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Foreign Direct Investments in R&D in Poland as an Instrument Implementing EU Technological Policy

Abstract

Making economies more competitive has become the key goal for most industrialised countries that wish either to retain or to enhance their international position. Leaders of the EU member states, trying to improve the situation in the entire group, formulated a technological policy at the Community level and set specific goals for attainment. In addition, foreign enterprises' interest in the EU market and the pursuit for competitiveness make the enterprises perceive the creation of knowledge and activities offering high value added as a very attractive investment target. For that reason, foreign direct investments in R&D that improve country's competitive position are a very important instrument for every member state, as they help attain the Lisbon Strategy goals.

This paper discusses foreign investors' involvement in R&D activities in Poland. The analysis concentrates on three closely related aspects – methodological issues associating technology transfers with R&D activities; the extent and degree to which foreign investors utilise Poland's scientific potential and finally legal aspects of various incentives attracting firms to the R&D business.

The conducted analysis of statistical data reveals that transnational corporations had not shown much interest in research and development activity in Poland from early 1990s. Their attitude changed only in the last several years.

Indicators such as total R&D spending, the structure of budget allocations to the industry, employment in the R&D sector and patent applications submitted in Poland (also under PCT) indicate that most foreign

firms active in Poland use the output of their parent-companies. However, greenfield investment projects establishing new R&D centres and increasing employment in the existing ones that have been launched in the recent years suggest that the situation is changing. Discussing issues in Poland's research and development potential and the newly introduced legal measures making R&D a more attractive business, the author endeavours to find out why foreign firms changed their attitude to R&D.

Introduction

Poland has been an EU member for more than three years now, but the level of our economic development will continue to lag behind EU-15 countries for long years. EU Framework Programmes and suitable policies pursued by the member states, coordinated with goals established at the Community level, offer a chance to reduce gaps in the development of individual member states.

One of the most important goals that the European Union wants to achieve is stronger economic competitiveness of all countries in the group. An instrumental measure in this area is appropriate technological policy (defined at the Community level in the Framework Programmes). The Lisbon Strategy 2000 proves that Brussels recognized the importance of technology for gaining competitive advantages long ago, even though the Strategy's assumptions turned out unattainable, as we see today. Notwithstanding, the document stirred a discussion about the growing disproportion between the EU and US economies with respect to the level and pace of development. We need to add that the positive outcome of the Lisbon Strategy was the acceptance of less rigorous criteria (achievable in the assumed time horizon), frequently called a New Lisbon Strategy.

However, its assumptions still require the member states to set R&D expenditures (GERD – Gross Expenditure on Research and Development) at the level of 3% of GDP. States being the most competitive economies in the world, such as Switzerland, Finland, Sweden, Denmark, Singapore, or USA allocate large funds to research and development work[1].

This target rate coincides with the global trends – the developed countries believe that broadly understood knowledge is the most valuable commodity today. Enterprises are of the opinion that knowledge creation is a vehicle improving their competitiveness and thus their business position. This attitude

[1] *The Global Competitiveness Report 2006-2007*, World Economic Forum 2007.

frequently makes them develop new technologies and improve the existing ones. In most cases, they establish R&D centres or build up the centres' infrastructure. Enterprises that want to stay in business and to secure their growth potential have to introduce innovations to manufacturing processes and products, or to organizational structures, or modernize both these areas at the same time.

Poland belongs to countries where the GERD indicator is one of the lowest. The situation did not improved in successive years (as one might have expected), but steadily deteriorated, and consequently the indicator's value does not exceed 0.6. The situation is mainly caused by cutbacks in governmental expenditure, so the question arises about the status of the sector of private enterprises that are exposed to market competition. Foreign firms are particularly interesting – the most recent data show that R&D centres founded by transnational corporations are not concentrated in a small group of highly industrialized countries – an increasing number of enterprises establish such centres in developing areas[2]. From the Polish perspective, this course of events provides Poland with a huge opportunity to increase her research and development capacity and to reduce the technological gap via to the expected transfer of technologies to the newly established R&D centres.

Considering the present trends in R&D internalization, the question must be asked, whether foreign firms have really increased their R&D activities, and, if the answer is yes, what made them do so?

1. Relationships between technology transfers and R&D activities

One might say that a transfer of technology is an attribute of the R&D centres, as this is the role they are supposed to play – to create knowledge that is then used by the enterprises. However, when FDI is one of the system's elements, two aspects have to be considered.

1) Activity profiles of R&D centres

a) only development work – technology is transferred between the parent-company and its subsidiary, and the exclusive task of the latter is adjusting a process or a product to the local market requirements;

b) only research – technology is transferred from an R&D centre to the parent company. In this case, the centre deals with a strictly defined

[2] *Transnational Corporations and the Internationalization of R&D, World Investment Report 2005*, pp. 99–117.

subject area, and its activities follow the parent-company's strategy of diversification[3];

c) mixed activities – transfers go both ways. In other words, an R&D centre is responsible for making product adjustments so that a product could meet market wants, but also extends research work on products, or develops spin-off technologies created within a major project.

2) Transfer of technology outside the corporation's structure, i.e. outwards. Technology flows from a local R&D centre to domestic organizations.

Naturally, the first aspect is much easier to capture, because of the very characteristics of the transfers. In its definition of a technology transfer, UNCTAD quotes M. Blakeney[4] who calls it a process in which commercial technologies are disseminated by way of transactions. A transaction can be, but does not have to, a formal contract under which the provider imparts important knowledge to the buyer[5].

For the sake of simplification and to respect the facts, we also need to mention another definition formulated by the US Department of Commerce. Here, a technology transfer occurs, when a firm acquires technology from an external source (such as a university, a state research laboratory, another enterprise, or an individual)[6].

The conclusion is that a transfer of technology can be understood as a flow of technical knowledge, taking various forms and occurring between specific entities.

Various methods are used to make the flow happen. Because of the special character of R&D, three channels of technology transfers seem to be crucial in the context of this paper:

- exchange of concepts via seminars, lectures, demonstrations and consultations;

[3] A case in point can be the Intel research centre in Gdańsk, which is completely separated from the parent-firm's operations in Poland – from the author.

[4] *Transfer of technology*, UNCTAD, New York and Geneva 2001, p. 6.

[5] Blakeney M., *Legal Aspects of Technology Transfer to Developing Countries*, ESC Publishing, Oxford 1989, p. 136.

[6] Reamer A., Icerman L., Youtie J., *Technology Transfer And Commercialization: Their Role In Economic Development*, *Economic Development Administration*, U. S. Department of Commerce 2003, p. 8.

- exchange of workers with another firm based on a temporary employment contract, or a permanent relocation of a worker;
- purchase of equipment, patents, and licences.

Examining technology transfers in terms of the two aspects mentioned above, we find that the channels can be used by each of them. Of course, the possibility of capturing changes is considerably different in each case. An attempt at quantifying the first two channels of technology transfer requires data from questionnaire surveys. The extent of the last channel is easier to identify and the identification process can be performed by observing the available macro and micro economic data.

2. A change in the R&D strategy of transnational corporations

The opinion that transnational corporations tend to take advantage of their initial technological superiority long functioned among researchers investigating the corporations' motivation for their foreign direct investment in R&D[7]. Enterprises were said to seek involvement in the industry, whenever they realised they had certain technological advantage over their rivals, which could be used most effectively by its internalization in foreign locations. The responsibilities of foreign subsidiaries were reduced to adapting a specific technology created at home to requirements prevailing in the local market.

Today it is essentially believed that corporations take their technological activity abroad to benefit from their initial technological advantages, but also to tap into the technological potential of the host country, to reduce the R&D costs and to accelerate the development of a new technology[8].

This opinion is supported by the fact that firms starting their first FDI tend to target industries that generate a relatively low value added. When they are successful, then lower and upper linkages going along the entire chain

[7] Kuemmerle W., *The Drivers Of Foreign Direct Investment Into Research And Development: An Empirical Investigation*, Harvard Business Review 30 (1) 1999, p.3.

[8] See, for instance. Dunning J. H., Narula R., *The R&D Activities Of Foreign Firms In The U. S.*, Discussion Papers In International Investment And Business Studies, No. 189, University of Reading, Reading 1994, p. 3, Gerybadze A., Reger G., *Globalization of R&D: Recent Changes In The Management Of Innovation In Transnational Corporations*, Research Policy 28 (1999), p. 254, or *Transnational Corporations and the Internationalization of R&D, World Investment Report 2005*, p. 99.

of values are consolidated to enhance the firms' activities. Such vertical integration may ultimately involve technologically advanced production and R&D activities.

Another argument favouring this explanation is the concept of a new paradigm of transnational innovation, distinctly different from the traditional approach to the internationalization of R&D activities[9]. While the traditional paradigm assumed a one-way movement of products and technological knowledge from a centre based in the home country to other regions, the new paradigm is its antithesis and it is characterised by:

- intensive interactions between a market and a technology;
- many knowledge centres existing in various geographical locations;
- learning processes, because different functions are integrated when the value added chains are being created;
- combined learning, induced by transfers of knowledge from the parent company and of knowledge created at a given location;
- a reversed and interactive transfer of technology, both among various locations and among organizational units.

The results of a questionnaire survey conducted by Gerybadze confirm that the concept of the paradigm is correct. Gerybadze used a sample with 21 transnational corporations[10]. The answers they provided allow to formulate 5 primary factors encouraging corporations' involvement in international R&D activities:

1) In most cases, Transnational Corporations (TNC) place their hi-tech R&D (such as the creation of new solutions, development of innovative technologies) in the most dynamic and leading markets. TNCs raise arguments such as stimulation of innovative processes by specific locations, learning from the leading markets and adaptation to consumers' high standards.
2) Knowledge-creating processes converge more and more strongly with those generating profits. As a result, R&D is located close to the points-of-sales, i.e. where capital stocks are large, and where the concept of a new product can be put to the test in the "probe and learn" process.

[9] Gerybadze A., Reger G., *Globalization of R&D: Recent Changes In The Management Of Innovation In Transnational Corporations*, Research Policy 28 (1999), p. 254.

[10] Gerybadze A., Reger G., *Globalization of R&D…*, p. 262.

3) For many high-tech products, the formulation of prevailing patterns and standards becomes more and more important. Active presence in places where laws, licensing procedures, and standardization agreements facilitate rather than impede innovation is the major reason behind running R&D business abroad.
4) For some integrated and advanced new products, close relationships among R&D, complex manufacturing processes and an efficient chain of supply are decisive. The motivation for merging high-quality production and readily available technical support is important. Effective integration of R&D with manufacturing offers considerable benefits, because the product development process becomes less time-consuming, adjustments to customers' wants can be more flexible and costs lower.
5) Finally, firms strongly involved in narrowly defined research activities (such as genetic engineering, conduction, the space industry) emphasise the access to unique sources of cutting-edge research outcomes and able personnel in excellence centres with established international reputation.

International corporations tend to formulate their strategies for establishing R&D centres in such a way that a whole corporation could function in an undisturbed and most effective way. In order to achieve this, R&D must be integrated with other components and the strategy applying to R&D centres must arise from the paramount expansion concept pursued by the entire corporation, as well as external circumstances[11].

3. The condition of the R&D sector in Poland and the country's research potential – an attempt at evaluation

The research potential of any economy can be described using a range of indicators that provide guidelines as to the practicality of making R&D investments in a given country. Examples of such indicators are R&D expenditures and employment in the sector. They are presented in table 1.

[11] We mean here, for instance, the industry in which a corporation operates, the level of competitiveness, etc. – from the author.

Table 1. Basic R&D indicators, years 1995-2004

Specification	1995	2000	2001	2002	2003	2004
R&D expenditures[a] (current prices):						
in relation to GDP[b] (GERD/GDP), %	0.65	0.66	0.64	0.58	0.56	0.58[c]
per capita (PLN)	55	125	126	118	119	135
Employment in R&D industry per 1,000 economically active persons[d]	4.9	4.6	4.5	4.5	4.5	4.6
including R&D staff	2.9	3.2	3.3	3.3	3.4	3.6

a – Excluding depreciation of fixed assets. *b* – GERD/GDP ratios were calculated based on updated GDP data derived using a new GDP calculation method applied for the first time in 2000. Compared with the previous method, the change involved a modified range of entities in the institutional sectors, replacement of cash accounting with the accrual accounting approach to transactions in the accounts of the governmental and self-governmental institutions' sector, and valuation of fixed assets according to market prices. *c* – Preliminary data. *d* – Employed – equivalents of full-time employment; economically active population (all working persons and those assumed to be unemployed) – based on the Labour Force Survey (BAEL): May of 1995 data, for years 2000–2004 the 4th quarter data.
Source: *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 21.

Data presented in the table indicate a very low GERD to GDP ratio. Throughout the period in question, the ratio never exceeded 1%; moreover, since 2002 the R&D expenditures accounted for less than 0.6% of GDP. This situation adversely influences the establishment of new R&D centres, as the number of research projects is regularly declining. However, the research quality cannot be explicitly evaluated, as it is not directly influenced by lower R&D expenditures. This statement cannot be easily verified, because of the lack of empirical research.

International comparisons between Poland and the EU countries show that the Polish public sector's expenditure on R&D in 2001 alone was not much lower than in the other member states at a similar level of economic development[12].

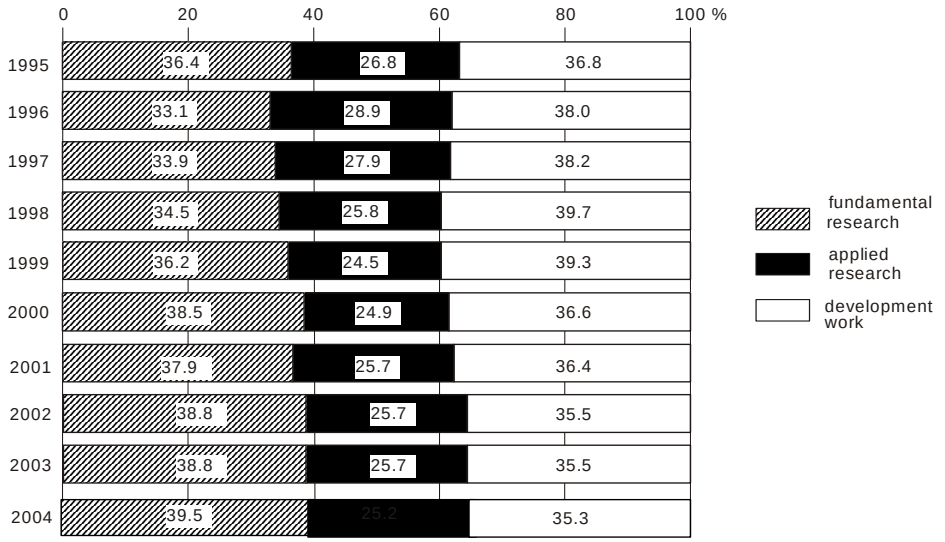
However, expenditure per capita shows a steady GDP growth starting from 2002, accompanied by an unchanged percentage of R&D expenditures, which suggests that governments in those years did not assign much weight to the sector. On the other hand, a positive thing is the systematically growing proportion of scientists engaged in the R&D sector, with the total employment in

[12] Orłowski W., *Scenariusze rozwoju sektora wiedzy w Polsce do roku 2040* [in:] *Wiedza a wzrost gospodarczy*, Zieliński L., (ed.), Wydawnictwo Naukowe SCHOLAR, Warsaw 2003, pp. 189-191.

the sector remaining the same. A natural conclusion is that the sector undergoes a gradual restructuring.

An analysis of domestic expenditures, their shares in GDP, and other indicators presented in table 1 do not allow the complete evaluation of R&D condition. Another important factor is the structure of R&D expenditures by type of research presented in Chart 1.

Chart 1. Structure of current expenditure on R&D activities in years 1995-2004



Source: author's calculations based on *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 24.

According to the chart, the smallest amounts were allocated to applied research; between 1995 and 1999, development work was ranked first in terms of received allocations, before fundamental research, in the next years they swapped their positions. Analysing chart 1 we find that applied research was considerably underfunded, because of excessive amounts going to fundamental research.

Whether R&D business in a given country is an attractive option, or not, is also determined by the size of employment in the sector. Large numbers of workers are an important encouragement, because a resource of qualified personnel is then easily accessible. This aspect is presented in table 2.

Table 2. Employees in the R&D sector, years 1995—2004. Number of persons as of 31 Dec.

Years	Total[a]	Incl. full-time employees	Scientific-research staff[a]	Scientific-research staff in relation to total employment (%)
1995	120004	111832	74748	62.29%
1996	128211	118584	81611	63.65%
1997	128396	120502	86309	67.22%
1998	128231	118738	85495	66.67%
1999	126000	118427	86318	68.51%
2000	125614	116824	88189	70.21%
2001	123840	115153	89596	72.35%
2002	122987	112369	90842	73.86%
2003	126241	115693	94432	74.80%
2004	127356	116779	96531	75.80%

a – Full-time and part-time employees without conversion to full-time employment.
Source: *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 21 and earlier editions.

Between 1995 and 1997, employment in the sector grew rapidly, by almost 7,000 in 1996 and 6,000 in 1997. Starting from 1998, Poland's economy showed a moderate upward trend (the number of scientists increased by 1% a year). Characteristically, the number of scientists in relation to total employment in the R&D sector was steadily growing in the analysed period, excluding 1998. This trend is favourable and seems to confirm conclusion derived from table 1 about restructuring processes going on in the sector.

The scientific potential of every country is defined as much by current indicators as the future opportunities. An increasing number of university students can be expected to expand the resource of potential R&D workers. Table 3 shows that the number of students almost tripled in the last decade.

Table 3. Higher learning institutions (selected types)

Specification	Schools	Institutes	Students (thousands)
Total **1995/1996**	179	727	794.6
..... **2000/2001**	310	945	1584.8
..... **2003/2004**	400	943	1858.7
..... **2004/2005**	427	1059	1926.1
Universities..... 2003/2004	17	371	543.4
..... 2004/2005	17	407	554.9

Table 3. Higher learning institutions (selected types) – continuation

Specification	Schools	Institutes	Students (thousands)
Technical universities.....2003/2004	22	212	342.4
.....2004/2005	22	212	340.2
Academies of Economics 2003/2004	93	55	382.3
.....2004/2005	93	65	387.9
Higher vocational schools.....2003/2004	151	134	166.8
.....2004/2005	181	152	207.1

a – established under the Higher Vocational Schools act dated 26 June 1997 (Official Journal No. 96, item. 590) with amendments.
Source: *Statistical Yearbook 2005*, GUS, Warsaw 2005, p. 334, and earlier editions.

In the last two years the number of students attending three types of schools increased, only technical schools suffered from a small drop, rather painless considering the total number of students.

Another indicator that reflects the condition of education is enrolment ratios presented in table 4.

Table 4. Enrolment ratios for tertiary education (age group 19 – 24 years[a])

Specification	Gross[b]	Net[c]
1990/1991	12.9	9.8
1995/1996	22.3	17.2
1999/2000	36.9	28
2000/2001	40.7	30.6
2001/2002	43.6	32.7
2002/2003	45.6	34.5
2003/2004	46.4	35.3
2004/2005	47.8	36.8

a – Excluding extramural students and foreigners, *b* – relation of students (as of beginning of the school year) at a given level of education (regardless of age) to the number of population (as of 31 Dec.) in the age group corresponding to that level of education, *c* – relation of students (as of beginning of the school year) at a given level of education (in a given age group) to the number of population (as of 31 Dec) in the age group corresponding to that level of education.
Source: *Statistical Yearbook 2005*, GUS, Warsaw 2005 p. 341 and earlier editions.

A year-by-year analysis of data provided in the table clearly reveals a steady upward trend. Special attention should be paid to relations between the gross and net values. The growing differences suggest that the tertiary education is taken by persons that did not have such plans before. A justified conclusion is that population is willing to improve its qualifications and that education is viewed as more and more important.

The presented data evidence that today's Poland has a large human potential in the field of R&D, although data on the numbers of scientific and research workers by research type are not available. Notwithstanding, assuming that employment is proportional to research expenditures, a picture can be formed in which fundamental research predominates and the emphasis on applied research is relatively weak. An unfavourable factor throughout the investigated period was the GERD/GDP ratio. The scientific potential can be expected to grow, as suggested by the increasing total number of students and their numbers in some types of schools. The trend is also confirmed by a growing enrolment ratio.

4. Assessment of foreign firms' involvement in R&D

Foreign enterprises have been allowed to establish their subsidiaries on the territory of Poland since 1990. In the first years of economic opening foreign organizations running R&D activities were rare phenomenons[13]. The available statistical data provide information on this type of involvement only from 1997.

Table 5. Domestic expenditure and numbers of R&D workers in enterprises with foreign majority ownership, years 1997–2004

Years	No. of units	Expenditure		Employment	
		Total	incl. budgetary funds	Total	incl. scientific-research workers
		thousand PLN		as full-time employment[a]	
1997	33	134 922.0	74.7	1283.0	697.0
1998	44	205 126.7	930.5	1793.4	730.2
1999	57	382 003.7	300.0	1595.1	924.1

[13] Because foreign enterprises wished to exploit their ownership, location and internalization advantages in the first period; besides, the R&D sector in Poland was unfamilar and its level of technological development was low – from the author.

Table 5. Domestic expenditure and numbers of R&D workers in enterprises with foreign majority ownership, years 1997–2004 – continuation

Years	No. of units	Expenditure		Employment	
		Total	incl. budgetary funds	Total	incl. scientific-research workers
		thousand PLN		as full-time employment[a]	
2000	57	224 992.0	4 700.5	1576.1	879.2
2001	44	91 937.9	768.1	670.9	463.7
2002	35	97 497. 6	1197.8	623.8	425.5
2003	44	116 087.5	205.0	857.3	587.9
2004	60	241 657.8	412.0	1382.0	1036.2

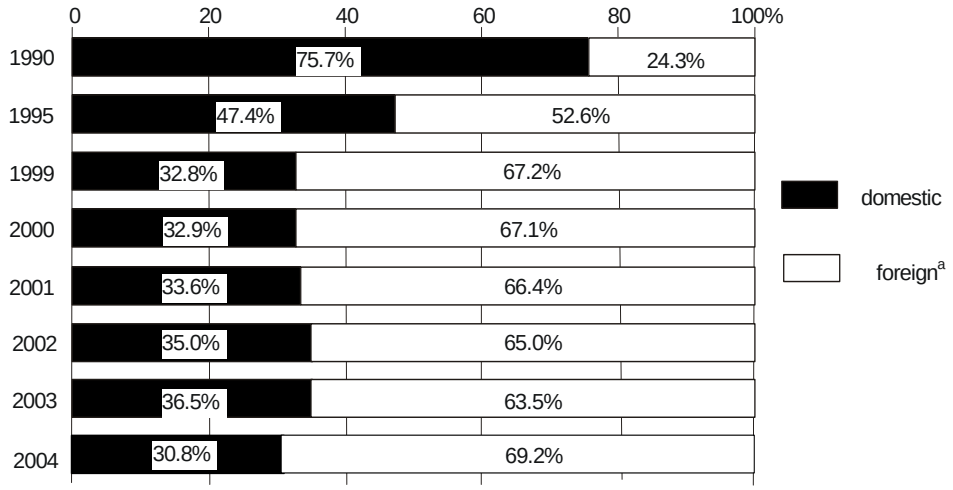
a – equivalents of full-time employment.
Source: developed by the author based on *Nauka i technika w 2004 roku*, GUS, Warsaw 2005 and earlier editions.

Data in table 5 show a small number of foreign enterprises conducting R&D activities; before the year 2004, their number never exceeded 60 organizations. Worth noting is the low proportion of national budget's funds in enterprises' expenditures – it surpassed 2% of total funds only in the year 2000. Employment clearly declined at the turn of 2000 and 2001. At that time, both total employment in the R&D sector as well as the number of scientific and research workers dropped by over 50%. The probable reason was restructuring aimed to improve enterprises' financial condition.

An interesting phenomenon is the major change that took place in 2004 – the total number of enterprises involved in R&D increased and employment in the sector grew by over 61%. When the number of employed scientists alone is analysed, a very positive situation is discovered – the group increased by over 76% compared with the previous year, which changed their proportion in total R&D employment.

Another measure allowing indirect identification of foreign enterprises' involvement in the R&D sector is the patent statistics. Chart 2 compares numbers of patent applications submitted by the domestic and foreign enterprises between 1990 and 2004.

Chart 2. Domestic and foreign patent applications submitted in Poland, years 1990-2004



a – Submitted to the Polish Patent Office- directly and under the PCT.
Source: Polish Patent Office data, after: *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 99.

According to the chart, the proportion of patent applications submitted by foreign firms started to **exceed** the number of domestic submissions from 1995, and between 1999 and 2003 it **oscillated** around 65%, coming close to 70% in 2004. Data that are more detailed are provided in table 4. They show that domestic firms made more submissions than foreign organizations did only before 1994. This trend proves that transnational corporations expanded their R&D activities.

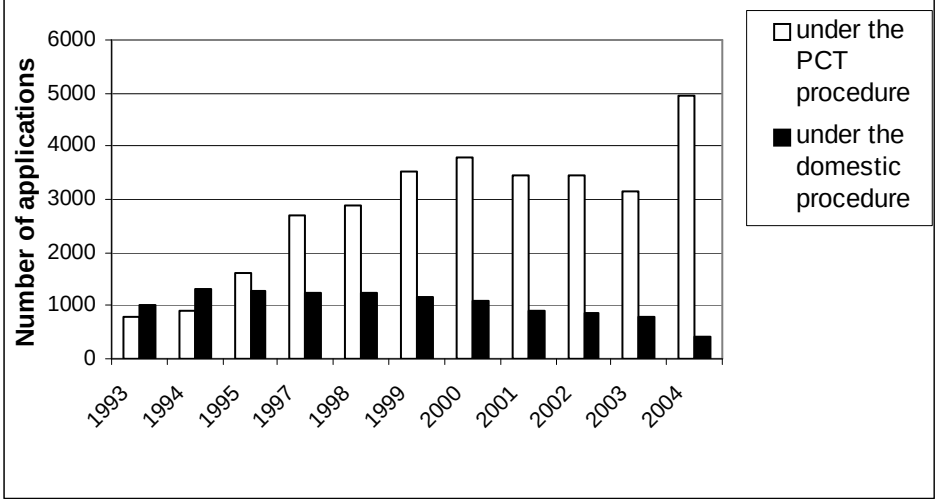
Table 6. Domestic and foreign patent applications filed in Poland between 1990 and 2004

Specification	1990	1993	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004
Inventions:												
Domestic	4105	2658	2676	2595	2399	2407	2285	2404	2202	2313	2268	2381
Foreign	1316	1807	2221	2874	3948	4128	4671	4894	4344	4295	3941	5359

Source: *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 100.

The above conclusion seems true, but when the mode of making the submissions is examined, then the earlier findings are not so certain any more[14]. This opinion is confirmed by chart 3 presented below.

Figure 3. Patent applications filed by foreign enterprises in Poland between 1993 – 2004

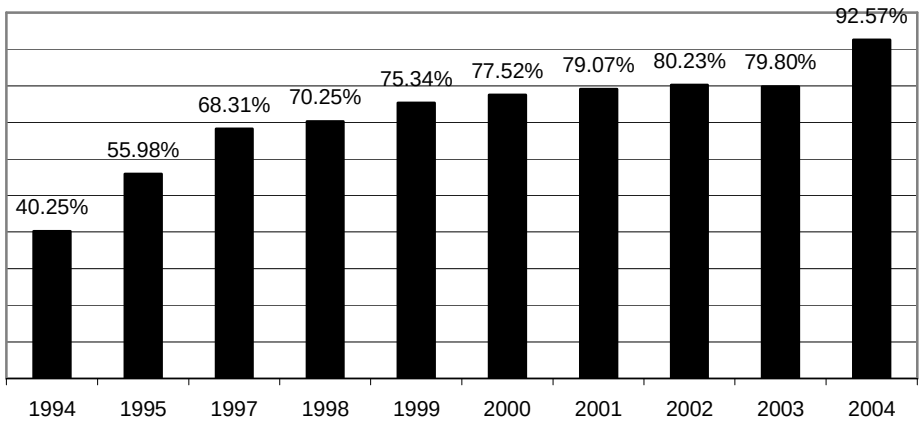


Source: *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 100.

Growth trends characterising the total number of patent submissions and patents made under PCT reveal a distinct similarity. This issue is presented more in detail in chart 4, where PCT submissions are shown as percentages of total patent submissions made by foreign firms.

[14] Patents can be submitted to the Polish Patent Office directly or under the Patent Cooperation Treaty. The other option is an international facility producing the same legal effects as a domestic submission made in a country-signatory to the treaty. For instance, a corporation applying for patent protection in Germany can also seek protection in Poland – from the author.

Chart 4. Share of patent applications submitted by foreign firms under PCT in total patents



Source: author's calculations based on *Nauka i technika w 2004 roku*, GUS, Warsaw 2005, p. 100 and other annual volumes.

The presented situation can be explained in one of two ways:

1. Corporations use scientific resources located outside Poland, which should indirectly induce a decline in R&D activities in Poland, but the 2004 data seem to challenge this interpretation.
2. Corporations prefer to submit patent applications in their own countries, perhaps hoping for a more effective patent protection (another issue is the very process of invention development that depends on the structure used to manage corporation's R&D centres)[15]. This case might suggest that technology transfers occur between a subsidiary and the parent company.

The presented data on R&D activities pursued in Poland by transnational corporations show that despite the availability of well-educated scientific staff, transnationals were not inclined to increase employment and establish new R&D centres until the year 2003. However, patent statistics are not a fully reliable source of information on transnational corporations' involvement in R&D. The last two years suggest that the situation has been gradually improving, judging by favourable data showing growth in employment and R&D centres in 2004.

[15] See: Gassmann O., von Zeidwitz M., *New Concepts And Trends In International R&D Organization*, Research Policy 28, 1999, p. 235.

The first signs of the trend appeared as early as 2000. Motorola, Siemens, and Samsung are examples of firms that decided to launch their R&D activities. In 2000, Motorola employed 50 engineers and the other two corporations 10 engineers each. After four years, Motorola employed as many as 500 specialists, Siemens 600, and Samsung 97. In 2005, the Korean company had 300 engineers, and the other two organizations around 700 each[16]. Statements made by the corporations' representatives suggest that they would increase their employment in the future. This attitude is very valuable, because it is much more costly to create one R&D job than a job in the manufacturing industry[17].

Examples of Motorola, Siemens, and Samsung are not unique – Poland has today around 40 research and development centres employing over 3000 specialists. The most important of them are presented in table 7.

Table 7. Foreign R&D units in Poland

Firm name and sector of activity	Place of establishment	No. of scientists	Employment expansion plans
ABB, Machinery	Krakow	N/A	N/A
ADB	Zielona Góra	320	N/A
Aldec-ADT	Katowice	80	95 (2005)
American Management System	Krakow	N/A	200
Avon	Garwolin	5 (2005)	N/A
Bombardier	Katowice	120	N/A
CapGemini Polska	Wrocław	N/A	N/A
Cederroth	Radzymin	N/A	N/A
CH2M HILL	Krakow	N/A	N/A
ComArch	Krakow	200 (2002)[18]	N/A
COMP Rzeszow	Rzeszów	N/A	N/A
Compuware	Gdansk	80	N/A
Delphi, Automotiv	Krakow	560 (2005)	800 (2007)
GE Security	Gdańsk	20	N/A
General Electric Aircraft Engines	Warsaw	150 (2005)	200 (2007)
GlaxoSmithKline	Poznań	N/A	N/A

[16] *Informatyka przyjmę*, Rzeczpospolita, 18.05.2005, no. 116.

[17] Only Samsung representatives decided to reveal how much it cost to create and then maintain one job in an R&D centre – the amounts are US$ 60,000 – 70,000 and 30,000 – 35,000, respectively – see *Informatyka przyjmę*, Rzeczpospolita, 18 May 2005, no. 116.

[18] http://www.pckurier.pl/archiwum/art0.asp?ID=5994.

Table 7. Foreign R&D units in Poland – continuation

Firm name and sector of activity	Place of establishment	No. of scientists	Employment expansion plans
IBM	Krakow	40 (2005)	200 (2007)[19]
IMG Poland	Warsaw	150 (2005)	N/A
Intel	Gdańsk	200	N/A
Kroll Ontrack	Katowice	10 (2004)	N/A
LG Electronics	Ciechanów	N/A	N/A
Lucent Technologies	Bydgoszcz	200	N/A
Lurgi	Krakow	N/A	N/A
Mentor Graphics Polska	Katowice/Warsaw	72 (2003)	100 (2005)
Microsoft	Warsaw	N/A	N/A
Motorola	Krakow	700 (2005)	N/A
Oracle	Warsaw	N/A	N/A
Philips	Piła, Kętrzyn	N/A	N/A
Pliva	Krakow	N/A	N/A
Pratt & Whitney	Rzeszów	N/A	N/A
Remy Internationale	Wrocław	N/A	N/A
Samsung Electronics	Warsaw	300 (2005)	600-700 (2007)
SAS Institute	Warsaw	160[20]	N/A
Siemens	Wrocław	600 (2006)	N/A
TopGaN	Warsaw	N/A	N/A
TRW Automotive	Częstochowa	150 (2005)	300 (2006)
WABCO/American Standards Companies, Inc.[21]	Wrocław	N/A	N/A

Source: developed by the author based on press articles (www.rzeczpospolita.pl) and information from the Polish Information and Foreign Investment Agency (http://paiiz.gov.pl.).

Foreign corporations assess Polish contribution to R&D upon growing employment in the domestic centres. Low labour costs combined with good results achieved by Polish scientists are the most important incentives encouraging R&D investments.

[19] http://www.finanznachrichten.de/nachrichten-2005-09/artikel-1960523.asp.

[20] http://www.sas.com/offices/europe/poland/sas/index.html.

[21] Information based on A. Grycuk, *Investment Conditions In Poland – Highlights, Trends & Recent Developments*, Doing Plastics Business in Poland 2005 Conference, Krakow, 30-31 May 2005 Adrian Grycuk PAIiZ 2005.

4. State's support to the R&D industry – the institutional framework

The presented data on R&D expenditures make us realize how seriously the industry collapsed. Poland is probably the only country in the region that did nothing for the 15 transition years to formulate a transparent R&D development strategy and an innovation policy[22].

Insufficient funding is only one aspect – the other one is that the fund distribution system does not meet, as empirical data suggest, the demands of today's economy. Some structures are the legacy of the previous system and now they effectively oppose all reformation attempts. These are state-owned RDUs (Research and Development Units) that operate under a Parliament Act made effective in 1985 and amended afterwards[23]. At present, the total number of RDUs is 204 and they employ around 25,000 workers. Formally, they pursue R&D activities; however, some of them actually do not do any research, but reap benefits associated with their status (e.g. exemptions from the income tax and local taxes).

Part of RDUs' privileges was extended to include private enterprises only in the middle of 2005. Before that, private enterprises' involvement in R&D did not entitle them to any tax exempts or relieves. In practice, they could not deduct any amounts spent on R&D. On 29 July 2005, the innovation support act was put into effect to rectify the situation. The act provides for a range of incentives intended to encourage entrepreneurs to cooperate with scientists (only 6% of SMEs have links with research units[24]) and to develop their own solutions. The most important instruments promoting enterprises' involvement in R&D are:[25]

1. A technological loan supporting entrepreneurs wishing to base their investment projects on new technologies. The loan is granted from the Technological Loan Fund via the Bank Gospodarstwa Krajowego; part of the loan is subject to remission. The loan is to serve the SME sector, which the act explicitly stresses by excluding large investment projects, and promotes firms according to the size criterion[26]. The loan is granted according to the market rules and entrepreneurs' matching funds cannot be less than 25% of the total loan amount, whose maximum value is set at 2 million euros.

[22] Until mid 2006, R&D activity was only regulated by tax provisions set out in the corporate income tax law of 15 February 1992 and the VAT law of 11 March 2004 – from the author.

[23] Amendment of 2000 and the bill of 2005, now discussed by the Polish Parliament.

[24] Ministry of Economy and Labour's data as of the end of December 2004.

[25] *Some forms of innovation supporting law*, 9 July 2005 (Official Journal 2005 no. 179, item. 1484).

[26] Article 6 item. 7 – from the author.

The largest amount of public funds subject to remission is 1 million euro, or 50% of the loan drawn; in each calendar year, the remitted amount must not exceed the product of 10% of the loan drawn times the number of years that elapsed from the day the loan was granted. The law imposes other restrictions as well, depending on investment project's location and purpose.

2. Eligible for the status of an R&D Centre are enterprises that meet predefined criteria (net receipts from the sale of own R&D products have to make up at least 50% of total receipts earned in the accounting year preceding the submission of the application for the status and cannot be less than 800,000 euros). The RDC status entitles organizations to tax exemptions applying to R&D activity (income tax, real property tax, agricultural tax, and forest tax).
3. Changes in the tax law. Enterprises are allowed to treat amounts spent on the development work as cost items in the fiscal year, in which the work was completed, regardless of its outcomes. Besides, the cost of a new technology purchased from Polish or foreign research institutes can be deducted from the tax base – SMEs are allowed 50% and other types of enterprises 30%.
4. R&D services are now taxable at 22% VAT rate. This solution makes it possible to deduct VAT amounts paid by firms in the R&D sector.

Final comments

Theory allows to distinguish between two aspects of technology transfers made by foreign R&D centres. One concerns the profile of activities run by a research and development unit and determines the directions of transfers within corporation’s structure. The other aspect is connected with technology transfers to the host country’s economy.

The most important factors motivating a corporation to set up an R&D centre and to run this type of activity are, *inter alia*, a dynamic and leading market; proximity of the points of sales, friendly legal regulations and agreements on standards; linkages connecting the R&D industry, manufacturing processes and networks of suppliers, access to highly skilled personnel and the presence of worldwide development centres in a given area.

Public allocations to R&D have been declining for many years. Since 1990, the state budget expenditures have never exceeded 1%. In 2003, the GERD indicator dropped to a record low value of 0.56. In addition, the structure of R&D expenditures suggests that the fundamental research is strongly emphasised at the cost of applied research and development work. Although new concepts are generated, the economic results do not improve, because of a lower

number of implementations. If budget allocations to R&D are not restructured, then the efficiency of the entire economy may deteriorate in the long term. Besides, this situation casts a very unfavourable light on Poland as an EU member, because of the goal the 27 countries set in the modified Lisbon Strategy (3% of GDP allocated to R&D).

An analysis of R&D employment reveals that Poland has a substantial scientific potential; particularly important is the growing share of scientists in total employment in the industry. However, the present structure of financial allocations prevents a full use of the phenomenon[27]. Another noteworthy fact is the expanding number of students and growing enrolment ratios in higher education – both the factors suggest that Poland's scientific potential keeps increasing.

After the beginning of 1990s, transnational organizations were not very much inclined to initiate R&D projects – those that were never exceeded 57 firms and in 2002 their number was only 35. This situation changed favourably in 2004, when the number of R&D units and scientists reached a record high value in the analysed period. Foreign organizations submit definitely more patent applications than the domestic firms do. A worrying phenomenon, however, is that most applications are filed at the Polish Patent Office under the PCT facility. This fact may suggest that the domestic units rarely participate in the development of new solutions. A probable reason is that transnational corporations adjust their structures managing R&D networks in the age of globalization.

Several tens of R&D centres develop new technologies in Poland today. Since the year 2000, we have been able to observe growing employment in R&D and formation of new R&D establishments. Interestingly, most of the projects are greenfield investments. The probable reasons are corporations' better knowledge of Poland's technological potential, but primarily results achieved by the existing R&D centres. The factors attract other foreign firms and encourage them to set up their own centres in order to accumulate the technological potential. International experts believe that Poland is one of the best places for investment[28]. It is also worth remembering that the very establishment of a research and development centre can be treated as a technology transfer in itself – the scientific and research equipment apart, the most important factor is humans. A corporation has to provide adequate training (i.e. to share the know-how) and relevant knowledge (tacit), enabling the performance of the

[27] For the sake of exemplification, the RDUs employ over 25 000 persons.

[28] *Transnational Corporations and the Internationalization of R&D, World Investment Report 2005*, p. 34.

programmed tasks. This evidently points to the existence of technology transfers between the parent companies and their subsidiaries. No tangible proof has been found, however, that might confirm the existence of such transfers to domestic firms.

An analysis of the system of incentives applied by the state to encourage private entrepreneurs' involvement in R&D activities unveils a long period of standstill – for almost 15 years Polish regulations did not change much, apart from minor modifications introduced to VAT and CIT laws. The consequences are private capital's limited participation in R&D expenditures and generally low degree of innovation in the Polish economy. The innovation support act passed in April 2004 has introduced a range of instruments improving the status of the private R&D sector. The instruments define state's direct aid (technological loans) and provide for tax incentives (exemptions from CIT and PIT, R&D services are taxable at 22% VAT rate, enterprises are entitled now to apply for the RDC status). Changes made by the new law are indisputably necessary and their course is favourable.

An additional argument for private enterprises to increase their R&D spending is the commencement of EU's 7th Framework Programme (2007 – 2013) and implementation of the related National Development Plan for Poland. It can be hoped that projects carried out under the programmes, supported by substantial funds and changes in the law, will increase R&D expenditures not only in foreign firms, but also in Polish organizations, and that the trend observed in Poland in the recent years will continue, fuelled by country's expanding scientific potential. We should not forget, however, that any effects of the introduced solutions can be reliably verified after some years from the initiated actions.

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