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A NOTE ON THE ROLE OF FOREIGN DIRECT INVESTMENT AND TECHNICAL CHANGE IN REGIONAL GROWTH

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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.

Keywords: Technical Change, Foreign Direct Investment, Innovation, Diffusion, modernisation, competitiveness, economic and regional growth

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).

FDI flows include assets, property (e.g. parent company technology, branding, skills) &/or capital investment (greater than 10% of total shares in a company), reinvested earnings (retained profits in an affiliate, or intra company loan/debt transaction (long term borrowing/lending) between firm and affiliate enterprises. FDI stocks are the value of capital and reserves (including retained profit) attributable to a parent enterprise. Other types of foreign investment: portfolio investment (shareholder investment in less than 10% of a company's capital) and bonds/loans are obtained from foreign banks. N.B. data is missing for certain countries and sectors (UNCTAD 1999).

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. Foreign and

domestic firms have used acquisitions as a tool for strengthening their position in domestic or international markets.

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.

This paper deals with the FDIs trends, and moreover with research activities. In the following sections, FDI trends and research activities are analyzed 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 models adopted here attempt to correlate and measure the effects of investment on technical change, through innovation and diffusion process, and productivity growth.

2. 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.

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 indicates the Flows of Direct Investment for OECD countries, 2000-2003 (in billion US $). Table 2 indicates the cumulative flows of FDI for OECD countries, 1994-2003 (in billion US $).

	Outflows				Inflows			
	2000	2001	2002	2003	2000	2001	2002	2003
Australia	0.7	12.2	7.6	14.3	13.2	4.7	16.5	**7.8**
Austria	5.7	3.1	5.3	7.1	8.8	5.9	1.0	**6.9**
Belgium/Luxembourg	218.4	100.6			221.0	84.7		
Belgium			11.0	39.0			13.1	**31.3**
Luxembourg			126.2	81.8			117.1	**73.2**
Canada	44.7	36.1	26.4	21.6	66.8	27.5	21.0	**6.6**
Czech Republic	0.0	0.2	0.2	0.2	5.0	5.6	8.5	**2.6**
Denmark	26.5	13.4	5.7	1.2	33.8	11.5	6.6	**2.6**
Finland	24.0	8.4	7.6	-7.4	8.8	3.7	7.9	**2.8**
France	177.5	86.8	49.5	57.3	43.3	50.5	48.9	**47.0**
Germany	56.6	36.9	8.6	2.6	198.3	21.1	36.0	**12.9**
Greece	2.1	0.6	0.7	0.0	1.1	1.6	0.1	**0.7**
Hungary	0.6	0.4	0.3	1.6	2.8	3.9	2.8	**2.5**
Iceland	0.4	0.3	0.2	0.2	0.2	0.2	0.1	**0.1**
Ireland	4.6	**4.1**	3.1	1.9	25.8	9.7	24.4	**25.5**
Italy	12.3	21.5	17.1	9.1	13.4	14.9	14.6	**17.0**
Japan	31.5	38.4	32.3	28.8	8.3	6.2	9.2	**6.3**
Korea	5.0	**2.4**	2.6	3.4	9.3	3.5	2.4	**3.2**
Mexico		**4.4**	1.0		16.4	26.6	14.4	**10.7**
Netherlands	75.6	48.0	34.6	36.1	63.9	51.9	25.6	**19.7**
New Zealand	0.6	0.9	-1.0	-0.1	1.3	4.2	**-0.6**	**0.8**
Norway	7.6	-1.3	4.2	2.6	6.9	2.0	**0.7**	**2.2**
Poland	0.0	-0.1	0.2	0.4	9.3	5.7	**4.1**	**4.2**
Portugal	7.5	7.6	3.3	0.1	6.8	5.9	**1.8**	**1.0**
Slovak Republic	0.0	0.1	0.0	0.0	2.4	1.6	4.1	**0.6**
Spain	54.7	33.1	31.5	23.4	37.5	28.0	35.9	**25.6**
Sweden	40.7	6.4	10.7	10.6	23.2	11.9	11.6	**3.4**
Switzerland	44.7	18.2	7.6	10.9	19.3	8.9	5.7	**12.2**
Turkey	0.9	0.5	0.2	0.5	1.0	3.3	1.0	**0.6**
United Kingdom	233.5	58.9	35.2	55.3	118.8	52.7	27.8	**14.6**
United States	159.2	120.0	134.8	173.8	321.3	167.0	72.4	**39.9**
Total OECD	1	661.9	566.7	576.3	1	624.9	535.0	384.4

Source: OECD International Direct Investment Database.

Table 1:Direct investment flows to and from OECD countries 2000-2003 (USD$bill.)

Germany was the target of a record USD 52 billion inflow, over twice the level of the previous year. 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. *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. As outflows were actually lower than in 1998, Sweden unusually became a net recipient. *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. 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.

Inflows		Outflows		Net outflows	
United States	1 349.6	United States	1 331.0	United Kingdom	**415.6**
Belgium/Luxembourg	762.7	United Kingdom	878.6	France	**301.0**
United Kingdom	463.1	Belgium/Luxembourg	767.0	Japan	**217.6**
Germany	387.0	France	652.7	Switzerland	**108.5**
France	351.6	Germany	452.7	Netherlands	**96.3**
Netherlands	286.5	Netherlands	382.8	Germany	**65.6**
Canada	208.1	Japan	268.0	Spain	**46.7**
Spain	183.5	Canada	237.3	Canada	**29.2**
Sweden	168.2	Spain	230.1	Finland	**26.7**
Mexico	138.2	Switzerland	190.4	Italy	**25.9**
Ireland	120.0	Sweden	150.2	Belgium/Luxembourg	**4.3**
Denmark	91.7	Italy	112.4	Portugal	**3.4**
Italy	86.5	Denmark	82.0	Norway	**2.2**
Australia	82.2	Finland	72.6	Iceland	**0.5**
Switzerland	81.9	Australia	57.3	Korea	**-3.4**
Poland	52.0	Norway	37.7	Greece	**-5.0**
Japan	50.5	Korea	37.5	Turkey	**-7.0**
Finland	45.9	Austria	33.6	Austria	**-7.6**
Austria	41.2	Portugal	29.2	Denmark	**-9.7**
Korea	40.9	Ireland	26.7	Slovak Republic	**-10.9**
Czech Republic	37.9	Mexico[1]	5.4	New Zealand	**-17.0**
Norway	35.5	Hungary	3.9	Sweden	**-18.0**
Hungary	32.4	Greece	3.7	United States	**-18.7**
Portugal	25.7	Turkey	3.6	Australia	**-24.8**
New Zealand	19.9	New Zealand	2.9	Hungary	**-28.4**
Slovak Republic	11.0	Iceland	1.5	Czech Republic	**-36.7**
Turkey	10.6	Czech Republic	1.2	Poland	**-50.9**
Greece	8.7	Poland	1.1	Ireland	**-93.3**
Iceland	1.0	Slovak Republic	0.1	Mexico[1]	**-132.9**
TOTAL OECD	5 174.0	TOTAL OECD	6 053.1	TOTAL OECD	879.2

Source: OECD, International Direct Investment Database.

Table 2: Cumulative FDI flows in OECD countries 1994-2003 (USD billion)

The most heavily indebted poor countries and low income countries of the world remain largely dependent on bilateral and multilateral aid for their development strategies. However, since 1990

total Overseas Development Assistance (ODA) has dropped by more than half. Much greater importance is now being placed on alternative sources of capital to finance national development (ECOSOC 2000) and Foreign Direct Investment (FDI) is now the largest source of foreign private capital reaching developing countries. Figure 1 illustrates the private capital flows to developing countries. Global flows of FDI have grown phenomenally over the last ten years. Total inflows rose by nearly four times, from US $174 billion in 1992 to US$ 644 billion in 1998. However, total flows to developing economies fell between 1997 and 1998 (UNCTAD 1999). Of the middle to low income countries, Asia has experienced the fastest rate of growth in FDI but also the greatest volatility (World Bank 1999). Attraction of FDI is becoming increasingly important for developing countries. Table 3 illustrates the relationship between The relationship between regional trends and the prospects of Foreign Direct Investment.

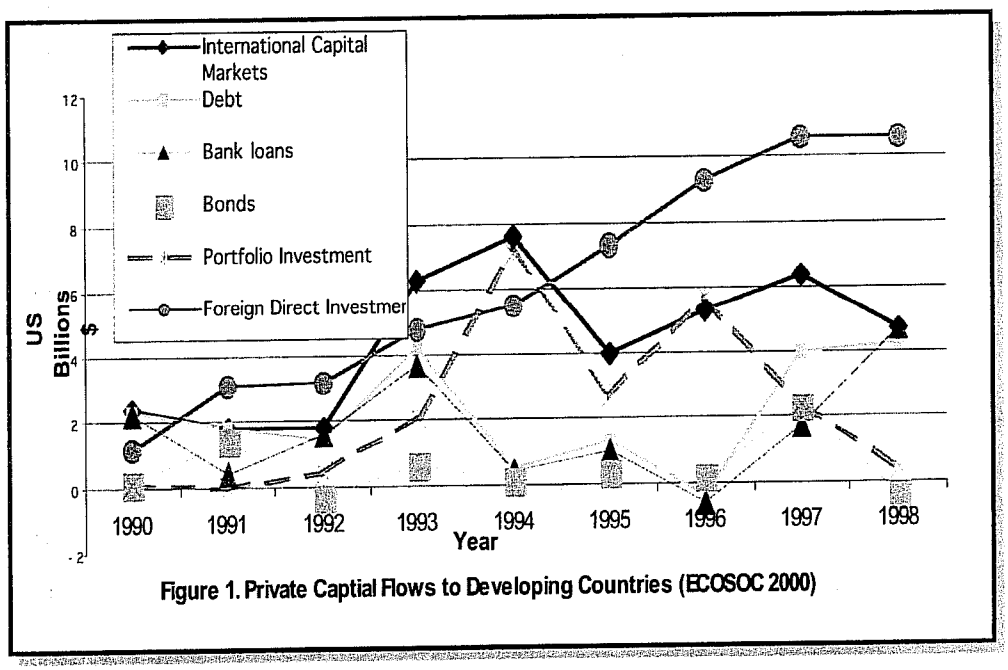

Figure 1. Private Captial Flows to Developing Countries (ECOSOC 2000)

The 2003 FDI inflows to European countries were 23 per cent lower than in 2002 (the decline in EU and the Euro-zone were of a comparable magnitude). This figure covers very considerable trend differences between individual countries. On the whole, most European nations saw larger-than-average declines, the effect of which on the overall figures was cushioned by the resilience of FDI in a few relatively large economies. We can summarize some of the most important observations:

- Some of the largest relative declines in FDI inflows were seen in Central Europe. FDI into Slovak and Czech Republics dropped by 85 and 70 per cent, owing in part to the one-off effect of large investment projects in 2002 (in the automotive and energy sector, respectively).
- Direct investment flows into Germany fell by 64 per cent, and by the same token recorded the second-largest absolute decline in 2003. FDI inflows were down by USD 23 billion from 2002.
- Other large declines were seen in the Nordic countries. FDI flows into Sweden and Finland fell by around two thirds in 2003, *inter alia* reflecting the effect of changed ownership structures within the Nordic region's largest commercial bank.
- The FDI flows into the United Kingdom fell almost by half in 2003, from a level that was already unimpressive by historical standards.
- Among the countries whose inward FDI has held up France stands out by the sheer volume of investment that the country continues to attract. In 2003, inflows to France were USD 47 billion, only marginally beneath in inflows of 2002 and at three times the levels

recorded in Germany and the United Kingdom.

- The figures indicate that Spain holds up very well, both as an inward and an outward direct investor.
- Some of the smaller European countries recorded sharp increases in inward FDI in 2003, in most cases reflecting the effect of particularly low investment the year before. Examples include Switzerland, Austria and Norway, all of whom saw their inflows more than double.

Latin America & Caribbean	**Total Inflows (1998): US$ 71 billion.** Key receivers: Brazil, Mexico, Argentina, ChileKey Sources: United States, Spain Key Sectors: Services (Business, electricity, finance), Manufacturing (chemicals, food/ beverage/tobacco), Mining.	**Total Outflows (1998): US$ 15 billion** Key sources: Cayman Islands, Chile, Brazil, Bermuda, Argentina. Receivers: Over 75% re- invested in the region.	**FDI inflows have steadily risen since 1991 and this is expected to increase. However, current accounts remain in deficit, and human, technical, infrastructural and financial constraints continue to limit attraction of inflows. Domestic markets are still largely geared to short term financing.**
Asia & Pacific	**Total Inflows: US$ 85 Billion.** Key receivers: China, Singapore, Thailand, Korea (Democratic Peoples Republic), Japan.Key Sources: Australia, Japan, New Zealand. Key Sectors: Manufacturing (chemicals, wood, electric), services (transport, real estate).	**Total Outflows: US$ 36 Billion.** Key sources: Japan, Hong Kong (China), Korea (DPR), Taiwan Province. Receivers: Over 50% of outflows are re-invested in region, China.	**Although financial crisis in 1996/7 hit many Asian countries (especially Indonesia) others were more resilient (Taiwan Province, China, Hong Kong). Long run growth is predicted but the region may need diversification to gain greater access to global economy.**

Central & Eastern Europe	**Total Inflows: US$ 19 billion.** Key receivers: Poland, Czech Republic, Russia, Romania, Hungary Key Sources: Europe (Germany, Netherlands) Key Sectors: Mining, metals, food production & services.	**Total Outflows: US$ 2 billion.** Key sources: Russia, Hungary, PolandReceivers: Europe	**Resilient and increasing FDI inflow to region, especially compared to portfolio investment and bank loans. Small outward investors lack access to finance. The financial crisis in Russia reduced FDI inflows but longer term outlook is more positive.**
Africa	**Total Inflows: US$ 8 billion.** Key receivers: Nigeria, Egypt, Tunisia, AlgeriaKey Sources: USA, Belgium, UK, France Key Sectors: Telecomm., food / beverage, tourism, mining/quarrying, textiles	**Total Outflows: US$ 0.5 billion.** Key sources: South Africa, Liberia, Nigeria Receivers: Namibia, Swaziland	**FDI has grown by 6 times in the last 10 years but only in a small number of countries and at a low level compared to international flows. Problems of extortion and corruption indicate a vital need for democratisation, transparent regulation and improved rule of law to support inflows to the region.**
North America	**Total Inflows: US$ 193 billion.** Key Sources: Mainly Europe (especially UK, Germany), JapanKey Sectors: Manufacturing (48%) and petroleum (30%)	**Total Outflows: U$ 110 billion.** Key sources: USAReceivers: Europe (54%) but also Latin AmericaKey Sectors: Services, banks, finance, insurance, manufacturing	**A strong FDI competitor. The distribution of inflows to USA is uneven across states, e.g. Hawaii has very high inflows (tourism). Although high FDI has little contribution to employment levels. Short run growth is predicted but in the medium term as the dollar strengthens inflows may drop.**
Western Europe	**Total Inflows: US$ 237 billion (1998).** Key receivers: UK, Netherlands, France, Belgium. Key Sources: United States, Europe, Japan Key Sectors: Services (finance & trade related), manufacturing (petroleum, chemicals).	**Total Outflows: US$ 406 billion** Key sources: UK, Germany, France. Receivers: Europe, United States, Japan.Key Sectors: Services (60%, especially finance and trade), manufacturing (petroleum, chemicals)	**Finland and Netherlands have seen the highest growth rate of inflows. Other countries, such as Italy, have fallen in recent years. The automobile sector is thought to have potential. The presence of the Single European Currency hasn't yet indicated noticeable benefit to members compared to non-members.**

Sources: World Bank (a) UNCTAD, ICC

Table 3: The relationship between regional trends and the prospects of FDI

According to the World Bank's Indicators, which offer data for FDI and gross capital formation in over 130 developing countries, the average share of FDI in total fixed investment over the last decade has been around 15 per cent. Furthermore, there is also a need to further develop and apply sustainability indicators to better assess the impacts of FDI for different regions and sectors. For instance, Table 3 indicates the main indicators for the measurement of FDI and sustainability. Table 4 illustrates the main indicators regarding the measurement of FDI and sustainability.

	Type	Main indicators
Economic	Investment and Productivity	**Net Foreign Direct Investment (FDI); Net Foreign Direct Investment (FDI) as % of GDP and of GFCP; Net change in foreign investment between the reporting country and the rest of the world; Net resource transfer. Ratio of aggregate Net Resource Transfers (long-term) to GNP (%). R & D expenditure from FDI in local economy. % of FDI into Greenfield investments.**
	Other financial factors	**Ratio of Total Official Development Assistance (ODA) given or received to Gross National Product (GNP) from Bilateral and multilateral sources. Ratio of total external debt to GNP (%), Ratio of total debt service to exports of goods and services, including worker's remittances %. Per capita domestic saving and investment.**
Social	Labour standards and employment	**Adoption of ILO labour standards and indicators. % employment in host economy created (directly/indirectly) by FDI.**
	Education	**Enrolment ratios by level of education, public/private expenditure on education/training, expected number of years of formal schooling**
Environ -ment	Environmental Best Practice	**Adoption of environmental management systems, environmental reporting, energy efficiency. Green accounting e.g. "green" net national product (green NNP), genuine savings etc.**
	Environmental Protection	**% of FDI into environmentally sensitive sectors. Ratio of environmental protection expenditures to Gross Domestic Product (GDP) %. Degree of implementation of Multi-lateral Environmental agreements.**

Sources: World Bank (a)., World Bank (b)., UNCED, WWF

Table 4: The Main Indicators for FDI and Sustainability effects

3. FDI, TECHNOLOGY AND PRODUCTIVITY GROWTH

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. 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 output 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. 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.

Investment in research & development (R&D) from parent companies can stimulate innovation in production and processing techniques in the host country. However, this assumes that in-house investment (in R&D, production, management, personnel training) will result in improvements. Foreign technology/organisational techniques may actually be inappropriate to local needs, capital intensive and have a negative affect on local competitors, especially smaller business who are less able to make equivalent adaptions (UNCTAD 1999).

FDI inflows are still highly concentrated in certain countries and regions. Figure 2 illustrates the regional FDI inflows as a percentage of total global inflows. Transnational Corporations (TNCs) are the largest source of FDI (about 95% of total inflows) and the majority of these are based in industrialised countries. The vast proportion of FDI flows go to other developed countries, especially the "Triad" of USA, UK, Japan, but also countries such as Germany, France, Canada, Netherlands.

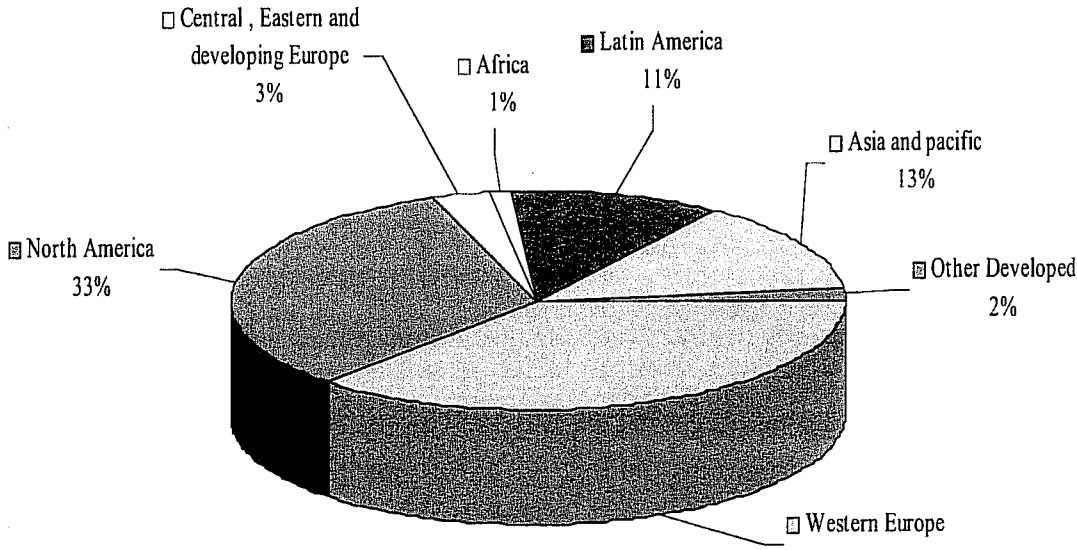

Figure 2. Regional FDI inflows 1998, as % of total global inflow US$ 644 bill. (UNCTAD 1999)

In 1998, 92% of total FDI outflows came from developed countries and 72% of the total inflows returned to these economies (UNCTAD 1999). Of the proportion that went to low-middle income countries, the highest percentage went to Asia and Latin America (42% and 38% respectively), 14% to Central Europe & East Asia, whilst only 6% was invested in Africa (World Bank 1999). Over half of the FDI that does reach developing countries is concentrated in 5 countries. This is also true transitional countries, for example in Eastern Europe 75 % of

FDI inflows is directed toward 5 countries (WTO 1999, ECOSOC 2000).

Productivity change is an important aspect of technological change, so that productivity measurement plays a crucial role in assessing the effects of technological change. 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

analysed 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.

The models below attempt to correlate and measure the effects of investment on technical change, through innovation and diffusion process, and productivity growth. *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.

<1>. The basic model including patents:
GDP=2.82-0.00zGDPCP-0.10EXPA-0.027INV
t=(1.53) (-3.30) (2.30) (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=1.499-0.384LGDPCP-0.155LEXPA-0.806LINV
t=(0.593) (-2.569) (0.930) (1.340), R^2=0.56 (adj.d.f:0.42) DW=1.36,
Rho(autocorrelation coefficient)=0.297, t=0.985.

The basic model including patents:
PROD=0.453-0.00015GDPCP-0.0198EXPA+0.174INV
t=(-0.386) (-3.979) (-0.245) (3.012), R^2=0.64
(adj.d.f:0.54) DW=1.49,
Rho(autocorrelation coefficient)=0.301.
The logarithmic model:
LPROD=-0.566-0.384LGDPCP-0.131LEXPA+1.558LINV
t=(-0.220) (-2.519) (-0.770) (2.541), R^2=0.75
(adj.d.f:0.66) DW=1.38,
Rho(autocorrelation coefficient)=0.241, t=0.786.
<1>.The basic model including the gross expenditures on R&D:
GDP=1.775-0.00129GDPCP+0.0142GERD+0.0646INV
t=(0.92) (-1.86) (0.21) (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=0.619-0.275LGDPCP+0.00625LGERD+0.837LINV
t=(0.246) (-2.098) (0.0396) (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) (-3.413) (0.933) (2.677), R^2=0.66
(adj.d.f:0.57) DW=1.43,
Rho(autocorrelation coefficient)=0.301.
The logarithmic model:
LPROD=-0.404-0.421LGDPCP-0.0345LGERD+1.568LINV
t=(-0.130) (-2.585) (-0.176) (2.126), R^2=0.61
(adj.d.f:0.50) DW=1.79,
Rho(autocorrelation coefficient)=-0.0131, t=-0.0402.

Table 5: Basic model tested for a selection of European member states, (1973-1997):(*)

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.

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 through FDI; 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 1973-1997 were calculated. We have tested the following version of the models:

GDP (or PROD) = f [GDPCP, EXPA (or GERD), INV],(basic model), **(1)**

GDP (or PROD) = f [GDPCP, EXPA (or GERD), INV, EXP], **(2)**

GDP = f [GDPCP, EXPA (or GERD), INV, TRD], **(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. 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). 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.

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 advance 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 R&TD) and channeling it towards sources of innovation (and R&TD), 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 R&TD 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 LDRs' efforts to attract FDI. Following the

OECD' regulations in order to attract the FDIs, it's necessary to pay emphasis on the following lines:

- (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;
- (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;
- (l). Strengthening human and institutional capacities for the formulation, application and evaluation of relevant policies and actions in the above areas.

4. CONCLUSIONS

On the basis of the previous discussion, the main conclusions and recommendations of this paper can be summarised as follows. 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 runway and should not be expected to explain medium run variations in the growth of GDP and productivity. 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.

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 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. However, 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.

Summarising the critical areas which need to be addressed, include:

- Assessment of the linkages between finance and trade flows, ODA and private investment flows, as well as domestic finance;
- how to redress the imbalance between rich investing nations and poor recipients e.g. through independent arbitration of investment agreements;
- how institutions can prioritise socially and environmentally responsible FDI, whilst stimulating domestic economies;
- how and who will support developing countries to maximise the benefits of FDI (employment, income generation, technology transfer, debt servicing, economic stability) whilst minimising the negative elements (monopolistic TNCs, transfer pricing, social/cultural intrusion, environmental degradation)
- Increasing support (funds, human resources) for monitoring the impacts and progress of macroeconomic policies which are aimed at enhancing the positive impact of FDI in developing countries.

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