attitudes, and industrial strengths and economical cycles (conjunctural versus structural).

GOVERNMENT POLICY OBJECTIVES AND RESULTS

The main objectives of government policies for sustaining research and innovation have been concentrated on improving technical, industrial and economical aspects while less attention was specifically paid to improving jobs and employment creation.

The weak labour market situation in OECD countries has resulted in a major focus on the outcomes of the relationships between technology innovation and the creation of new business and jobs.

A tentative analysis of the present situation is complex and is conditioned by phenomena such as the impact of globalisation, technological cultures and industrial capabilities and economic trends.

At the same time, some observations as to the future trends in the labour market for science and technology personnel can be made. First, globalisation has a strong impact on innovation technology development and transfer thus exerting consequences for the labour market. This means that investments in science and technology are obliged to follow rules and evaluation criteria that are strongly based not only on the scientific and technological achievements, but also on the applications aimed at the creation of new products and/or processes. In this way, most of the criteria for successful results are governed by the rules of competition and therefore the "winning" technologies (and quite often the winning societies and countries) will impose themselves in science and technology. The weaker countries however, will pay for their dependence with a reduction of their R&D activities and with negative constraints on the labour market.

Moreover, this phenomenon is spreading to most high-tech activities, i.e. to the major part of high value or high return products. This worsens the labour market in general and provokes a negative spiral between the lowering of high-technologies activities, diminishing the quantity and quality of high-tech employers. The rapid pace of innovation is generating more and more power (cultural and economical) in the first, advanced countries. However, it is causing problems, even of a reduction in jobs in the countries which cannot meet the challenge and, in some way, are suffering due to the innovation technology developments in the most advanced countries. These laggard countries are obliged to pay for the know-how to be active, in some way, in the global market.

This problem is particularly notable in some other advanced countries (e.g. Italy) which were among the first countries to produce highly specialised, high-tech products (e.g. refined mechanics, etc.). As globalisation imposed the rule of being the first or otherwise becoming a secondary actor, these countries, for various reasons (economic situation, limited culture of risk taking and contained size of the industrial structures), were suffering the constraints of the new situation.

Moreover, another aspect of the globalisation process was that the integration and merger of industries has directed strategic activities towards the greatest industries and towards centres of excellence on the global scale. This gave more and more power and consistency to the leading countries, especially the United States, but also to certain centres of excellence in niche markets in other countries. Most of Italy's centres of excellence were quite active and efficient, although few attained the level of success achieved in other European countries (e.g. the Mobile Telephones in Finland, advanced Microsystems Technology in Sweden and Norway, high-tech Sw and Hd microelectronics in Ireland etc.).

GENERAL CONSIDERATIONS

Globalisation phenomena are impacting over human life aspects and are strongly influencing innovation technology development and transfer.

Innovation technology (and even "innovation *per se*") is a key factor for socio-economic growth and therefore greatly influences employment creation and maintenance.

Innovation technology is strongly affecting the economy but needs high investments in human and capital resources.

High-tech countries are becoming richer, acquiring capital investments for sustaining high-tech developments in a positive spiral.

Excellence in science and technology is only possible at the highest global level.

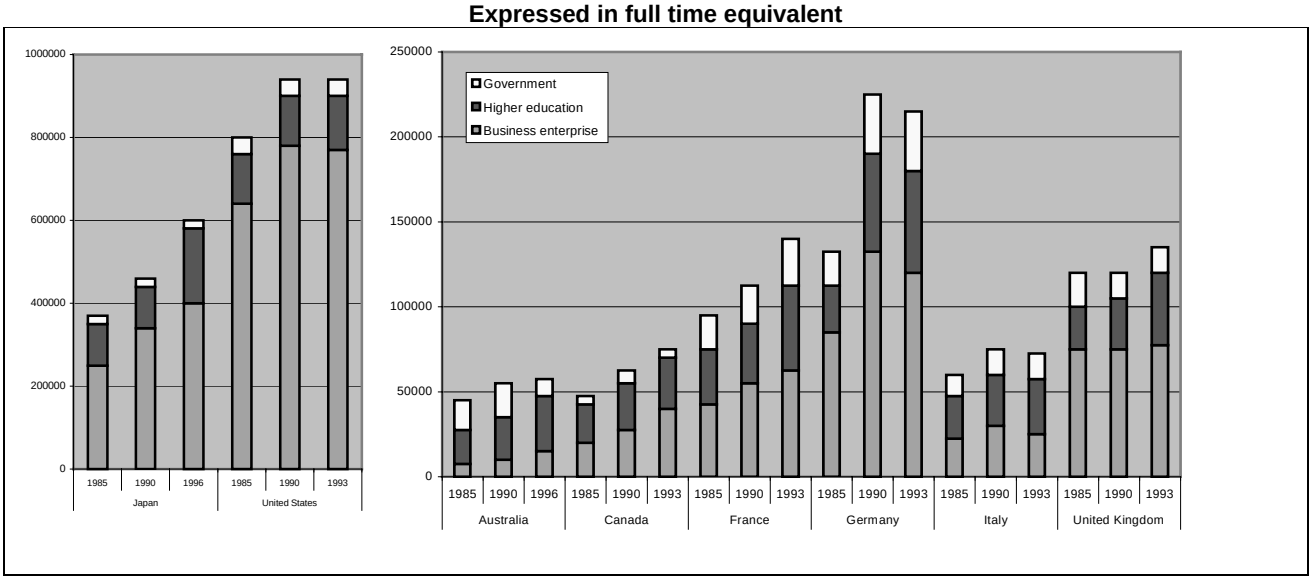
Secondary roles for economies cannot be sustained in the long run. In the future, economies will be obliged to unite as powerful entities.

The Italian situation

Due to reasons mentioned above, mainly weak investments in R&D in recent years (R&D investments in Italy are lower than in most advanced countries), but also due to stricter fiscal policies in light of EU engagements, the Italian situation is characterised by weak job creation in the higher technology sector where Italy, despite its size, had assumed a leading international role.

This is evident in some key strategic sectors such as microelectronics and biotechnology, sectors where the presence of large high-tech industry is needed for sustaining a high level of investment. In recent years a restructuring process has been carried out. Among other developments in recent years, the movement of a growing share of young researchers to the advanced professional training sector has become clear. This movement has been directed mainly towards the high-level research activities sponsored by grants for Research Doctorates and which have partially compensated the reductions in the large company R&D Centres. On the other hand this phenomenon is clearly emerging in all high-technology countries that have recently shown, due to reasons cited above, a large shift of their intellectual resources from the R&D sector towards higher education. The most evident examples are Germany, the United Kingdom and most recently, Japan (Figure 1).

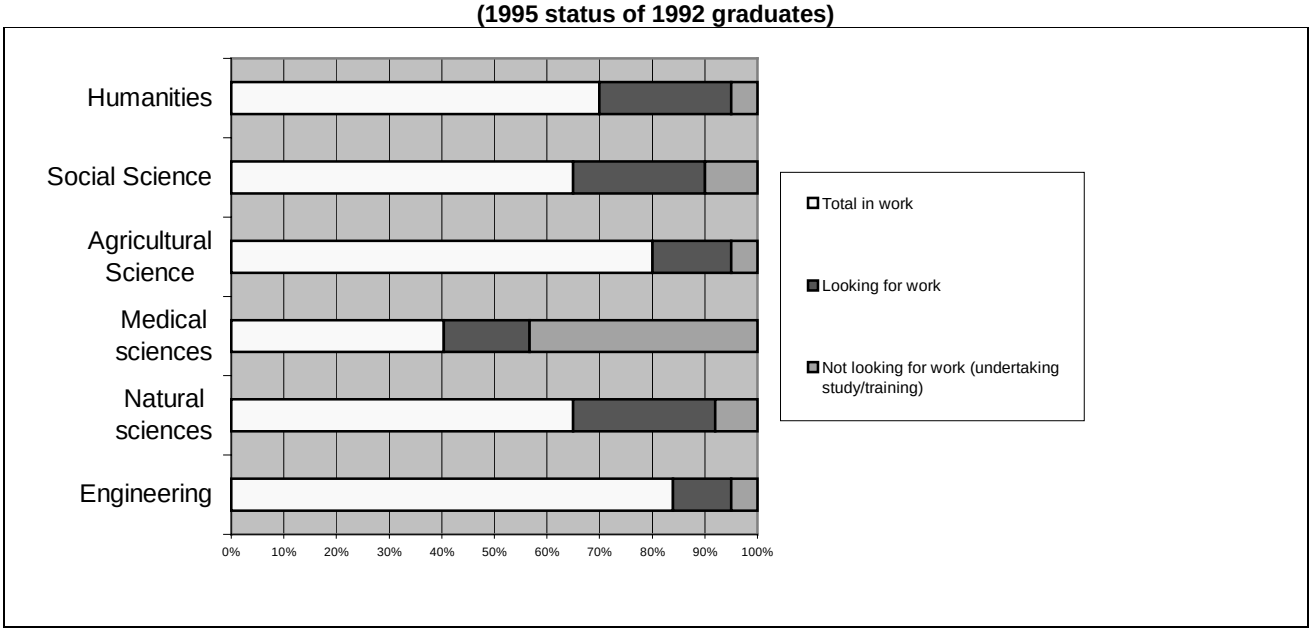
Figure 1.
Number of researchers by sector of employment, 1985, 1990, 1996
Expressed in full time equivalent



Source: OECD.

This trend has been aggravated by the absence of a positive attitude of flexibility and mobility for employment in highly specialised activities. This greatly influences the chances of getting experience and access to highly specialised training which is needed for high technology. So the employment possibilities for young researchers worsen at a time when the market already shows signs of "industrial" crisis, even in the high-tech sectors (Figure 2).

Figure 2.
Labour market status of first degree (Laurea S&T graduates in Italy
(1995 status of 1992 graduates)



Source: OECD calculations based on data from ISTAT – Italy (G. Sirilli).

The increase in specialisation is narrowing the field of technological application. The high rate of innovation is increasing the "use of the right specialisation at the right time " and decreasing the value of flexibility.

The narrowing of technical specialisation results in a more rigid and selective form of job creation. Although higher salaries usually compensate this, such a narrowing of specialisation reduces the "cultural flexibility" of the highly specialised personnel.

Recent policy actions

At the national level, the strong acknowledgement of the importance of R&D in high technology for socio-economic development has resulted in important legislative action to sustain social and cultural growth in the high technology sector. Several new laws (Laws No 196. and No 449, in addition to the law on financing and sustaining applied research – mainly Law No 46 and No 488) illustrate the government's commitment to this important sector, even if the current economic situation, and the ongoing changes in the world economy, will influence the future outcome of these efforts.

Statistical data on R&D investments show a small decrease, but recent policy actions aim to address this, such as:

Law 196: Contribution of Euros 15 000 per year (2 years maximum) for supporting the employment of professionals with a Laurea degree in R&D activities by SMEs.

Law 449: The same objective as Law 196 but with a tax credit of Euros 7 500 per each new researcher hired up to a total of Euros 30 000 for each SME. This law also encourages the mobility of researchers between universities, public research institutes and SMEs.

The industrial crisis in some large high-tech companies (e.g. those operating in military, pharmaceutical and even telecommunications sectors) has had a negative impact on high-tech job creation, or has at least lowered expectations.

Many of these actions are the result of evaluations by economic policy based on scientific information and knowledge. The gap between science and technology (even if these two themes have, of course, very close cultural roots) often causes confusion and it is important to stress the fact that job creation is more strongly related to innovation technology than it is to science. Therefore, strategic policies focusing on innovation to create a number of relevant jobs for young people should be strictly related to new product innovations. Besides drawing on macro-economic analysis and scientific forecasting by universities and research centres, the development of these policies should consider the innovation culture in the high-tech companies where these innovative products are developed.

The “continuous selling” of “new methods of managing innovation” is creating new jobs, but the “continuous change in technical culture” and moreover in “working methodology” is pushing a lot of high-tech personnel aside, often outside the line of productive work.

These positive and negative aspects are almost balanced on a global scale, but there is a clear trend of positive balancing in the most advanced countries that are creating and managing innovative technologies. However, there is a negative balance in those countries that are not leaders in the high-tech sectors.

In conclusion, these trends have lead to a greater commitment by the more advanced countries’ governments (of which Italy is one) to the issue of job creation in the high-tech and R&D intensive sectors. At the same time, since this sector is operating at a global level, its rapid development is vital for its success. Yet, competition is so intense and global that it not only minimises the potential of “third” catch-up countries, but also the role of "second” following countries. This is illustrated by the recent results that show employment opportunities in the high tech and R&D intensive sectors to be below the expectations, or, aspirations of young people.