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THE IMPACT OF FOREIGN DIRECT INVESTMENT AND TECHNICAL CHANGE ON REGIONAL GROWTH

Abstract:

Research and Development (R&D) and technical change are both directly related to industrial infrastructure conditions, modernization process, productivity levels, regional and socio-economic growth. Technological change caused by Foreign Direct Investments (FDIs) usually widens the socio-economic gap and divergence between different regions (concentration effect), whereas technological imitation, transfer and diffusion tend to enhance regional convergence and cohesion (diffusion effect). This paper attempts to investigate the relation between FDIs, technical change and regional growth. Additionally, it aims to estimate the impact of technical change generated by FDIs on regional growth, and uses the theory and empirical evidence in an investigation of the implications of FDIs, and research activities at the regional and economic growth.

Key Words: Technical Change, Foreign Direct Investment, Innovation, Diffusion, modernisation, competitiveness, economic and regional growth.

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1. Introduction

Foreign direct investment (FDI) inflows and outflows to and from OECD countries showed continuing rapid growth last year. Inward investment into OECD countries grew by 35% and reached US dollars (USD) 684 billion, while outflows showed an increase of 22% and amounted to USD 768 billion. Some OECD experienced an unprecedented level of inflows (*e.g.* Japan, Sweden and Germany) and others recorded historically high outflows (*e.g.* Denmark, France and Ireland).

The increase in greenfield investment was significant in 1999, but it was by far exceeded by the growth in mergers and acquisitions (M&A). As in previous years, M&A was the primary vehicle behind the increase in FDI. Last year, Western Europe was the world's leading region for cross-border M&A. The 1990s brought considerable improvements in the investment climate, influenced in part by the recognition of the benefits of FDI.

The change in attitudes, in turn, led to a removal of direct obstacles to FDI and to an increase in the use of FDI incentives. Continued removal of domestic impediments through deregulation and privatisation was also widespread. Deregulation and enhanced competition policy made M&A more viable in the telecommunications, electricity, other public utilities and financial services sectors, while privatisation programmes provided opportunities for international investment. The sale of state-owned companies to foreign investors represented a large share of the source of FDI, particularly among new members to the OECD and in some emerging economies.

Foreign direct investment contributed substantially to the transfer of new technologies and consequently to the modernisation and reorientation of the structure of the economies. The main bulk of technology transfer took place either through foreign direct investments (FDIs) (mainly through multinationals MNEs) or through *technological agreements* (for instance, licensing and joint ventures). *Mergers and acquisitions* have played a major role in this direction. Acquisitions have been used by foreign and domestic firms as a tool for strengthening their position in domestic or international markets.

This paper questions the proclaimed crisis and the industry it has spawned, and assesses the implications for policy. To do this, it examines critically the claims of regional disadvantage and examines the factors that influence regional economic and social conditions. This article's section deals with the FDIs trends, and moreover with Research activities. In the following sections, FDI trends and Research Activities are analysed and used to illustrate the role of regional growth.

In particular, this paper focuses on regional development, one of the critical policy issues which emerged during the 1990s for reasons of social and national development. The term regional development is somewhat amorphous. Its definition varies according to context, although a common thread concerns some kind of economic and social improvement. Such improvement can take the form of more and better quality infrastructure, improved community services, a greater and more diverse volume of production, lower unemployment, growing numbers of jobs, rising average wealth, improved quality of life, and so on. These dimensions are, of course, interconnected in some degree, though not invariably so. Regional development is a difficult policy arena in which all tiers of government have had limited success.

2. Main concepts and definitions: a review on main issues and indicators of Innovation, Research Activities and Foreign Direct Investment

Efforts in the areas of FDIs and Research Activities have been associated in the economic literature with higher growth rates, increases in exports and trade, gains in productivity, growth in income and output, bigger business profits and lower inflation, international competitiveness. In this section will present and analyze the terminology, classification and the main concepts of Foreign Direct Investment, Research Activities and Innovation.

Innovation is about taking risks and managing changes. It is about economics over and above research, science and technology. Some have defined it as «profitable change», others as economic exploitation of new ideas. A more business-related definition could be:

«Innovation means harnessing creativity to invent new or improved products, equipment or services which are successful on the market and thus add value to businesses» (Guy de Vaucleroy , European Business Summit, Brussels June 2000).

In short, as Professor Joseph Schumpeter said:

«Innovation is at the root of the evolution of the economic system and its main engine for change and “creative destruction”».

There are many aspects of technology transfer to be studied, (such as through the direct investment, multinational corporations, joint-ventures and the licensing agreements). This section investigates the transfer of technological inputs in Greece (through FDIs, MNEs and licensing agreements). Technology transfer has been variously defined. According to the definition provided by UNCTAD, it can be considered as:

«Technology as the essential input to production which can embodied either in capital and in intermediate goods or in the human labour and in manpower or finally in information which is provided through markets», (United Nations).

We can also distinguish between *technology transfer* and *technology capacity* (that is the flow of *knowledge* as against the *stock of knowledge*), and also the *technology of innovation* (which indicates the type of technology that gives to the recipients country's the capacity to establish a new infrastructure or to upgrade obsolete technologies).

Direct investment is a category in which an international investment made by a resident entity in one economy (direct investor) with the objective of establishing a lasting interest in an enterprise (or otherwise the direct investment enterprise) resident in another economy is classified. *Direct investment* involves both the initial transaction between the two entities and all subsequent capital transactions between them and among affiliated enterprises, both incorporated and unincorporated.

OECD recommends that direct investment flows be defined as:

«A foreign direct investor may be an individual, an incorporated or unincorporated public or private enterprise, a government, a group of related individuals, or a group of related incorporated and/or unincorporated enterprises which has a direct investment enterprise – that is, a subsidiary, associate or branch – operating in a country other than the country or countries of residence of the foreign direct investor or investors».

Moreover, following the IMF definition, we can say that:

«Direct investment refers to investment that is made to acquire a stake in an enterprise operating in an economy other than that of the investor, the investor's purpose being to have an effective voice in the management of the enterprise. The foreign entity or group of associate entities that makes the investment is termed the direct investor. The unincorporated or incorporated enterprise (a branch or subsidiary, respectively) in which a direct investment is made is referred to as a direct investment enterprise».

According to the OECD definition:

«A foreign direct investor is an individual an incorporated or unincorporated public or private enterprise, a government, a group of related individuals, or a group of related incorporated and/or unincorporated enterprises which has a direct investment enterprise (that is a subsidiary, associated enterprise or branch operating in a country other than the country(ies) of residence of the direct investors)».

Also, *Direct Investment Enterprises* defined as:

«Incorporated or unincorporated enterprises in which a single foreign investor either controls ten per-cent or more of the ordinary shares or voting power of an incorporated enterprise (or the equivalent of an unincorporated enterprise) or has an effective voice in the management of the enterprise».

Finally, the OECD definition states that:

«Direct investment flows are defined to include for subsidiary and associated companies: the direct investor's share of the company's reinvested earnings plus the direct investor's net purchases of the company's share and loans plus the net increase in trade and other short-term credits given by the direct investor to the company. For branches this includes the increase in unremitted profits plus the net increase in funds received from the direct investor. Finally, loans on short-term balances from fellow subsidiaries and branches to foreign direct investment enterprises, loans by subsidiaries to their direct investors and loans guaranteed by direct investors and defaulted as well as the value of goods leased by direct investors should be included in direct investment, with an exception only for the bank, deposits, bills and short term loans which should be excluded from direct investments».

A direct investment enterprise may be defined as an incorporated or unincorporated enterprise in which a foreign investor owns 10 per cent or more of the ordinary shares or voting power of an incorporated enterprise or the equivalent of an unincorporated enterprise. The numerical guideline of ownership of 10 per cent of ordinary shares or voting stock determines the existence of a direct investment relationship. Some countries may consider that the existence of elements of a direct investment relationship may be indicated by a combination of factors such as:

- (a). representation on the board of directors;
- (b). participation in policy-making processes;
- (c). material inter-company transactions;
- (d). interchange of managerial personnel;
- (e). provision of technical information;

- (f). provision of long-term loans at lower than existing market rates.

The concept of Scientific and Technological Activities has been developed by OECD and UNESCO and EUROSTAT. According to “International Standardization of Statistics on Science and Technology”, we can consider as scientific and technological activities as:

«The systematic activities which are closely concerned with the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of scientific and technology. These include activities on R&D, scientific and technical education and training and scientific and technological services».

Furthermore, we can distinguish the Research and Development (R&D) activities from Scientific and Technical Education and Training and also from Scientific and Technological Services.

«Scientific and Technical Education and Training activities comprising specialised non-university higher education and training, higher education and training leading to a university degree, post-graduate and further training, and organised lifelong training for scientists and engineers».

while Scientific and Technological Services consider as the following main categories:

«Scientific and Technological Services comprise scientific and technological activities of libraries, museums, data collection on socio-economic phenomena, testing, standardization and quality control and patent and license activities by public bodies».

There is a huge literature studying the effects of innovation activities, however, only a small part of these studying the effects to a regional level. One of the major problems for the measurement of innovation activities is the availability of disaggregate data and the lack of information in a regional level (in particular, for the less advanced technological countries).

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The major sources of these data are coming OECD, United Nations and European Union and local authorities. Since 1965, the statistics divisions of OECD and UNESCO have organised the systematic collection, publication and standardization of research and technological data. We can collect and present data both for Business, Government and Private non-profit sectors. Business Sector including all firms, private and non-private institutions, organisations whose primary activity is the production of goods and services for sale to the general public at price intended to cover at least the

cost of production; public enterprises are also included in the Business Enterprise sector. Government sector includes all departments, offices and other bodies which normally do not sell to the community those services which cannot otherwise be conveniently and economically provided. Private non-profit sector includes private or semi-public organisations and also individuals and households, however be excluded all enterprises which serve government or those which financed and controlled by government and those offering higher education services or controlled by institutes of higher education. Higher education is comprise of all universities, colleges of technology and other institutes of post-secondary education. Finally, data from abroad includes all institutions and individuals located outside the political frontiers of a country, and all international organisations (except business enterprise) including facilities and operations within the frontiers of a country.

Apart from the OECD and the U.N. research departments, there is another committee (the *Scientific and Technical Research Committee*) which deals with research and innovation statistics. The research and scientific indicators not only provide a view of the innovation and research structure of a given country, but also indicate its *technological strength and capacity* relative to others.

The various research and technological indicators attempt to explain *technological relationships* at a specific point of time or for a whole period. The aim is to measure the nature, the capacity and the efficiency of scientific and technological activities both at a national level and at a sectoral level. Technological indicators related to *output measures* are more meaningful than those related to *input measures* (such as the number of scientists and engineers which are involved in research activities or the number of research institutions), since the later say little about the achieved research.

The use of research and technological data implied a lot of problems with the collection and measurement. The problems of data quality and comparability are characteristic for the whole range of data on dynamic socio-economic activities. However, most of the research and technological indicators capture technological investment in small industries and in small firms only imperfectly. Usually only, the manufacturing firms with more than 10,000 employees have established some research and technological laboratories, while industrial units with less than 1,000 employees usually do not have any particular research activities. Finally, the research and technological statistics concentrate mostly on the manufacturing sectors, while usually neglecting some service activities.

3. Recent trends in OECD countries

This section reviews the trends in FDI in the 1990s in some of the major host countries among the emerging economies.

The increase in FDI in the OECD area continued in 1999, both in absolute value and as a percentage of GDP. This took FDI activity to a remarkable peak, following almost a decade of continued growth. In 1999, the increase of FDI inflows in Japan, Sweden and Germany were particularly notable. Compared with the previous year, they almost quadrupled in Japan, more than tripled in Sweden and more than doubled in Germany. Spectacular growth rates were also recorded in OECD outflows, with the outgoing FDI of Denmark, France, Ireland, New Zealand and Norway more than doubling compared with 1998.

The United States and United Kingdom witnessed record high FDI flows in 1999. These countries were the most prominent home and host countries, accounting for more than half of total OECD inflows and more than 45% of outflows. Investment

inflows to the United States grew by almost 50% and by 28% to the United Kingdom. Outflows from these countries increased by 15% and 67% respectively.

Table 1 illustrates the main figures of FDI for the period 1982-1999. Developed countries attracted \$ 636 billion in FDI flows in 1999, nearly three quarters of the world's total. The United States and the United Kingdom were the leaders as both investor and recipients with \$ 199 billion, the United Kingdom became the largest outward investor in 1999.

Table 1: Selected Indicators of FDI, 1982-1999, (billions of dollars and percentages).

	1982	1990	1992	1986-1990	1991-1995	1996-1999	1995	1999
FDI inflows	55	209	565	24.0	28.0	31.9	43.5	27.3
FDI outflows	37	245	600	27.6	15.7	27.0	45.6	16.4
FDI inward stock	594	1761	4772	15.2	9.4	16.2	20.1	15.5
FDI outward stock	567	1716	4759	20.5	10.7	14.5	17.6	17.1

Source: UNCTAD, World Investment Report, 2000.

The driving force behind this trend was transatlantic M&A. Compared with last year, the United States strengthened its net capital importing position, while the United Kingdom's balance shows increasingly high net outflows. Inflows into the United States came mainly from Europe. The most important investors were the United Kingdom, Germany and the Netherlands. In 1999, as in the previous year, the United Kingdom's share represented more than one third of total investments in the United States. As far as the sectoral distribution of investments is concerned, the manufacturing sector (especially the machinery industry) and telecommunications were the most prominent absorbers of investments, while the traditionally higher share of the petroleum industry declined over the year.

On the outflow side, Europe is still the most important recipient of US FDI. However, between 1998 and 1999, its share decreased from 61% to 53%. Canada's, Latin America's and especially Asia's shares of outflows increased, with each representing around 15% of total FDI outflows.

Asia

Asia has been attracting the lion's share of international investment in developing countries for some time. Inward investment into Asia in the 1990s experienced healthy, uninterrupted growth prior to the financial crisis. It recorded a decline in 1998 as the impact of the crisis took effect. Consequently, its share in the global investment flow declined and became almost on a par with that of Latin America. The Asian financial crisis in the late 1990s had varying impacts in countries of the region, depending on the nature of investment and local economic conditions. Investment in Asia in the 1990s was characterised by the rising prominence of China both as an FDI recipient and investor, and by the growth of intra-regional FDI. China emerged as a popular destination of FDI in the early 1990s, and became the second largest FDI recipient in the world after the United States by 1993. Other main destinations of international investment within Asia in the 1990s are Singapore, Malaysia, Thailand, Indonesia, Hong Kong (China), Chinese Taipei and Philippines. These eight countries together account for over 80% of investment into non-OECD Asian countries.

By 1997, the level of inward investment in newly industrialising economies [NIEs – Chinese Taipei, Singapore and Hong Kong (China)] had almost doubled compared with the beginning of the decade. Flows into Hong Kong (China) and Singapore have not been stable, while Chinese Taipei attracted a steady flow until the

crisis. The volume of FDI in Chinese Taipei and Hong Kong (China) declined considerably in 1998, due to the slowdown of the regional economies. OECD investment into Hong Kong (China) turned negative, minus USD 1.1 billion in 1998, from USD 4.3 billion in 1997. Although it is suggested that China surpassed the United States and Japan to become the largest investor in Hong Kong (China) since the early 1990s, the decline of OECD investment provides a substantial explanation for the shrinking investment.

Since the latter part of 1980s, inward investment in ASEAN has grown at an impressive rate. The growth was largely led by Japanese investment, triggered by the appreciation of the yen, which pushed Japanese manufacturers out of the home country. The share of Japanese manufacturing investment in ASEAN4 (Malaysia, Indonesia, Philippines, and Thailand) grew from 8% in 1987 to 18% in 1992. Although it has not regained its peak, it has maintained a 16-17% share to date. Malaysia began to support export-oriented investments at an early stage.

Since the late 1980s, Malaysia recorded a phenomenal growth of inward investment. After its peak in 1992, investment was maintained at the high level until the financial crisis, whereafter it dropped substantially. Indonesia owes its success in attracting investment principally to the oil and gas sector. The country recorded uninterrupted growth until 1997, but was hit hardest by the crisis. Thailand, successful in attracting both market-seeking and export-oriented investors during the 1990s, increased its FDI inflow by 47% in 1998. The conversion of the Philippines to investment promotion is more recent, since the mid-1990s. The country demonstrated its advantage as an export platform and increased export-oriented investment in the aftermath of the financial crisis.

The origin of inward investment differs considerably among the countries. The majority of inward investment in Singapore originates in OECD countries. The presence of European investment is also strong in Indonesia, while in the Philippines and Thailand the share of investors is evenly divided among the United States, Japan, Europe and NIEs. The increasing prominence of NIEs investment in Malaysia is notable. It is worth noting the growth of intra-regional FDI in the 1990s, particularly from NIEs in the neighbouring countries. The role of Singapore may serve as an illustration. Today, a quarter of FDI in Malaysia comes from Singapore, which makes the country the largest investor in Malaysia. The share of Singaporean investment in Thailand, 12%, is also high. Chinese Taipei is also gaining importance in the region as an investor. The country was the second largest investor in Vietnam in 1997, which accounted for 17% of the total investment into Vietnam, although Singapore surpassed it in the following year. Chinese Taipei began to venture outside of the region in the 1990s. While 44% of investment went to

ASEAN

Asean countries in the early 1990s its share has been shifting rapidly towards Latin America since the latter part of the 1990s. Perhaps the biggest beneficiaries of the growth of intra-regional FDI are less developed ASEAN members. In most of these countries, other ASEAN countries play a vital role as investors. Hong Kong (China) has been the biggest investor into China since the inauguration of China's open policy in 1979, consistently accounting for roughly 60% of foreign investment. Contrary to its dynamism in China, Hong Kong (China) is much less active in other Asian countries. At the same time China has emerged as the biggest investor in Hong Kong (China) in the 1990s. In fact, China's outward investment expansion is another noteworthy phenomenon of the 1990s. Chinese investors – mostly state-owned

enterprises – have demonstrated diversified interests: there is high concentration of investment in the trade and services sector in Hong Kong (China), whereas the availability of raw materials is seen as the main motive for their investments in Australia and Canada. Chinese investment in the United States is also active, in search of proprietary technology. Market-seeking investment from China can be found in a great variety of locations around the world.

Latin America

Most of the countries in Latin America have undergone drastic policy reformulation in the 1990s. Macroeconomic stabilisation, trade liberalisation, privatisation programmes, deregulation of policies regarding private investment, and regional integration all contributed to creating a favourable climate for foreign investments. As a result, the level of FDI inflows into the region has increased eightfold compared with the end of the 1980s⁶. The healthy growth of FDI in the region throughout the 1990s demonstrates that the confidence of foreign investors has recovered after going through the difficult decade of the post debt-crisis. In fact, the share of the region in global inward investment has at last recovered to the level prior to the debt crisis. The growth of FDI is largely influenced by privatisation programmes throughout the region.

The four largest economies of Latin America – Mexico, Argentina, Brazil and Chile – have been constantly receiving over 70% of the total inward FDI in Latin America since the 1970s. This trend remained unchanged in the 1990s. It should, however, be kept in mind that the amount of FDI attracted by some of the smaller countries in the region are quite significant when measured against the size of their economies. Although the region as a whole demonstrates a steady growth in FDI flows in the 1990s, the country breakdown shows a rather different picture. Annual investment flows in individual countries depend largely on the completion of large-scale investment projects – be they privatisation, acquisition or a greenfield investment. As a result, most countries' FDI flow in the 1990s has shown large year-to-year fluctuations.

The change in the nature of FDI is even more striking. For example, the role of debt-equity swaps in attracting FDI has diminished. In the 1980s, the level of FDI flows to some countries, especially larger recipients were mainly sustained by such swaps. Argentina, Chile and Mexico owed their growth in FDI in the former half of the 1990s largely to their privatisation programmes. In the latter part of the 1990s Brazil has emerged as the largest FDI recipient in the region as a result of the sell-off of publicly owned entities. Over one-third of investment in the telecommunications and electricity industries – the two high profile industries that also in other countries usually attract foreign investors – was generated by privatisation.

The change in investment climate has also affected the sectoral distribution of FDI in the region. Prior to the wave of liberalisation, the majority of investment targeted the manufacturing sector and aimed at penetrating highly protected domestic markets. In the 1990s, however, privatisation and the opening up of industry previously closed to foreign investment induced a much higher growth of investment in the services sector, which is usually market oriented investment. While the United States is by far the largest investor in the region,

Spain has become very active since the mid-1990s, especially in Mercosur, Chile and the Andean countries. Latin America's share of Spain's total FDI soared from 29% to 72% between 1990-1998. A very large proportion of those FDI flows went to the services industry, through privatisation or M&A that became possible

thanks to deregulation. Since 1996, Spain has overtaken the United Kingdom as main European investor. Led by MNEs in the more mature economies in the region, outward investment in Latin America increased in the 1990s. The process of liberalisation, privatisation and deregulation forced some local MNEs into increased domestic competition, which made corporate restructuring inevitable.

There are signs that countries in the region may be able to sustain the level of FDI inflows once privatisation is completed. Experiences elsewhere indicate that as the privatisation process comes to an end, infusions of capital continue to occur in order to upgrade existing facilities that have been privatised. Mexico and some Caribbean countries have begun to attract a type of investment that is not related to privatisation but aimed at increasing the efficiency of MNEs' international production facilities. This type of investment is particularly concentrated in the automotive, computers, electronics and apparel industries.

Central and Eastern Europe and CIS economies

The history of FDI is relatively short for the formerly planned-economies, which opened up to capital inflows only at the end of the eighties and beginning of the nineties. Absolute values of FDI inflows have been growing during the last decade. However, compared with its contribution to world GDP or world imports, the region's share in total world FDI stock is still relatively low. FDI performance can be differentiated by two groups of countries. The first group consists of countries aiming at EU accession. This group contains 10 countries⁷, which have concluded association agreements with the EU and are currently negotiating accession. These countries, on average, performed better in the nineties than other countries in the region. The second group of countries attracted less FDI and includes countries belonging to the former Soviet Union (other than the Baltic republics) and the war-ridden economies of the Balkans. In the first group of countries, according to balance of payments data from 1989 to 1999, Poland, Hungary and the Czech Republic attracted the largest FDI inflows, with the stocks of capital invested approaching or exceeding USD 20 billion in 1999.

As for FDI flows per capita, Estonia, Latvia and Slovenia can be added to the best performers with a more than USD 1500 per capita inflow. Countries in the second group had negligible inflows of FDI, with the notable exceptions of Russia, Kazakhstan and Azerbaijan. On the one hand, the growth of FDI in these countries is determined by their progress in transition and macroeconomic stabilisation. Countries begin to receive significant inflows of FDI after their economies are more or less stabilised. Thus, in most of the countries in the first group, inflows increased to a significant level only in the second half of the nineties. Compared with the countries in the first group, distortions in factor markets and macroeconomic instabilities are still prevalent in most of the countries in the second group.

Moreover, market institutions and the legal systems are often not in place or not working properly. These factors continue to act as a draw on FDI inflows in the second group. It must, however, be added that countries with a stable investment environment or with natural resources attracted more investment than would be expected on the basis of their progress in transition, in part because resource-seeking investments are traditionally less sensitive to economic policies and economic prospects of the home country. The reliance on privatisation to attract FDI continues to cause annual fluctuations in the inflows into individual countries – and different methods and timing of privatisation may explain some level differences in FDI inflows. By the end of the nineties, only Hungary had shifted to post-privatisation

FDI, with annual inflows standing at USD 1.5-2 billion without privatisation projects. Other countries in the first group still rely more on privatisation-related FDI inflows, while countries in the second group may be characterised by pre-privatisation FDI. The most important countries investing in the region are the United States and Germany. The majority of these investments are made by large MNEs. Other large investors from Western Europe, like France, the United Kingdom and the Netherlands also have a relatively high share in the overall stock of investment. Some smaller companies have also taken part, notably companies located geographically close to the recipient countries (*e.g.* Germany, Austria, Italy and the Scandinavian countries). Asian investors, on the other hand, such as Japan and Korea are relatively underrepresented – especially when considering their otherwise global presence. They do, however, account for a few large projects, typically of the greenfield type. The sectoral distribution of FDI depends on the privatisation process or on countries' endowments of natural and other production resources. Manufacturing companies are usually the first targets of privatisation, so in the early stages this sector's share is dominant in total FDI. The privatisation of services usually comes second, with the sale of state-owned companies in telecommunications, financial services and in retail trade⁸. Export-oriented investors attracted by the labour force – and, in some cases, by generous incentives – have in some cases undertaken greenfield investment in the vehicles and electronic industries. Table 2 indicates the Flows of Direct Investment for OECD countries, 1996-1999 (million US \$).

Table 2: Direct Investment Flows for OECD countries, 1996-1999 (million US \$).

	Inflows				Outflows			
Australia	1996	1997	1998	1999	1996	1997	1998	1999
Austria	5 171	7 510	6 502	4 441	5 927	6 262	2 466	-3 192
Belgium-Luxemb.	4 429	2 656	4 902	2 952	1 935	1 948	2 948	2 703
Canada	14 061	12 093	22 724	15 868	8 065	7 273	28 453	24 937
Czech Republic	1 428	1 300	2 540	4 877	153	25	175	197
Denmark	7 76	2 801	6 722	7 450	2 518	4 210	3 962	8 207
Finland	1 109	2 116	12 141	3 024	3 596	5 292	18 643	4 194
France	21 942	23 174	28 955	37 416	30 395	35 586	41 913	88 324
Germany	6 577	11 092	21 271	52 403	50 841	40 716	91 183	98 853
Greece	5 888	3 586	3 709	539	----	----	----	573
Hungary	2 275	2 173	2 036	1 944	-3	431	481	249
Iceland	82	149	112	90	62	51	99	70
Ireland	1 888	1 676	3 904	5 422	----	----	8 569	18 326
Italy	3 535	3 698	2 611	5 019	6 465	10 619	12 078	3 038
Japan	228	3 224	3 193	12 378	23 424	25 991	24 159	20 730
Korea	2 325	2 844	5 416	8 798	4 670	4 449	4 799	4 044
Mexico	9 185	12 830	11 311	11 568	----	----	----	----
Netherlands	15 055	14 499	41 977	33 341	31 230	29 247	51 365	45 540
New Zealand	3 697	1 832	2 172	989	-1 260	-1 602	376	1 020
Norway	3 201	3 786	3 882	6 579	5 918	5 047	2 418	5 483
Poland	4 498	4 908	6 365	6 471	53	45	316	123
Portugal	1 368	2 278	2 802	570	776	1 668	2 901	2 679
Spain	6 820	6 387	11 797	9 357	5 590	12 547	18 935	35 421
Sweden	5 076	10 968	19 569	59 102	4 664	12 648	24 376	18 951
Switzerland	3 078	6 642	7 499	3 412	16 150	17 747	16 631	17 910
Turkey	722	805	940	783	110	251	367	645
United Kingdom	26 084	33 245	64 388	82 176	34 125	61 620	119 463	199 275
United States	88 977	109 264	193 375	282 507	92 694	109 955	132 829	152 152
Total OECD	248 882	299 004	509 313	683 744	340 977	414 079	636 480	767 814

Note: Data are converted using the yearly average exchange rates.

Source: OECD /FDI database - Based on national sources.

Despite the relatively short history of the presence of foreign firms, companies with foreign participation already play a critical role in some economies of the first group. In Hungary, Estonia, Latvia and the Czech Republic, these companies' contribution to value added, foreign trade and GDP is exceedingly significant, even by international comparison. However, in some cases, the beneficial impact of companies with foreign participation on the host economy is arguably limited, on account of underdeveloped linkages with local companies.

Prospects of attracting FDI in the future seem to be relatively bright for the countries in the first group. Their aim to become EU members induces them to adapt policy and legal changes to make their economic environment more similar to that found inside the EU. Because of the self-perpetuating nature of FDI their relatively high existing FDI stock in itself attracts more foreign investment. The FDI, in turn, assists the transition process and, indeed, these countries' recovery from the transformation recession has been quicker than for those in the second group. FDI into the second group of countries could increase significantly as they make further progress toward structural reform.

Germany was the target of a record USD 52 billion inflow last year, over twice the level of the previous year. The record was due to a merger in the chemical industry, in the course of which the newly established enterprise located its headquarters abroad and acquired the majority stake in the German company. German investments abroad remained on the record high level of the previous year, and were also led by M&A. The four largest mergers in which German investors participated accounted for more than half of total investments abroad. The most important host countries were the United States and the United Kingdom, accounting for 45% and 23% of German FDI outflows, respectively. As a result, Germany maintained its net investor position in 1999.

The *Netherlands* witnessed a decrease over the previous year's record high capital movements, though inflows and outflows were still high compared with the years before 1998. The country remained an important net outward investor. While still experiencing high inflows, *Spain* became a large investor, mainly due to its increased activity in Latin America. Spanish participation in the privatisation of public utilities and banks in the region was considerable. M&A between companies in the private domain (the most important of which including an Argentinean company) contributed to the high level of flows. As a result, Spain was a net investor for the third consecutive year. In 1999, while remaining a recipient of high gross inflows, *Ireland* doubled its investments abroad compared with 1998. This is related to the increasing importance of the country as a European platform for overseas companies.

Sweden became one of the largest recipients of FDI in the OECD area in 1999. The country absorbed almost the same amount of FDI inflows as in the previous decade put together. The record-high inflows (almost USD 60 billion) were due to an M&A deal in the chemical industry, which accounted for around two-thirds of the value of total inflows. As outflows were actually lower than in 1998, Sweden unusually became a net recipient.

The *Czech Republic* and *Poland* increased the level of FDI inflows due to large privatisation projects. Together with *Hungary*, they are still on the net receiving end of the FDI spectrum, as the companies in each country have been able to invest only negligible amounts abroad.

Greece, *Portugal* and *Turkey* continued to experience low inflows. On the other hand, Portugal has been playing an increasingly active role on the outflow side

in the last few years, effectively becoming a net investor abroad. As a new phenomenon, OECD members in Asia figured prominently as gross recipients of FDI.

Japan received a historical record of inflows last year driven by the acquisition by Renault of an important stake in Nissan, as well as other M&A. Inflow into Japan was almost four times that of 1998, and almost half of the amount of the inflows of the entire decade, with European (especially French and Dutch) investors taking the leading role. However, even the record inflow did not come close to the traditionally high level of outflows, meaning that last year Japan was still a net investor abroad.

Table 3: Cumulative FDI flows in OECD countries, 1990-99 (million US \$).

<u>Inflows</u>		<u>Outflows</u>		<u>Net Outflows (+)</u>	
United States	927 378	United States	876 705	Germany	305 988
United Kingdom	319 726	United Kingdom	566 400	United Kingdom	246 674
France	215 804	Germany	422 455	Japan	222 720
Netherlands	159 523	France	347 839	France	132 035
Sweden	127 633	Netherlands	250 860	Netherlands	91 337
Belgium-Luxem.	123 206	Japan	248 729	Switzerland	84 506
Germany	116 467	Canada	120 113	Italy	33 451
Canada	99 000	Switzerland	119 187	Canada	21 113
Spain	97 780	Belgium-Luxem.	109 350	Finland	17 919
Mexico	81 570	Sweden	102 114	Ireland	9 444
Australia	58 910	Spain	93 236	Korea	4 366
Italy	37 697	Italy	71 148	Norway	1 460
Switzerland	34 680	Finland	40 760	Denmark	782
Denmark	32 176	Denmark	32 958	Iceland	-96
Poland	30 616	Korea	29 018	Austria	-2 929
Greece	26 942	Norway	28 131	Spain	-4 544
Norway	26 670	Ireland	26 895	Turkey	-6 029
Japan	26 008	Australia	26 596	Portugal	-7 038
Korea	24 653	Austria	18 155	Belgium-Luxem.	-13 856
Finland	22 841	Portugal	10 463	Czech Republic	-14 404
Austria	21 084	New Zealand	5 135	New Zealand	-15 620
New Zealand	20 754	Turkey	2 087	Hungary	-18 357
Hungary	19 618	Hungary	1 261	Sweden	-25 519
Portugal	17 501	Czech Republic	828	Greece	-26 369
Ireland	17 451	Poland	639	Poland	-29 977
Czech Republic	15 233	Greece	573	Australia	-32 314
Turkey	8 116	Iceland	380	United States	-50 673
Iceland	476	Mexico	na	Mexico	-81 570
Total OECD	2 709 512	TOTAL OECD	3 552 013	TOTAL OECD	842 501

na: not available.

Source: OECD, International Direct Investment database.

In *Korea*, in response to the financial crisis, regulatory changes favouring FDI continued last year, resulting in a further increase in the inflow of direct investments. After almost doubling the previous year, FDI grew by more than 60% in 1999. Inflows exceeded a generally unchanged level of outflows for the second consecutive year, changing the country's position to that of a net recipient of FDI. The inflows were boosted by an ongoing process of corporate restructuring and privatisation. The growth in direct investment from the EU and Japan was particularly pronounced. The fact that the first three countries listed in Table 3 account for half of the cumulated inflows and outflows indicates the high concentration of OECD FDI in the nineties. Eight of the top ten recipients of FDI are also among the top ten outward investing countries, indicating that the larger OECD countries tend to be active in

both undertaking and receiving FDI. Germany, the United Kingdom and Japan were the largest net investors in the nineties, and the United States is the largest net recipient.

4. The Role of Investment, Saving, Human Capital, and Productivity

It is well established that the accumulation of physical and human capital and advances in production efficiencies and technology lead to higher per capita income. Studies have typically found that approximately 60–70 percent of per capita growth in developing countries reflects increases in physical capital and another 10–20 percent is due to increases in education and human capital with the remaining 10–30 percent attributed to improved (total factor) productivity. Not surprisingly, the low- and middle-income countries with declining or slowly rising per capita income had on average lower investment and saving rates than their faster-growing counterparts in recent years, confirming the importance of capital accumulation in the growth process. Causality is difficult to infer, however, because investment and saving rates were not substantially different, on average, across groups during the early 1970s except for perhaps the fastest-growing economies.

Even in this latter group of countries, investment rates rose only after the growth takeoff. In other words, it is far from obvious that high initial investment and saving rates are preconditions for growth. It may indeed be that higher investment and saving rates result because of higher growth or that other factors cause both growth and investment. Low levels of schooling or investment in human capital may be impediments to growth and also delay takeoff. Secondary school enrollment rates in the 1970s were substantially lower on average in nonrapidly converging, low-income countries than in the middle-income countries.

Moreover, the fastest-growing, low and middle-income countries also experienced larger improvements in enrollments rates than the other developing countries did between 1975 and 1995. Although it is possible that growth induces more education as demand increases with income, it is noteworthy that among the low-income countries enrollment levels in the 1970s were highest (and similar to the levels in the middle-income countries) in the countries that subsequently grew the fastest. Basic education, including training, can contribute directly to a country's potential for growth by raising the skill level of the workforce.

In addition, because physical and human capital are often complementary, education can also raise growth indirectly by inducing greater investment. While increased schooling and training alone may not be sufficient to boost growth, particularly when economic opportunities to use the acquired skills are missing, improving education will be an important part of a sustainable growth and poverty reduction strategy for developing countries. It therefore makes sense for countries to shift resources toward basic education and for the donor community to emphasize education as a high priority.

Another obstacle to a productive workforce (and society) is inadequate health care. As with school enrollment rates, life expectancy rates at birth were substantially lower on average in nonrapidly-converging, low-income countries than in the middle-income countries in the 1970s, and other health indicators show a similar pattern. Even though these health indicators have improved over time in most developing countries, they remain relatively bad in many low-income countries—for example, average life expectancy is still below 55 years for the negative- and slow-growth, low-income countries—representing an enormous loss in potential human capital. In addition, progress in improving life expectancy rates has slowed in some countries

mainly because of the devastating effects of the AIDS epidemic. Figure 1 illustrates the relationship and the effects of FDI and cross-border M&A to global socio-economic environment and at the firm level.

Figure 1: Cross Border FDI and M&A activity

Source: World Bank

Inefficient investment has also been a hindrance for many countries, although, again, causality is difficult to infer. Not surprisingly, in the developing countries with declining per capita growth during the last three decades, the incremental output-capital ratio (the inverse of the incremental capital-output ratio), which is a very rough proxy for the productivity of investment, was lower on average than in the countries that were growing.

Estimates of total factor productivity growth, which are available for only a subset of the countries under review, also confirm that resources were not used as efficiently in many of the negative-growth countries as in other developing countries. Although a difficult task that needs to be addressed through a variety of reforms depending on country-specific circumstances, increasing productivity and allocative efficiency will allow these countries to better use their limited resources. To the extent that this and other resource reallocations can be accomplished relatively quickly, countries could begin to grow without immediate increases in saving and investment.

5. Policy Effects: Implementation, Lessons and Issues for LDCs (Less Development Countries)

Technology transfer through FDI is an important factor on the process of economic development and economic performance. MNEs and FDIs are the main policy tools for the international technology transfer and the development of innovation activities in many countries. Multinationals also produce and control most of the world's advanced technology. About four fifths of the FDIs and the production of advanced technology originates from the Japan, Germany, United Kingdom, United States and Switzerland.

Technology transfer through MNEs and FDIs lead to a geographical diffusion of technology and contribute substantially towards the development of research and innovation activities in the less technologically advanced countries. Most of these countries are lacking the funds and the opportunities to develop their own technologies and they aligned on the policies of technology transfer through MNEs. However, multinationals transfer only the technologies that needed and have been developed abroad from the host laboratories. The ownership and the control of new technologies from MNEs does not automatically implies the improvement and the development of research activities at a national level.

Most of the empirical studies emphasized the profits, the age and the amount of new technologies transferred by MNEs. Usually, the affiliate companies operate in a monopolistic market where the new technologies gives its products a *quality advantage* and a higher market share.

SMEs (Small Medium enterprises) in less favoured regions may need assistance in tapping into the necessary resources (related to knowledge, in the form of technology or qualified human capital in particular), to face up to the new forms of

competition developing in the global economy. Regional innovation policy may help stimulate firms, SMEs in particular, in less favoured regions to adopt improved production methods (e.g. quality and environmentally friendly processes, incorporation of technological developments and innovation management methods, etc), make new/different products and services (e.g. : design, customization, etc), and exploit new economic opportunities and markets (university spin-offs, new technology-based firms, etc). Thus using their regional innovation potential to the full in order to compete in the global economy.

Regional policy has to cope with fresh challenges, globalisation and rapid technological change in particular, in order to provide the economic opportunities and quality jobs needed in less favoured regions.

Today, the innovation-gap is nearly twice as great as the cohesion gap. Many of the causes of disparities among regions can be traced to disparities in productivity and competitiveness. Education, research, technological development and innovation are vital components of regional competitiveness.

The 25 least developed regions in Europe spend, as a percentage of GDP, less than a quarter of the European Union average (0,5% compared to an EC average of 2% - 1995). On a regional level, business expenditure on innovation as a percentage of GDP in the most developed 25 regions is on average 1,9%, while in the 25 least developed regions this figure falls to around 1,1%.

This difference in financial input also has consequences in terms of innovation outputs. For example, there are over 20 times the number of patent application in Germany alone, than in the four cohesion countries together (Ireland, Greece, Portugal and Spain).

The “technology gap” is a particular cause for concern with regard to the human resources for innovation, since human capital is increasingly a source of the dynamic comparative advantage which governs regional potential for innovation. In an increasingly "knowledge-based" economy, the only real capital is human capital. In terms of High Technology employment, in the 25 most advanced regions high technology accounts for an average of 14,6% of total employment, compared to just over 4% on average in the 25 least developed regions. This is compared to a community average of around 10,5%.

Denmark, with a labour force of around 2,5 million has almost twice the number of innovation personnel than Portugal, with a labour force of around 4,5 million. Germany has almost double the number of innovation personnel per thousand labour force than Spain, three times more than Greece and four times more than Portugal.

If international comparison shows substantial disparities in the innovation input indicators, inter-regional differences within member states, are even greater in some cases. In Greece for example, over half the country's innovation expenditure takes place around Athens and over two-thirds of business innovation is located in this same region. In Spain over three-quarters of business innovation is located in three of the seventeen regions (Madrid alone accounting for over 30%).

Moreover, the collection and presentation of R&D data of regional statistics implied a lot of problems in comparison to data of national statistics. For the collection of regional statistics, we should take into the local differences and the difficulties. R&D units can operate in more than one region and we should allocate these activities between regions. Usually, regional statistics focused on the three first levels of NUTS (Nomenclature of Territorial Units for Statistics). The reliability of R&D and innovation regional statistics is directly connected and depending on estimation-method and the

application of statistical technique. Another important question on R&D and innovation regional statistics is the confidentiality and the collection-method of data-set that may be cover the whole or the majority of the local-units. For the statistical methods focused on a regional level, we can use either the "local-units" (i.e. enterprises, office, manufacturing etc.) or the "local-economic-units" (NACE codes, which is a division of national codes of European member states).

Therefore, we can use the first method «top-to-the-bottom method» for the collection of aggregate R&D data (for the whole country) and after that on the distribution of these figures into a regional-level; the disadvantage of this method is that there is not a direct collection of data from the regions. The second method «bottom-to-the-top method» for the collection of disaggregate R&D data (for the whole regions) based on the direct-collection at a regional-level and after that on the summation of these figures in order to obtain the aggregate-total R&D data (for the whole country); the advantage of this method is that there is a consistency in the summary of figures between regional and national level.

We can classify four-groups using four different scientific criteria of UNESCO, so to be able to measure and to evaluate the *technological efficiency and capabilities strength through FDI*. Table 4 illustrates the classification according to scientific and research criteria through FDI. The first criterion refers to the *scientists and engineers engaged in research activities per million inhabitants (full-time equivalents)*. For instance, according to this, we can classify Greece in the third group of the new industrialised countries (those which had established a research and scientific apparatus).

Table 4: Classification of scientific and research capabilities

Groups of S&T countries: capabilities	
Group A:	Most underdeveloped countries (without S&T capabilities)
Group B:	Most developing countries (with some fundamental elements of S&T base)
Group C:	New & semi-industrialized countries (i.e. Greece, Israel Finland, Singapore, New Zealand and so on (with S&T base established)
Group D:	Industrialized countries: (advanced EEC states) with effective S&T base.

Source: UNESCO, "Science & technology in developing countries-strategies- 1990s".

Using the second criterion of research and development personnel in higher education per thousand inhabitants (full-time equivalent), Greece belongs to the second group of the developing countries (the countries which had established some initial elements of innovation activities). The third criterion refers to the *third level students per 100,000 inhabitants*; according to this, Greece belongs to the fourth group of industrialised countries (indicate the countries with an effective scientific and technological apparatus).

According to the fourth measure of the *percentage of manufacturing in GDP and the growth of manufacturing in the value added*, Greece is classifying in the third group of the new industrialised countries (those which had established a scientific apparatus). Finally, using the measure of *scientific and capabilities strength*, Greece belongs to the second group of developing countries (those which have established some initial elements of research and technological apparatus).

Long-term foreign private capital flows have a complementary and catalytic role to play in building domestic supply capacity as they lead to tangible and

intangible benefits, including export growth, technology and skills transfer, employment generation and poverty eradication. Policies to attract FDI are essential components of national development strategies.

The inter-regional innovation-gap is not only of a quantitative nature but also of a qualitative one. There are a number of characteristics of regional innovation systems in less advanced regions which make them less efficient:

- **Firms may not be capable of identifying their innovation needs** or maybe unaware of the existence of a technical solution.
- **There may be poorly developed financial systems** in the area with few funds available for risk or seed capital, which are specifically adapted to the terms and risks of the process of innovation in firms.
- **There may be a lack of technological intermediaries** capable of identifying and 'federating' local business demand for innovation (and RTD&I) and channelling it towards sources of innovation (and RTD&I) which may be able to respond to these demands.
- **Co-operation between the public and private sectors may be weak**, and the area may lack an entrepreneurial culture which is open to inter-firm co-operation, leading to an absence of economies of scale and business critical mass which may make certain local innovation efforts profitable.
- **Traditional industries and small family firms may dominate** which have little inclination towards innovation. There may be a low level of participation in international RTD&I networks and a low incidence of large, multinational firms.

Given all the above, we believe that regional policy should increasingly concentrate its efforts on the promotion of innovation to prepare regions for the new economy and close the 'technology gap' if it is to be successful in creating the conditions for a sustained (and sustainable) economic development process in less favoured regions. Now, before we turn to what has been our policy response over the last decade and what our ideas about the future are, let me briefly pick up the second question.

Regional policy should evolve from supporting physical innovation infrastructure and equipment towards encouraging co-operation and a collective learning process among local actors in the field of innovation. A policy which facilitates the creation of rich, dynamic regional innovation systems and which assists in the exchange of skills and expertise which small and medium sized firms may not have available in-house.

In this context, a stable economic, legal and institutional framework is crucial in order to attract foreign investment and to promote sustainable development through investment. In this regard a conducive international financial environment is also crucial. Promoting a conducive macro-economic environment, good governance and democracy, as well as strengthening structural aspects of the economy and improved institutional and human capacities, are important also in the context of attracting FDI and other private external flows.

Development partners would need to provide a range of support measures, complementing LDCs' efforts to attract FDI. Action by LDCs (Less Developed Countries) and the development partners will be along the following lines:

(i) Action by LDCs

- (a). Strengthening the enabling environment for private sector development and foreign investment flows; of particular importance is a supportive regulatory and legal framework for new and existing FDI along with the

necessary institutional infrastructure and capacity to implement and maintain it;

- (b). Designing and implementing policies that reduce risks which deter foreign investment, including through the negotiation of bilateral and regional investment treaties and accession to international conventions providing investment guarantees and insurance, as well as dispute settlement;
- (c). Attracting foreign capital, especially FDI, towards the building of supply capacity;
- (d). Encouraging linkages between domestic businesses and foreign affiliates with a view towards helping to disseminate appropriately tangible and intangible assets, including technology, to domestic enterprises;
- (e). Taking appropriate action for the avoidance of double taxation;
- (f). Improving the timely availability, as well as reliability, of investment information and statistics, including those related to investment opportunities and the regulatory framework;
- (g). Continuing efforts to establish an effective, fair and stable institutional, legal and regulatory framework in order to strengthen the rule of law and to foster effective participation of and close cooperation among all relevant stakeholders at national and local levels in the development process;
- (h). Promoting broad-based popular participation in development, *inter alia* through decentralization, where appropriate;
- (j). Enabling the poor through promoting social inclusion and empowerment in order to enhance their effective participation in the governance process, *inter alia* by strengthening their social networks;
- (i). Strengthening policies and measures aimed at social, economic and political inclusion of all segments of societies;
- (k). Continuing to promote and enhance effective measures, including fiscal and financial sector reforms for better domestic resource mobilization, and reallocating public resources for investment in social development, *inter alia* through the appropriate reduction of excessive military expenditures, including global military expenditures;
- (l). Strengthening human and institutional capacities for the formulation, application and evaluation of relevant policies and actions in the above areas.

(ii) *Action by development partners*

- (a). Encouraging increased non-official flows, including investment flows, to LDCs;
- (b). Supporting LDCs in devising and implementing appropriate FDI strategies and policy frameworks and institutions through the development of a comprehensive approach to FDI and actions aimed at improving the regulatory framework and the availability of reliable investment information;
- (c). Supporting LDCs' efforts to attract foreign businesses and their affiliates, encouraging the appropriate dissemination of tangible and intangible assets, including technology, to domestic enterprises in LDCs;
- (d). Assisting LDCs in human resource development so as to enable them to attract and benefit from FDI and to participate effectively in negotiations on international agreements in this regard;
- (e). Supporting LDCs' efforts towards infrastructure development to attract FDI flows;

- (f). Identifying and implementing best practices for encouraging and facilitating FDI to LDCs;
- (g). Supporting initiatives in the development of public and private venture capital funds for LDCs;
- (h). Assisting LDCs in establishing foreign investment advisory bodies in their own countries, as a one-stop shop which would be responsible for providing information, service and administrative support to potential foreign investors;
- (j). Improving coordination among relevant international organizations on advisory services for investment to the LDCs, with possible participation of the private sector, *inter alia* by supporting global investment advisory services;

6. The formulation of a Model: FDI, Technology, productivity and economic growth

Technical progress (through production functions) plays a crucial role in the theory of economic growth. A production function specifies a long-run relationship between inputs and outputs and technical progress is an essential factor underlying the growth of per capita income. The promotion of technological progress has been one of the main objectives of economic policy. There are a number of ways to approach the estimation of production functions and technical progress. A shift in the production function over time is generally considered to represent technical progress through greater efficiency in combining inputs. These shifts are achieved in a variety of ways, including changes in the coefficients of labour and capital. Theoretical and empirical aspects of technical progress have been extensively considered in a numerous studies. The characteristics of technical change may be shown by the shifts of the unit isoquant towards the origin over time. A greater saving in one input than in others will result in a bias in technical change. The relative contribution of factors to the production process is measured by the elasticity of substitution. Then, a bias in technical change will be represented by a modification in the position of the isoquant and will lead, for example, to greater labour savings for all techniques. when $i=j$, then $(w_j/w_i)^{1/2}=1$, then the γ_{ij} is a constant term in the above input-output equation.

We can define productivity as the ratio of output to input. A productivity ratio may be changed when the price or unit cost of an output or input is changed. Productivity change is an important aspect of technological change, so that productivity measurement plays a crucial role in assessing the effects of technological change. Total Factor Productivity (TFP) indicates the productivity of all purchased inputs and is the most useful approach to productivity measurement. Technological change is a concept based on the physical measurements of science and engineering, while the Total Factor Productivity measures the economic impact of technological change. Any change in the quantities or qualities of inputs or outputs is classified as technological change.

This section attempts to measure the relationship between FDI, Technology and Productivity, or in other words to investigate the relation between the decline in FDI, Productivity growth and Technology (*technological and catching up models*).

There is a big literature (including the cross country empirical studies) demonstrating that R&D makes an important contribution to the growth at the firm, industry and national levels. Most of these studies have investigated the relation between productivity growth and R&D.

Economists have analyzed different possible views of why productivity growth has declined. These alternative explanations can be grouped into the following categories:

- (a). the capital factor, for instance investment (FDI) may have been inadequate to sustain the level of productivity growth;
- (b). the technology factor which affects the productivity level, for instance a decline in innovation activities can affect productivity growth;
- (c). the increased price of raw materials and energy;
- (d). government regulations and demand policies that affect the productivity level;
- (e). the skills and experience of labour force may have deteriorated or moreover workers may not work as hard as they used to;
- (f). the products and services produced by the economy have become more diverse;
- (g). productivity levels differ greatly across industries.

A higher level of Foreign Direct Investment and consequently the Innovation and Research activities tend to have a higher level of value added per worker (or a higher GDP per head) and a higher level of innovation activities than others. Following this argument, it would be expected that the more attracted of FDI and Technologically advanced countries would be the most economically advanced (in terms of a high level of innovation activities and in terms of GDP per capita).

However, the level of technology in a country cannot be measured directly. A proxy measure can be used to give an overall picture of the set of techniques invented or diffused by the country of the international economic environment. For the productivity measure, we can use the real GDP per capita as an approximate measure. The most representative measures for *technological inputs and outputs* are the indicators of patent activities and the research expenditures.

The only possible way for technologically weak countries to converge and *catch up* on the advanced countries is to imitate the more productive technologies. The outcome of the international innovation and diffusion process is uncertain; this process may generate a pattern where some countries follow diverging trends or a pattern where countries converge towards a common trend.

In this literature, economic development is analyzed as a disequilibrium process characterized by two conflicting forces:

- (a). innovation which tends to increase economic and technological differences between countries and
- (b). diffusion (or the imitation), through FDI, which tends to reduce them.

Technological gap theories are an application of Schumpeter's dynamic theory.

Whatever the form of the independent variable, a positive relation between productivity and national patent activity exists. However, there is a negative relationship between productivity and gross expenditures on R&D; this can be interpreted as due to the weak level of reliability of the gross research expenditure data as an explanatory variable of innovation activities.

As expected, the best results are obtained for the logarithmic models, which imply a steeper curve. Patenting data reflect the innovation process better, while the research indexes reflect both imitation and innovation processes. Research and development data reflect imitation, innovation and diffusion activities. The relation between productivity (as measured by GDP per capita) and innovation activities

should be expected to be log linear rather than linear and steeper for the patent data than for the index based on research data.

For the level of productivity, we can use as a proxy real GDP per capita (GDPCP). For the measurement of *national technological level*, we can use some approximate measures; for instance, we can again use the traditional variables of *technological input* and *technological output* measures, (GERD and EXPA).

The majority of empirical studies in the estimations between productivity growth and R&D follow a standard linear model; on this context we use a similar approach. The reason is that even though a more dynamic relationship exists, the data limitations (lackness of time series annual data on R&D activities for most countries) prevent the application of some complex models.

We may use the external patent applications (EXPA) and gross expenditures on research and development (GERD) as proxies for the growth of the national technological activities, GDP per capita (GDPCP) (in absolute values at constant prices) as a proxy for the total level of knowledge appropriated in the country (or *productivity*).

Investment share (INV) has been chosen as an indicator of growth in the capacity for economic exploitation of innovation and diffusion; the share of investment may also be seen as the outcome of a process in which institutional factors take part (since differences in the size of investment share may reflect differences in institutional system as well).

For the structural change we used as an approximation changes in the shares of exports and agriculture in GDP. *Technological gap models* as developed here have little to say on how to achieve higher growth of innovation activities or the exploitation of diffusion and innovation. Since annual observations are heavily affected by the short-run fluctuations, average values of the variables covering the period 1973-1987 were calculated.

We have tested the following version of the models:

$$\text{GDP(or PROD)} = f[\text{GDPCP}, \text{EXPA (or GERD)}, \text{INV}], (\text{basic model}), \quad (1)$$

$$\text{GDP(or PROD)} = f[\text{GDPCP}, \text{EXPA (or GERD)}, \text{INV}, \text{EXP}], \quad (2)$$

$$\text{GDP} = f[\text{GDPCP}, \text{EXPA (or GERD)}, \text{INV}, \text{TRD}], \quad (3)$$

The first model may be regarded as a pure *supply model*, where economic growth is supposed to be a function of the level of economic development GDPCP (GDP per capita with a negative expected sign), the growth of patenting activity (EXPA with a positive sign) and the investment share (INV with a positive sign).

However, it can be argued that this model overlooks differences in overall growth rates between periods due to other factors and especially differences in economic policies.

The second model takes account of structural changes using as a proxy the share of exports in share of GDP. The third model uses an additional variable which reflects the changes of macroeconomic conditions and suggest that growth rates are seriously affected by changes in the terms of trade.

The models are tested for the fourteen EU member states (countries Belgium and Luxembourg considered as a single country and including in the new members). The basic model is tested for the variables of GDP, GDP per capita, external patent applications and investment as a share of GDP. The results are presented in Table 5.

The explanatory power (or the overall goodness of fit of the estimated regression models) is not very high, but this is not surprising for cross-sectional data. However, there is a problem of interdependence between the variables. For this reason, we will focus on the relationship between productivity and innovation.

Most of the variables have the expected signs. Some of the results presented in Table 5 are not statistically significant. In addition, the results were not sensitive to the choice of innovation proxy; as before, the better results are obtained for the loglinear models.

In both cases we are using the same approach with firstly basic model and then introducing terms of trade and the export variables. It is worth noting that for the first category of more technologically advanced member states the estimated coefficients display the expected signs except for exports (EXPA) and gross expenditure on R&D (GERD).

The results do not support the hypothesis of structural changes as independent, causal factors of economic growth. These results can be interpreted in order to support the view that the influence of change in outward orientation on growth depends on international macroeconomic conditions (since random shocks and crises and slow growth in world demand in the 1970s restrained the growth of outward oriented countries).

Table 5: The Basic model tested for all EEC member states, (1973-1997):(*)

<p><1>.The basic model including patents: $GDP=2.824-0.002GDPCP+0.10EXPA+0.027INV$ $t=(1.53) \quad (-3.30) \quad (2.30) \quad (0.32), R^2=0.52$ (adj.d.f:0.39) DW=1.52, Rho(autocorrelation coefficient)=0.385, t=1.475. The logarithm model: $LGDP=1.499-0.384LGDP+0.155LEXPA+0.806LINV$ $t=(0.593) \quad (-2.569) \quad (0.930) \quad (1.340), R^2=0.56$ (adj.d.f:0.42) DW=1.36, Rho(autocorrelation coefficient)=0.297, t=0.985.</p>
<p>The basic model including patents: $PROD=0.453-0.00015GDPCP-0.0198EXPA+0.174INV$ $t=(-0.386) \quad (-3.979) \quad (-0.245) \quad (3.012), R^2=0.64$ (adj.d.f:0.54) DW=1.49, Rho(autocorrelation coefficient)=0.301. The logarithmic model: $LPROD=-0.566-0.384LGDP-0.131LEXPA+1.558LINV$ $t=(-0.220) \quad (-2.519) \quad (-0.770) \quad (2.541), R^2=0.75$ (adj.d.f:0.66) DW=1.38, Rho(autocorrelation coefficient)=0.241, t=0.786.</p>
<p><1>.The basic model including the gross expenditures on R&D: $GDP=1.775-0.00129GDPCP+0.0142GERD+0.0646INV$ $t=(0.92) \quad (-1.86) \quad (0.21) \quad (0.75), R^2=0.40$ (adj.d.f:0.24) DW=2.30, Rho(autocorrelation coefficient)=-0.153, t=-0.539. The logarithm model: $LGDP=0.619-0.275LGDP+0.00625LGERD+0.837LINV$ $t=(0.246) \quad (-2.098) \quad (0.0396) \quad (1.408), R^2=0.47$ (adj.d.f:0.33) DW=2.38, Rho(autocor.coefficient)=-0.228, t=-0.815. The basic model including the gross expenditures on R&D: $PROD=0.349-0.00018GDPCP-0.0716GERD+0.168INV$ $t=(0.231) \quad (-3.413) \quad (0.933) \quad (2.677), R^2=0.66$ (adj.d.f:0.57) DW=1.43, Rho(autocorrelation coefficient)=0.301.</p>

The logarithmic model:

$$\text{LPROD} = -0.404 - 0.421\text{LGDP} - 0.0345\text{LGERD} + 1.568\text{LINV}$$

$$t = (-0.130) \quad (-2.585) \quad (-0.176) \quad (2.126), R^2 = 0.61 \text{ (adj.d.f.:0.50)} \quad \text{DW} = 1.79,$$

$$\text{Rho(autocorrelation coefficient)} = -0.0131, t = -0.0402.$$

Note:(*)=Including the three prospective member states. The standard errors & the variance shown in the above examples that are heteroskedastic-consistent estimates. Definition of variables: GDP=annual average growth rates (1973-97) for real gross domestic product. PROD=annual average growth rates (1973-97) for product.(defined as labour prod:GDP per person employed).GDPCP=average absolute values constant (1985) prices (000 US \$) for GDP per capita.EXPA=annual average growth rates for external patent applications.GERD=annual average growth rates for GERD. EXP=annual average growth rates (1973-97) for exports as a share of GDP.INV=annual average growth rates (1973-97) for investment as a share of GDP.TRD=annual average growth rates (1973-97) for terms of trade.LGDP, LPROD, LEXPA, LGERD, LEXP, LINV, LTRD are the above variables in a logarithmic form.

According to these results, the coefficient of investment (INV) has the wrong sign. In terms of data, it is not difficult to see why this happened. For instance, during the whole period under examination, only the more advanced countries have a large capacity for innovation activities; they had already established a technological infrastructure and they could produce a large number of patents, while the second group were trying to establish and upgrade their technological infrastructure. The results show that the degree of explanation is very high, (above 80 per cent); most of the variables are statistically significant, while the standard errors and the variance shown are heteroscedastic consistent estimates.

7. Conclusions

Technological progress has become virtually synonymous with long run economic growth. It raises a basic question about the capacity of both industrial and newly industrialized countries to translate their seemingly greater technological capacity into productivity and economic growth. In the literature there are various explanations for the slow-down in productivity growth for OECD countries. One source of the slow-down may be substantial changes in FDI, and in the industrial composition of output, employment, capital accumulation and resource utilization. The second source of the slow down in productivity growth may be that technological opportunities have declined; otherwise, new technologies have been developed but the application of new technologies to production has been less successful. Technological factors act in a long run way and should not be expected to explain medium run variations in the growth of GDP and productivity.

This article attempts to identify the R&D activities and also to investigate the estimation-methods, the techniques of scientific and technological activities and the measurement problems at a regional level. According to 'International Standardization of Statistics on Science and Technology', we can estimate the most important inputs and outputs of scientific and technological activities and also the Scientific and Technical Education and Training and Scientific and Technological Services. The term of «Research and Development Statistics» covers a wide range of statistical series measuring the resources devoted to R&D stages, R&D activities and R&D results. It is important for science policy advisors to know who finances R&D and who performs it.

UNESCO, OECD and EUROSTAT divisions organised the systematic collection, analysis publication and standardization of data concerning science and technological activities. The first experimental questionnaires were circulated to

member states by UNESCO in 1966 and standardized periodical surveys were established in 1969.

The collection of R&D data of regional statistics implied a lot of problems in comparison to data of national statistics. For the collection of regional statistics, we should take into the local differences and the difficulties. In addition, we can use either the "local-units" or the "local-economic-units". R&D and innovation activities are directly related with economic and regional growth. The outcome of the international innovation and diffusion process is uncertain; this process may generate a pattern where some countries follow diverging trends or a pattern where countries converge towards a common trend. Economic development may be analyzed as a disequilibrium process characterized by two conflicting forces: (a) innovation which tends to increase economic and technological differences between countries and (b) diffusion (or the imitation) which tends to reduce them.

On the basis of the previous discussion, the main conclusions and recommendations of this paper can be summarised as follows:

Technological gap models represent two conflicting forces, innovation which tends to increase the productivity differences between countries and diffusion which tends to reduce them. In the Schumpeterian theory, growth differences are seen as the combined results of these forces. Research on *why growth rates differ* has a long history which goes well beyond growth accounting exercises. The idea that the poorer countries should catch up on the richer ones was advanced already in the nineteenth century, in order to explain continental Europe's convergence with Britain. In the 1960s one of the most basic was the Marx-Lewis model of abundant labour supplies which explained the divergent growth experience in the Western European countries.

The countries that are technologically backward have a potentiality to generate more rapid growth even greater than that of the advanced countries, if they are able to exploit the new technologies which have already employed by the technological leaders. The pace of the catching up depends on the diffusion of knowledge, the rate of structural change, the accumulation of capital and the expansion of demand. The member states that are lagging behind in growth rates can succeed in catching up, if they are able to reduce the technological gap. An important aspect of this is that they cannot rely only on the combination of technology imports and investment, but they should increase their innovation activities and improve locally produced technologies (such as in the case of new industrialized countries Korea and Singapore).

However, our results confirm that some of the small and medium sized EU member states have attained high levels of GDP per capita without a large innovation capacity. To explain the differences in growth between these countries in the post-war period a much more detailed analysis of economic, social and institutional structures should be implemented. If we are comparing technologically advanced and less advanced member states, we can easily find that the less advanced countries lacked experience of large scale production, technical education and resources.

Conclusions cannot be easily drawn from simple summary measures of the extent or the rate of compositional structural change, without having some additional information regarding the direction of change, the path followed from the previous industrial structure and associated and institutional factors.

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