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FORMS AND TRENDS OF THE INTERNATIONAL TECHNOLOGY TRANSFER WITHIN THE CMEA

Technology transfer in the World Economy

The development of knowledge and acceleration of the process of scientific-technological progress are the elements which determine the competitive position of particular countries or group of countries on the international market. [1]

Modern technology and scientific-technical ideas, understood as the knowledge applied in the process of goods production and material services, have become the main factor of production.

The dominant role of technology as a production factor results from its impact on:

— the effectiveness of utilization of other production factors and resource intensity of GNP,

— creating new methods (process innovation) and new products (product innovation),

— rate of growth and trends in the economic development.

The result of the above mentioned features of modern technology and of the role it plays as production factor, is technology transfer on the international scale, frequently very closely connected with transfer of capital and labour. [2]

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[1] Worth mentioning here is the paper „The Theory of Economic Development" by J.A. Schumpeter in which the author, as one of the first theoreticians of economics,points out to the role of innovation in the process of economic growth.

[2] Neofactorial theory of international trade introduces a new category of human capital in order to underline the importance of employees' qualifications and organization efficiency of economic process of comparative superiority formation.

International technology transfer derives from technological-economic premises and it is a universal phenomenon occurring independently from the socio-economic systems. [3]

We can distinguish technology transfer in its pure form (as written information, technical documentation) and as embodied technology (in the form of machine and high tech trade).

From the point of view of its form, technology transfer can be commercial and non-commercial .Commercial transfer of technology comprises:

— licence and know-how trade, [4]
— high-tech trade,
— direct investments. [5]

Non-commercial transfer comprises — international exchange of scientists and highly qualified staff (conferences, symposiums), and international programmes of scientific-technological co-operation or economic assistance.

Mainly the commercial forms of technology transfer, ie. licences and high-tech trade, are subject to economic analysis.

In order to determine the place of the CMEA in the international technology transfer, we shall consider in this article these basic forms of transfer.

Socialist Countries in the International Licence Trade

The international market of licences has been dominated by highly developed capitalist countries. They account for over 80% of licence trade, whereas socialist countries account for 10 to 15%, and developing countries for 5 to 7%.

The CMEA countries, like developing countries, play the role of importers on the international market of licences and know-how. A certain gradual increase in licence export revenues can be observed, especially in the seventies when out of the total of 700 licences sold by socialist countries till 1976, more than half was sold in 1971—1976. The import of licences in that period was characterized by considerably higher dynamics and absolute volume. In the period 1960—1965, socialist countries bought from capitalist countries about 300 licences, in 1966—1970 about 700, and in 1971—1975 as many as 1200. [6]

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[3] A great importance of modern technologies for the economic growth (also in the military sector) often causes hampering of international technology transfer, especially in case of double use goods, for political reasons. An example can be the activity of the COCOM Committee.

[4] The structure of technology transfer in its pure form is as follows: 55% of licence transactions comprise mixed licences (patents and know-how), 25—30% are licences of know-how type, 15—20 are patent licences. Comp. M. Bijak-Kaszuba, Transfer technologii we współczesnej gospodarce światowej a stosunki ekonomiczne Wschód—Zachód, Zeszyty Naukowe Uniwersytetu Łódzkiego, 1980, no. 45, p. 3.

[5] For mutual CMEA turnover it can be assumed: joint investments (mainly in the sector of raw materials) and export of turn-key objects.

[6] The largest number of licences was bought by the Soviet Union (ca. 100 a year), then by Poland and Czechoslovakia (ca. 50 a year). Comp. J. Wilczyński, Licences in the East-West Transfer of Technology, Journal of Trade Law, March-April 1977. Purchase of licences was most frequently connected with import of machines, devices, production lines, turn-key objects and with substantial import of supplies for current production. This resulted in a considerable dependence of socialist countries on deliveries from developed capitalist countries.

The value of licence trade of socialist countries with capitalist countries is illustrated by the table below.

Table I

LICENCE TRADE BETWEEN SOCIALIST AND CAPITALIST COUNTRIES IN THE PERIOD 1966—1977 (IN $ MLN)

Country	1966		1970		1977	
	revenues	expenditures	revenues	expenditures	revenues	expenditures
Bulgaria	—	32,5	—	0,7	—	—
Czechoslovakia	0,8	4,0	9,0	47,0	12,0	48,0
GDR	—	10,0	2,0	15,0	7,5	6,0
Poland	0,3	6,3	0,2	50,0	2,6	80,0
Hungary	0,1	0,9	0,4	1,5	3,0	3,6
Roumania	—	127,0	—	—	—	—
USSR	—	300,0	—	300,0	—	—

Source: J. Monkiewicz, Międzynarodowy rynek myśli naukowo-technicznej w latach osiemdziesiątych (International market of scientific-technological ideas in the eighties), Handel Zagraniczny 1980, no. 2, p. 24.

Along with licence trade with capitalist countries, the CMEA countries practise the intra-bloc exchange of licences. This reflects the importance ascribed by the CMEA countries — including the Soviet Union — to technology diffusion over the whole area of the CMEA in accordance with the principle of leveling the economic development. [4]

In the first period of the CMEA functioning, this task was accomplished by the free intra-bloc exchange of technical documentation. It has been estimated that till 1970 the Soviet Union provided the member states andYugoslavia with over 27 thousand sets of scientific-technological documentation, worth about 15 billion roubels. Sixty per cent of that documentation was supplied to Bulgaria, Poland and Czechoslovakia. In the same time, the Soviet Union received from other CMEA countries about 15 thousand sets of documentation, mainly from Czechoslovakia (38,4%), German Democratic Republic (19,2%) and Poland (18,6%). The documentation was meant mostly for heavy industry.

Till 1970, the CMEA countries (exclusive of the Soviet Uniont) exchanged about 40 thousand sets of documentation. [8]

Since 1970 the intra-bloc flow of documentation has been on commercial principles, i.e. licence sale. In 1971—1975 the CMEA countries concluded over 400 licence transactions, and moreover, they exchanged about 14 thousand sets of technical documentation free of charge. [9]

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[7] In the history of Soviet economy, technology transfer was an important factor of economic reconstruction both in the first period of industrialization and in the period of industrial development during the Second World War. Comp. A. Köves, Opening to the World Economy: Challenge and Pressure. Budapest 1980.

[8] Comp.: S.I. Stiepanienko, Sowierszenstwowanije nauczno-tiechniczeskogo sotrudniczestwa stran SEW, Moscow 1974, p. 154.

[9] Comp.: S.I. Simanowskij, Pieredacza tiechnołogii miedzu stranami czlenami SEW. Woprosy Izobrietatielstwa, 1978, no. 5. In the period 1970—1978 Poland bought 452 licences and sold 78. Only 8,4% of the purchased licences were from the CMEA countries. Comp.: S. Bukowski, Kooperacja przemysłowa Polski z krajami RWPG, Sprawy Międzynarodowe 1986, no. 6, p. 71.

The CMEA in the International Exchange of Patents

The data concerning the international exchange of patents published by the World Intellectual Property Organization, duly reflect the effect of resarch carried out in particular countries. The data are very closely connected with the world licence exchange which has already been presented. Many authors stress close relationship between the number of inventions submitted for patents and the development of exports. Patents are particularly connected with high-tech exports and exchange of scientific-technological ideas. [10] In the CMEA countries there have been observed various periods in patenting activity; it showed a decreasing tendency in the seventies. In 1980 the total number of patents granted abroad to the CMEA countries (exclusive of the Soviet Union) did not exceed the level of Italy (5.888 patents).

The number of patents granted to inventors in the CMEA countries varies. In the Soviet Union the number of inventions submitted for patents every year is comparable with that in Japan; Czechoslovakia, Poland and GDR are on the level of Great Britain, whereas other European socialist countries are on the level of Austria and Benelux counries. [11] Due to low effectiveness of the chain science-technology-production, in the socialist countries the commercialisation, process of an invention is very long or ends at the stage of an idea. Therefore many inventions are submitted abroad to be sold, without any connection with other forms of expansion to foreign markets.

Low patenting activity of the CMEA countries (see Table 2) is connected with the commodity structure of exports which differes from that of the developed market economies. [12] In the socialist countries the share of high technology goods is smaller than the share of traditional

Table II

PATENTS GRANTED ABROAD TO THE CMEA COUNTRIES

Country	1970	1975	1980
Bulgaria	98	168	197
Czechoslovakia	1512	1039	505
GDR	1844	2430	653
Poland	481	382	407
Roumania	207	150	92
Hungary	752	1260	1351
Total:	6619	8440	5774

Source: Industrial Property Statistics, WIPO, Geneva, year-books 1970, 1975, 1980.

[10] Comp.: K. Pavitt, R+D, Patenting and Innovating Activities. A Statistical Exploration ,Research Policy 1982, no. 11.

[11] Comp.: J. Maciejewicz, Międzynarodowa wymiana patentowa, Sprawy Międzynarodowe 1984,no. 2.

[12] For the sake of comparison it can be added here that in 1980 Holland was granted 4.016 patents, France 13.159, Japan 20.949, West Germany 33.953 and USA 56.240.

goods wich do not require patent protection. The effectiveness of R+D is still low due to insufficient motivation for innovative activity and unsatisfactory implementation of the effects of research works. [13].

The CMEA share in the international high-tech trade is not satisfactory — at the end of the seventies it constituted 9,4% of the world export and 12,3% of the world import of goods from the group SITC 5 (chemical products) and SITC 7 (machines, equipment and means of transportation). The small share in high-tech trade deprives socialist countries of the possibility to gain profits from the most dynamically developing segment of the world market. [14]

The share of intra-bloc trade in satysfying the demand for high-tech goods is large. In the seventies 20 to 30% of this demand was satisfied with supplies from capitalist countries.

The share (in per cent) of machines and transportation equipment in the CMEA total imports from western countries is ilustrated by the following list:

1965	1970	1975	1980	1983
28,8	35,2	36,0	25,9	31,7

Source: A. Köves, The CMEA countries in the World Economy, Turning Inwards or Turning Outwars, Budapest 1985.

These data show that in the period of the CMEA „open policy towards the West" in the seventies, the share of machines and transportation equipment in the CMEA total imports from western countries did not exceed 36%. Thus it never exceeded the outside OECD export of products from this group. This indicator, then, cannot be regarded as excessive. It was subject to rapid fluctuations, slumping in 1980 to the level much lower than in 1965. In the seventies, 70 to 80% of machines and equipment were of the CMEA origin. [15] The problem of quality, punctuality of intra-bloc deliveries, their technical level and technological advancement has not been solved yet. [16]

The statistical data, presented above, show the position of the CMEA in the international technology transfer and point out to its relatively small share, inadequate to the economic potential.

In spite of considerable „openness" of economies in the seventies, most of the CMEA countries have retained the position of exporters of

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[13] Poland's licence trade with capitalist countries usually lead to industrial co-operation, whereas in case of CMEA countries, licence co-operation agreements do not occur. Comp.: S. Bukowski, op. cit., p. 72.

[14] It has been assessed that world's high-tech turnover increases at the rate twice as high as the average rate of growth of the world's global turnover. The CMEA countries lose their share in this turnover for the benefit of developing countries, particularly the NICs. For example, still in 1970 the CMEA countries exported more machines than developing countries, but already in 1977 export of machines by developing countries exceeded four times the value of the CMEA exports. Comp.: L. Csaba, Rola RWPG w gospodarce światowej lat osiemdziesiątych, Sprawy Międzynarodowe 1984, p. 19.

[15] Comp.: P. Hanson, Forms and Dimensions of Technology Transfer between East and West, Vienna-New York 1977.

[16] Comp.: R. Chwieduk, Zmiany strukturalne w gospodarce krajów RWPG i ich wpływ na handel zagraniczny (synteza), Warsaw 1981.

traditional goods, not requiring advanced technology and exposed to the competition of the Third World countries. [17]

Lack of coherent and efficient policy in technology transfer development and lack of economic mechanisms resulted in a limited adaptability of the CMEA production and export structures to the changes in the world demand pattern and to the changing terms of competitiveness in the world market.

Main Trends in Forming the CMEA Policy of Scientific-Technological Co-operation

The assessment of the CMEA share in the international transfer of technology triggers off questions about the trends of scientific-technological policy which could improve the current situation.

Medium- term programmes of scientific-technological co-operation, approved by the CMEA organs, will be proceeded ty the presentation of scientific-research potentials of the member states. These potentials constitute a considerable part of the world's scientific-research capacity. A policy characteristic for integration processes i.e. concentration of means and selection of research programmes within the whole grouping, facilitates the synergy effect and averts insufficient effectiveness and overlapping of research works. [18]

The expenditures on research and development programmes in the CMEA countries (in roubles at the official rate of exchange) amounted to 29,5 billion roubles in 1980; this sum constituted 24,4% of the world expenditures. In the same year, the expenditures in capitalist countries were 87,8 billion roubles, what meant 72,7% of the world expenditures (the USA share was 38,6%). [19]

The seventies were characterised by diversified dynamics of R+D growth in the CMEA countries. It reached 148,7% (1970 = 100) in the first half of the decade, then it declined and the index value fell to 122% (1975 = 100) in 1980. [20] The drop in R+D costs was connected with weakened dynamics of economic development in the CMEA countries in that period. [21]

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[17] It must be stressed here how important a closer scientific and production intra-bloc co-operation is, especially when accepting the variant of increasing the mutual turnover and decreasing the necessity of adjustment to competitive pressure in the world market. Weakness of the previous co--operation bonds can be proved by the fact that in 1972—1984 Poland's share of the co-operation turnover reached the range of 0,5% to 2,3%; the maximum was in the mid-seventies. Comp.: S. Bukowski, op. cit. p. 65.

[18] A necessary condition for making joint or co-ordinated scientific-research policy efficient is the introduction of changes into the functioning systems of particular economies.

[19] Comp.: S. Budziszewski, M. Waleszko, Ekonomiczne problemy współpracy naukowo-technicznej krajów RWPG, Warsaw 1985, p. 47.

[20] In 1980 the growth index of outlays on R+D in capitalist countries amounted to 150% (1975 = 100), and in the USA 162% (1975 = 100).

[21] It must be remembered that there exists a possibility of feed-back effect in the form of hampering the GNP rate of growth triggered off by the decreased outlays on R+D, which means the weakened impact of the intensive growth factor, i.e. scientific and technological progress.

Apart from substantial R+D outlays, the CMEA countries possess a considerable labour force potential of 5,2 million people employed in the R+D sector, out of which 1,6 million are research workers — — this accounts for 1/3 of the research workers employed in the world. Relatively low effectiveness of this potential is proved by the fact that the number of inventions and new technological solutions per one employee in the R+D sector is twice as low as the world average.[22] There are various reasons for this situation. Apart from weak economic motivation ,low technological level of laboratory equipment, dispersion of valuable apparatuses in many research centers, the weakness of the chain „science-industry" must be also mentioned. All these factors are responsible for the fact that on average only 30% of patented inventions are implemented by industry (in the USSR 25—30%, GDR 40%).[23] This in turn means that over 60% of patents do not find any practical application in the CMEA countries. The same concerns the results of joint research works carried out in the member states (according to the data of MIEP MSS in Moscow only about 30% of the results are implemented). The reason for this is that previously the subjects of joint research works were decided upon on he basis of the existing structure and level of production, without taking into consideration the anticipated changes in methods and technology of production.

The structure of joint research works is ilustrated by the table below.

Table III

THE SHARE OF THE CMEA COUNTRIES IN JOINT SCIENTIFIC TECHNOLOGICAL RESEARCH WORKS IN THE PERIOD 1976—1980

Country	Number of problems worked out by a country	Share of a particular country in research outlays (in per cent)
Bulgaria	14	3,10
Czechoslovakia	16	10,35
Mongolia	3	0,10
GDR	13	8,3
Poland	16	16,6
Roumania	16	—
Hungary	16	5,4
USSR	16	54,15

Source: Nauczno-tiechniczeskaja rewolucyja i strukturnyje sdwigi w ekonomikie socyalisticzeskich stran, Moscow 1981, p. 130.

[22] Comp.: R. Krcz, Innowacija kak gławnyj faktor intensifikacyi ekonomiczeskogo razwitija, in: Wnutriennije i wniesznije faktory intensiwnego razwitija jewpejskich stran czlenow SEW, Budapest 1986.

[23] Comp.: G.A. Wlaskin, Aktualnyje probliemy intensifikacyi nauczno-techniczeskogo razwitija stran SEW, in: Wnutriennije ... op. cit., p. 77.

Prospects of Research Works and Technology Transfer within the CMEA

A crucial element of the scientific-technological co-operation and technology transfer between East European countries should be the Complex Programme of Scientific-Technological Progress of he CMEA till 2000 which was approved during the 41 session (extraordinary) in December 1985.[24] The main task of the Programme is to raise the level of the international scientific-technological co-operation and to speed up the intra-bloc technology transfer.

The Programme provides close, multilateral co-operation in research and development, and subsequent transfer of new types of technology and production in five areas which were given priority:

I. Electronics in the national economy for wide application of electronic and microprocessing calculation techniques and optical fibres means of communication. The agreement signed in 1985 concerning co-operation in the field of optical fibres, covers a wide scope of techniques designed for telecomunication, which in turn will constitute the basis for other applications of optical fibres.[25]

In the frame of multilateral agreement the following distribution of specialisation tasks was accepted:

1. computer aided designs	Bulgaria and USSR
2. measuring-testing devices	Hungary
3. optical-mechanical devices	GDR
4. devices for assembling monolithic integrated circuits	Poland
5. devices for semiconductor material processing	Roumania
6. production of large monolithic strucures of semiconductors	USSR
7. devices for research work and monitoring-measuring devices	CSRS, GDR[26]

II. Complex automatization with the application of flexible automated production systems. The development of complex automatization will be supported by „Interrobot" — an association established at the 41 session of the CMEA. The task of the association is to elaborate projects and impletment robots in production based on he standardized norms approved by the member states.[27]

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[24] Comp.: Biuletyn Prasowy Sekretariatu RWPG, no. 16 (1985) (special issue).

[25] Poland's anticipated share in the production of optical fibres within the CMEA is about 30%, which will earn over 500 million zlotys of active balance in the turnover of these goods. Comp.: J. Ptaszek, Polska a proces koordynacji narodowych planów gospodarczych RWPG, Sprawy Międzynarodowe 1986, no. 5, p. 72.

[26] Comp.: Biuletyn Prasowy Sekretariatu RWPG 1985, no. 16 — special issue.

[27] Poland's tasks are welding robots, electric drives and control systems.

III. Development of atomic energy aiming at the growth of effectiveness and reliability of atomic energy supplies.

IV. Research on new materials, technology of their production and processing. The main interest is focused on supplying national economies with materials of increased corrosion and radiation resistance and with high degree of chemical purity. The programme anticipates elaboration of ceramic internal combustion engines for cars, ceramic gas turbines, amorphous and monocrystal materials and their production technology. Application of new materials will increase working time and reliability of machines and devices, decrease their material and energy consumption. It will also result in a more rational utilization of such metals as platinum, chromium, nickiel or cobalt.

V. Biotechnology, with the task of increasing the available food reserves, supplementing raw material supplies, access to new sources of energy, low-waste production, decreasing environmental pollution, production of new drugs and prophylactic medicines. [28]

The tasks presented above will be carried out by a new form of joint ventures i.e. research and production co-operation comprising the whole cycle: science-development-production-scale. The CMEA countries look forward to this new form of co-operation since it would facilitate concentration of means and close co-operation at the level of an enterprise, a group of enterprises and research centres, either existing or specially established for this purpose. [29]

There has been a tendency now towards signing co-operation agreements on production of many assemblies and elements for the entire industry. The CMEA countries are highly dependent on supplies of these products from the West. [30]

Rights and duties of the participants of the research and production co-operaion are stated in the document (the so called „Orgmetodokument") approved by the CMEA Executive Committee at the 116 meeting in September 1985. [31] The following elements were taken into consideration:

1. stimulation of technology transfer based on the economic calculus,
2. development of systems of technical information transmission and processing in particular industries,
3. financing joint research in the selected branches of industry,
4. terms of international transfer of research results.

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[28] Poland participates in 220, out of 300, scientific-research problems contained in the Complex Programme. Comp. Kursom nauczno-tiechniczeskogo progressa, Moscow 1986, pp. 31—50.

[29] It is anticipated that Poland will participate together with the USSR in the project of a new delivery truck and in co-operation with Hungary and the USSR, in developing a new generation of coloured TV sets.

[30] Semiconductors and integrated circuits, microprocessors radio sub-assemblies rolling bearings, hydraulic and pneumatic elements must be mentioned here.

[31] Comp.: Programma naucznych issliedowanij po tiemmam: „Problemy nauczno-techniczeskogo sotrudniczestwa stran czlenow SEW na dogowornoj osnowie" and „Ekonomiczeskije i organizacjonnyje aspekty sowierszenstwowanija nauczno-proizwodstwiennoj kooperacji stran czlenow SEW", (duplicated material) Moscow, July 1986.

The solutions accepted in this document are of temporary and general character; the detailed measures will be introduces in the course of international research co-operation between the CMEA countries.

Summary

The analysis reveals that the position which the CMEA countries occupy in the international technology transfer and high-tech trade continues to be indaquate to their scientific-research and production potentials.

If market relations are activated and egzogenic factors bring about the desired effects, the complex programme of scientific-technological co-operation within the CMEA till 2000 may prove a turning point in the current situation.

1. Institutional framework of the scientific-technological co-operation programme should be completed with a wider usage of market mechanisms and economic calculus parameters, which would facilitate tightening production-technological bonds in the form of direct co-operation at the level of enterprise and, moreover, would bring about positive transformations in the commodity structure of trade turnover.

2. Close production-trade co-operation within the CMEA grouping requires further equalization of economic development levels, creating high level infrastructures in industry, science and research and unification of technical norms and standards.

3. In relations with other coutries, the CMEA economic policy should secure improvement of adjustment mechanisms to the world economy. The hithero existing mechanisms have caused weak positive impulses, but to a higher extent they have reinforced negative impulses resulting from the world economy. [32]

4. Adjustment mechanisms resulting from the economic reforms gradually introduced by the European socialist countries should comprise the whole economy, not only those sectors exposed to the world competition.

5. Introduction of economic reform mechanisms would facilitate the increased effect of innovation spread. [33]

6. Complementary usage of East and West technology (credits, licences) cannot be excluded, providing that their effective application is ex ante guaranteed and on the condition of detente in international relations.

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[32] Comp.: J. Kleer, Procesy dostosowawcze w gospodarce krajów socjalistycznych, Gospodarka Planowa, 1986, no. 6, p. 229.

[33] Two super-powers, the USA and the USSR, have space and military sectors on the same level of development, however, the effect of innovation spread to the civil sector is much stronger in the USA economy: Comp.: S. Gomulka, A. Nove, East-West Technology Transfer, OECD Paris 1984.