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## TECHNOLOGICAL INNOVATIONS UNDER REAL SOCIALISM: FROM SOCIOTECHNICAL NETWORKS TO "SECOND NETWORKS"

I will try to look at economic development of classical socialism and its potential for innovation by juxtaposing three different theoretical frameworks:

- 1) The resent understanding of functioning socialist economy as performing pendulum-like movement from total dominance of administrative (hierarchical) coordination (i.e. taking of the power of objects/commodities) to rise of 'second networks' (weakening the power of hierarchies and restoring the power of goods and money);
- 2) Classical Joseph Schumeter's ideas about economic development in market and non-market economies;
- 3) The STS understanding of innovations as "science and technology based" and considered as specific socio-technical (or techno-economic) networks;

The critical analysis of these three theoretical frameworks make possible the outline of the specific innovation regime in socialist economies as an dynamic interplay between a) process of expansion of universal/world-wide socio-technical networks of industrial production (and which makes former socialist economies compatible in principle with capitalist ones) and b) indigenous mechanism of straggles and negotiations between different "second networks" hidden behind the all-encompassing administrative coordination (hierarchies). This interplay possess its internal dynamics, which at the 'surface' of socialist economic development appears as changes in the capacity of socialist economy to introduce indigenous technological innovations and to absorb those made elsewhere (marked by Kornai as "two phase" in socialist technological development).

The text, which will be presented, begins and ends with two stories, presenting the the entrepreneurial activity of one key person in Bulgarian industrialization in 1960s amd 1970s – Ivan Popov. First story briefly outlines his life as small innovative entrepreneur in mid 1930s Bulgaria, which completely fits to classical Shumpeter model. The second present his role in building Bulgarian electronic industry – then as member of Politburo of Bulgarian Communist Party and Minister of electronics. The two stories helps help to understand the economic development under two very different social and economic environment and to clarify the long-term impact of these environments on the long term how the entrepreneurial activity.

### *1. Joseph Schumpeter: Communist Leaders as Entrepreneurs*

I will propose you to put aside for a while the "standard story" of communism, at least those at the time we were taught in "Scientific Communism" courses in the university: about the main contradiction of capital, exploitation and the rise of the working class headed by his vanguard, the Communist Party... We will took the less fascinating, rather ordinary Schumpeter's story about what he called *economic development* and how it is possible under the conditions of "non-market" economy.

I take for granted some preliminary knowledge about Schumpeter model of economic development. To start with few key statements that summarizes the outcome of Schumpeter's analysis:

\* The distinction between *circular flow* and *development* is fundamental for the capitalist economy. In regime of "circular flow" means that economics functions in a "static" state, routinely following the beaten track of "past cycles". The regime of "development" signifies a specific class of economic changes - the radical, abrupt changes in production.

\* The source of development is "functioning in a different way", i.e. the introduction of innovations or what he called "new combinations"

*The fundamental impulse, which puts the capitalist machine in motion is printed onto the level of consumer goods, the new methods of production and transport, new markets, new forms of industrial organisation, i.e. all those components born by the capitalist initiative. Because the new combinations are always more profitable, key aspect of "economic development" is the **competitive elimination** of the old forms of production. This process of "creative destruction" is fundamental trait of capitalism.*

\* The introduction of innovations is impossible without the function of the entrepreneur. The only contribution of entrepreneurs is their **will** and **action** in channelling the existing production resources along new tracks. But the entrepreneurs could not implement new combinations without resources, i.e.

\* having no access to capital - already existing or created ad hoc, which explains

\* the essentially different role of credits when the economy functions in a regime of development. Creating "ex nihilo" means of disbursement (through a plethora of credit tools) and thus ensuring credit to entrepreneurs, the banker seems to "suck value from the future", introduce it into the economic cycle and channel it into a new direction.

The entrepreneurs' specific combination of "will and action" is a type of leadership and demands qualities possessed as rule *by a limited circle of individuals*. This leadership is needed not only to

break routine and tradition, but also to overcome the adverse reactions of the social environment in which the new combination is carried out: the resistance of endangered producers ousted from the market by the new combination; winning over consumers; finding allies, etc. Precisely because these are "rare qualities" the next condition - providing the possibility for **every** potential entrepreneur to possess [though temporarily] the resources necessary for the implementation of new combinations, i.e. **access to credit**, was a key condition for economic development. Another conditions being **the possibility to receive the anticipated entrepreneurial profit** as compensation for his efforts.

What is the state of affairs in non-market economy? In "Theory of Economic Development" Schumpeter quotes *two cases of non-market economy*:

- The isolated kingdom where all the means belong to the signor;
- The isolated communist society in which the central authority possesses **all** commodities and labour resources and determines all commodity values.

What is common between the two cases, according to Schumpeter, is that **some** individuals enjoy **absolute control** over the means of production. They expect no production cooperation, nor do they provide possibilities for making profit to other economic agents. So the problem of access to resources necessary for carrying out the new combinations "... does not exist in a non-exchange economy even if new combinations are carried out in it; for the directing organ, for example a socialist economic ministry, is in a position to direct the productive resources of the society to new uses exactly as it can direct them to their previous employments". This distinction allows Schumpeter to define the *difference between the two types of economies*:

*From the point of view of innovations "capitalist" economy is the one in which resources necessary for new production are drawn from the circular flow by an ad hoc established purchasing power (bank loan), while "communist" economy is an economic form where the resources necessary for new production are drawn through some kind of power or command.*

Hence follows the assumption that "leaders" in communist economy can play the role of entrepreneurs **directly**, without using bankers as middlemen. In the case when the banking system is formally preserved, but is controlled by the leaders, the latter combine both functions: of a motive power for the introduction of new combinations (entrepreneurs) and of creators of an ad hoc purchasing power by a decree for financing the new combinations (bankers). What are the effects

of the functions of the communist leaders as entrepreneurs for the functioning of non-market economy?

**First**, the "development" as a specific form of functioning of the economy - in the sense of channelling the economic process along new tracks, introducing product, technological, organizational, market, etc. innovations - is by no means related only and solely to market economy. Moreover, according to Schumpeter, in the developing non-market economy "...*the entrepreneurial activity of the leaders*, which is indeed a necessary condition of the realisation of the combination, *may be conceived as means of production.*" It is the **third production factor**, alongside labour and natural resources (the land). Hence follows that part of the value of the new product should be ascribed to it. The amount of this part, as well as the part ascribed to labour and land, is determined by competition. But since in non-market economy there is no competition, and profit is much less significant than in market economy, *the value of the leader's entrepreneurial activity is not clearly articulated.*

**Second**, the direct control by communist nomenclature over the necessary resources creates an essentially different situation as regards risks and the speed of introducing innovations. In market economy the entrepreneur must first persuade the banker, gain his confidence so as to get the necessary credit. The conjuncture of the credit market has a strong impact on the rates and scope of entrepreneurial activity. In non-market economy all this is non-existent. If he deems so, the leader may always withdraw the necessary resources (the bigger the scope of the economy, the bigger the leader's possibilities are, e.g. the USSR), even risking holding back or worsening the living standards of the remaining social groups.

**Third**, given a direct control over production factors, the communist leaders, that have introduced the new combination in the economy, are rightfully entitled to the entire entrepreneurial profit. In a non-market economy the leaders need not share the entrepreneurial profit with bankers and other owners of capital (resources). Thus, at the start-up of development and the successful mass introduction of new combinations in the economy the ruling elite gets an additional, new source of resources for the purposes of its economic policy. They are entitled to it by rights and whether they will share it with the other economic agents depends solely on their good will. In a feudal society, Schumpeter wrote, the signor disposes of the whole profit, while in a communist society the profit belongs completely to the community. However, this does not mean that profit from innovations is transformed into wages, even if it is distributed in its entirety.

**Fourth,** the phenomenon of creative destruction practically disappears. In market economy with private property the profit reaches the entrepreneur only after it has made its way through competition. This means that it is not only competitively distributed among bankers and owners of capital, but also that its very existence stimulates the next waves of entrepreneurs who, attracted by the success and monopoly profit of the First Innovator, also introduce the new combination and depending on the speed of introduction "steal" a bigger or smaller portion of the profit until fully exhausting it (the new combination has "aged"). In market economy in the long run this is irreversibly linked to the relative drop of prices as regards wages as a result of the higher effectiveness of new combinations. The communist leaders' direct control over resources in non-market economy does away with competition and economic agents related to it: bankers and other autonomous entrepreneurs. On the one hand this abolishes barriers before the quick introduction of innovations, but on the other it also does away with pressure on sectors working under old combinations. Schumpeter maintains that here new and old combinations can exist in parallel and profit be distributed among them. The complete restructuring of the sector on the basis of new more effective combinations is a matter of **authoritative, administrative decision**, rather than a competitive pressure.

**The fifth,** and maybe the most important difference between market and non-market economy is **the narrowing of the social basis of entrepreneurship**. Control over necessary resources is a key condition for introducing the new combinations. Credit in the market economy with private property and the relevant re-distributive function of entrepreneurial profit aim precisely at providing **every potential entrepreneur** with such [temporary] control over the necessary resources, at the respective cost. The direct and absolute control on behalf of the communist leaders over resources deprives the remaining economic agents of the possibility to carry out independent entrepreneurial activities. They are economically unable to become entrepreneurs. This has some major long-term effects on the rates of innovations and hence on the rates of economic development in communist economy.

To summarize: the theoretical model, build by Schumpeter in 1912 admits, that non-market economies are also capable to development, i.e. to introduce new combinations (innovations). The empirical observations of the development in existing socialist economies almost unanimously revealed the interesting phenomenon of *two phase of in their economic development: 1) phase of forceful (accelerated) growth, followed by the 2) phase of slowing down the growth* (Kornaj), leading to stagnation (falling into "circular flow") and even "*technological glaciation*" (Revol). In the long run these economies appeared to be less innovative, i.e. less capable for development

compared to the market economies. Given the specificities of the development in non-market economy, how could we account for these observations?

***Two critical remarks to the Schumpeter model:***

***1) Source of innovation (invention, discovery) taken from granted***

In the analysis of entrepreneurial function Schumpeter notes that "... it is no part of entrepreneurial function to 'find' or to 'create' new possibilities. They are always present, abundantly accumulated by all sorts of people. Often they are also generally known and being discussed by scientific or literary writers. In other cases, there is nothing to discover them, because they are quite obvious." (Schumpeter 1936, p.87)

This assumption - that inventions and innovations are potentially "given" and easily "available" - ignores major aspects of the relation between the process of discovery and invention - on the one hand, and their implementation in the economy, i.e. innovation - on the other. This problem became especially acute since the early 20<sup>th</sup> century with the rise of first "science-based" industries like electro-technical industry, organic chemical industry, aviation industry, etc. Recent studies have revealed close interdependence between public investment in science and education and the heavy "infrastructural work" that mediate appropriation of relevant discoveries in the economy. Here the socio-technical networks approach and especially its notion of 'emerging' and 'stabilised' configuration becomes crucial for understanding the intimated interrelation between former socialist economies and capitalist economies.

***2) "Communist leaders" are not homogeneous group.***

Leaders - although hierarchically organized, are split in different camps not only vertically, but also horizontally. The division lines and functions of the different groups vary during the different stages of evolution of socialism. **The entrepreneurial behavior of leaders varies!** Hence the speed and direction of economic development depends in a crucial manner from the internal strangle and constellation of forces between different camps of leaders. Here the recent ideas about so-called "second networks" of socialism and their long-term role provide the clue for understanding the real dynamics of innovation process in socialist economy.

Hence in rest of the paper I will try to reconsider the Schumpeter model of innovation in communist economy in the light of the latest developments in STS and historical sociology of socialism. Each of them provides the resources to cope with two major weaknesses of Schumpeter's model we pointed above. We will present them in reverse order, followed by conclusion.

## *2. Innovations as "science based" and as 'socio-technical network'. Emerging and stabilised socio-technical networks.*

During the last century in developed capitalist economies *research laboratory* has gradually become an actor at least as significant as the *enterprise* (company) was believed to be. In the movement forward and backward through the endless interactions by which markets, products and production chains adapt to each other, it is already practically impossible at a certain moment not to pass through the laboratory. Hence socio-technical network are defined as *coordinated interrelations of heterogeneous factors - publicly-financed laboratories, technological research centres, financial organisations, consumers and governments - that partake collectively in the determining, development, production and distribution/diffusion of procedures of commodity and service production, some of which set the beginning of market transactions.* (Callon, 1992, p.73)

The theory of socio-technical networks implies specific understanding about the scientific and technological knowledge, developd by the social studies of science and technology and presented as a unity of three interrelated components: 1) Codified knowledge (objectified in scientific texts, formulas, charts, diagrams, and the like); 2) Technical artefacts (scientific apparata) by which this knowledge can be empirically verified or rejected; 3) Specific "embodied" skills to use scientific texts, to work with reserach equipment, and to interpret and compare data. So the socio-technical networks of innovation "...must not be confused with *technical networks of engineers* (i.e. communication or transportation networks), nor with *social networks of sociologists* (friendship, confidence, reputation), nor for that matter with the *networks of statements or text* that philosophers or specialist of discourse analysis love so much. They are hybrid of these three forms of networks." (Callon 1994:411)

Improving a country's scientific and technological potential are precondition for economic development and this was underestimated in the initial Schumepeter model. The industrialisation strategy presposes implies simultaneous development of he following three components of (techno)science:

- 1) Establishing an information potential (libraries, computer databases, etc.) and communication means along which codified knowledge circulates;
- 2) Ensuring production (import) and maintaining of adequate scientific equipment for verifying and developing further the created or imported new knowledge, and

- 3) Providing conditions for a stable reproduction of local scientific and engineering communities, where the embodied skills for knowledge production and work with scientific apparatus are reproduced and developed.

This understanding of science - that there is nothing "spontaneous" and "natural" in scientific results, and the acknowledged necessity of big and **permanent** investment for obtaining, distributing and mastering them - has an immediate effect on the economic theory. Science and engineering can be regarded as a **specific type of capital** - as a continuously expanding warehouse of methods for coping with problems and a source of "new combinations". The proof of the inadequacy of old knowledge in solving new problems by no means revokes the use of old knowledge and technologies wherever they "work". So the availability and mobilisation of this specific capital depends on the **local level of investment**: only if you have invested in people and apparatus, the announcement of a new scientific discovery or the publication of a new patent becomes for you "appropriable" or "contestable". From this point of view the development of science and technologies, both within the framework of a national economy, and internationally, by no means follows the principle of "communism" as Robert Merton once claimed (i.e. science as a public good), but rather resembles an **oligopolistic market** with high entrance-barriers. Only those of club members who have ensured and maintain a constant level of investment in the (techno)science and related science-based industries, will be able to "appropriate" and "contest" the results from scientific research, to introduce "new combinations".

*So theory of socio-technical networks substantially modifies the initial model of Schumpeter we begin with - it points to the preliminary stage, to the work and investments needed in order introduction of "new combinations" to be possible at all. It reveals the "static state" of the economy, the state of "circular flow" from which economic development detaches as constructed, as an outcome of specific types of efforts. Without this "infrastructural work" there will be no economically relevant ideas, resources, people, etc to be combined in a new way. During the 20<sup>th</sup> century maintaining this preliminary work became essential part of the economic activities.*

There is one aspect of the theory of socio-technical networks that makes them especially suitable for the analysis of former socialist societies in Eastern Europe - the concept of "**state of the technoeconomic network**" (see Callon, 1996a; Callon, 1996b). The hypothesis is that whether the scientific and technical knowledge is 'public goods' (freely available) or specific capital (that is rival and difficult to appropriate) depend on the state of the socio-technical network in which this knowledge has been produced and circulated. Two such states are differentiated: **emerging**

**networks** (emergent configurations) and **long and well-established networks** (consolidated configurations).

### *Emerging socio-technical networks*

It might be claimed that "newly emerging" socio-technical networks represent corresponding national economies at the point of appearance of each of the technologies that "revolutionized our century", which are listed in Janosh Kornai in "The Socialist system..." - the nuclear reactor, the transistor, the microprocessor, the laser, deep refrigeration, the supersonic plane, penicillin, oral contraceptives, etc. It is well known that in order to recognize a new scientific invention as a proven fact, it has to be repeated. However, the studies carried out by Dominique Pestre and P. Gallison on particle physics have shown that "...in the 1930's no one was able to construct a cyclotron without staying long enough at Berkeley, the place where it had been invented, and without being immediately engaged in the production of one accelerator". "Copying" the instruments" involves continued and complex operations of gauging, of preparing the materials and substances to be used, as well as all that work on **standardisation** which is practically impossible without **transformation** and **adaptation**. In order to transfer knowledge, either in the form of incorporated skills or in the form of technical devices, there is no other way but **demonstration** and **apprenticeship** and no other strategy but repetitions and corrections until the skills and devices become available and mobilizable whenever wanted. In other words this means to build **infrastructure** - assembly lines, theories, scientific communities, etc. Collins and Hutchins have shown in their book *The Mind in the Wild* that "...In a situation of emergence nobody knows exactly what is to be transferred: the only thing known is that some patterns of behaviour under particular circumstances lead to results which can be identified, while other patterns of behaviour do not bring about such results... to repeat an experiment at some other, different place and to prove the validity of a given assumption, we have to transport the instruments, and researchers, and technicians **simultaneously**."

Thus, the assertions having **just** been produced in the laboratories turn out to be explicitly contestable as any other commodity: "they are not merely a statement, but a whole complex of **assertion+instruments+incorporated skills**. In the beginning, this pack exists in one single copy and the first reproductions require the reproduction of the rest of the elements of the pack. (Callon 1996, p. 48) The "channels of circulation" are missing - building such channels is an expensive undertaking, sometimes it is even impossible to be created.

### *Sociotechnical networks at the stage of stabilisation*

With consolidated configurations we enter completely different world "...Here laboratories have already been repeated... There exist a great number of places, scattered all around the nodes of the network, where one and the same instruments and incorporated skills are available and mobilizable making it possible to lend meaning and utility to the assertions circulating in the network. Now *any assertion can already be transferred through the network without being accompanied by equipment or people* possessing incorporated skills. Now, with this configuration, scientific assertions are really undeniable and unappropriable... This is universalism **within the network.**" (Callon, p. 50)

In the stabilised networks the agents are alike - they share **common** competencies and problems, now they can compete each other. "The possibility of formulating full expectations" here is particularly important - in stabilized technoeconomic network the programmes of the different economic agents (individual entrepreneurs, corporations, governments) "...**precede** action and format it, in a sense, they are interchangeable, as **their goals are familiar** and the competencies they mobilize are similar... Expectations are rational and each agent, having identical analyzing abilities, makes estimates analogous to those made by the others from the point of view of the consequences it leads to. In this respect, competitors' behaviour is predictable..." (p. 51).

The stabilized scientific networks corresponds to what Thomas Kuhn describes as "normal science". In the economy stablesd networks could be associated with the research programmes of rival companies possessing comparable technological potentialities - for example, the rivalry between the pharmaceutical laboratories trying to isolate molecules active in the treatment of a particular disease.

Have we not seen this world already - objectives are clear and well-specified, priorities have been determined, the necessary resources can be **estimated** and they can be scheduled out in programmes... But why programmes and not plans? - Five-year plans, yearly plans... Plans can be split into particular tasks, behind each one of them there stands a definite agent with corresponding rights and responsibilities, i.e. clearly defined roles... "*Communism - this is Soviet power plus electrification of the whole country!*" The GOELRO (State Commission of Electrification of Russia) Plan... There followed - the total use of chemicals, electronization, biologization. In the Bulgarian case, as put in an ideological slogan of the mid 1960's - "A Nation Technical, a Nation Communist!" Is this not simply a technoeconomic network, or a series of reconfiguring networks?. But networks already familiar, "approbated", stabilized **somewere else**. What remains for them is only to be spread and expanded.

The opposition between *emerging* and *stabilised* networks makes possible to catch the specificity of the situation immediately after "socialist revolution". In the case of Bulgaria, defined by socialist propaganda as "backward agrarian country", having centralized its economy and having introduced a **single will** in it - the will of the communist leaders, the initial economic state was essentially different from two opposite states of "emergent configuration" and "consolidated configuration". On the one hand, country's economy was still far from being part of a "long and stabilized network" with its agents of similar competencies and incorporated skills; analogous production or experimental facilities; steadfast channels for circulating codified knowledge as "information". In this case, information, skills, and artefacts, all together, were yet to be developed. On the other hand, however, the process of creating these elements differed essentially from that in the newly emerging networks - the implied structures were more or less familiar, rather than unique newly emerged complexes of *assertions+artefacts+incorporated skills*. Therefore, the task of communist leaders here only seemingly resembled the one in emergent networks - like there, the three elements had to be "transferred" simultaneously, but at the same time, *agents were largely unburdened of all those difficulties stemming from the lack of clarity and the uncertainty as to what exactly was to be transferred, which particular types of behaviour "lead to results that can be identified"*, etc. The communist leaders, like the agents in a long and stable network, were aware in advance of what the necessary statements, artefacts and incorporated skills were.

This is the reason why the communist leaders of a "backward agrarian country", being the only economic agents able to put the newly established non-market economy in regime of *development*, found themselves in the remarkable situation of having to combine characteristics and functions of *both "first movers"*, i.e. the entrepreneurs revolutionized the then existing means and methods of production, and *"second-line movers"* who were saved the risks of the first phases of innovation. This is further supported by the fact, perceived correctly by Kornai, that during its first decades the classical socialist system isolated itself from the hostile world of the capitalist economies, without disrupting, however, its industrialization by following in their steps technologically.

At this initial stage, under conditions of "clarity of aims" and "predictability of resources", compared to the market economy in terms of mobilization and control of resources, the advantages of administrative coordination were manifested - lack of competition on the credit market, removing threat of imitation, appropriation of the entire entrepreneurial profit by the communist leaders. *Hitherto unthinkable freedom of action opened out before the leaders* - the opponents of the system, and, in this sense, its rivals were ruthlessly crushed, a large number of the masses of

working people in towns and villages were overwhelmed by communist propaganda, they were prepared for discipline and temporary sacrifices in the name of the "bright future". None of the entrepreneurs in market economy could have dream of such a power.

Communist leaders faced the difficult and complicated task of reproducing, in a new economic environment, the whole complex of "assertions-artifacts-incorporated skills" in given economic sector or even whole new branches of industry. This task was more difficult and complicated than the tasks being solved in the stabilized socio-technical networks in advanced capitalist societies, because in de-centralized economy with no central control it is rather "structural effect" of the activities of many autonomous agents. But the fact that they had total control over the resources of society gave the communist leaders exceptional advantages in performing this task - *they were able to invest simultaneously in construction and in production equipment facilities, in personnel training and in education growth, in the development of science and R&D and in the building of "channels" for the circulation of "information"*.

Communist leaders in non-market economy had one rare advantage in comparison with the classical entrepreneurs and the founders of new technoeconomic networks - **they knew beforehand their own aims and the resources required, and, therefore, they were able to plan**. No matter how large the difficulties for planning within the framework of an entire national economy, as indicated by Hayek or Williamson, in the first decades of classical socialism this task was made much easier by the fact that the goals and resources were clear - "programmes can be defined in advance" and "engaging certain resources... can make the link between these resources and the expected outcomes". *This was a privileged world in which one could act both a first innovator (first mover) and as "second mover" (those who copy innovation), protected against making the mistakes of those who had already created and stabilized the network somewhere else.*

The ideological impulse, provoked by the production of the "first tractor", the "first motor car", the "first electric bulb", the "first television set", etc., which incited millions of people during the decades of socialist economy, contained in itself, as in a "nutshell" the paradox of this development - these innovations were really "the first", but in a much more substantial way, they were "the second", because earlier **they had already been** materialized somewhere else, most often in the advanced capitalist countries. The fascination of anyhow being "the first", although accompanied by attributes like "Soviet", "Bulgarian", "socialist", sprang right from the barriers erected between, the closure from and confrontation with the "truly first" countries. One of the founders of Bulgarian electronics, whom I interviewed, told me the eloquent story of the enthusiasm of the Cuban leader Fidel Castro evoked by the first Bulgarian electronic calculators,

small series of which were being exported to France in the early 1970's. Castro, he said, brandished the calculator in question at one of the customary congresses of the Cuban Communist Party as a "glaring example of the power of socialism" and the success achieved by the "Bulgarian comrades" who rivaled the Japanese and "are conquering the capitalist market" in no less than the sphere of high technologies.

And so, it has already become clear that what Kornai used to call "copying" of Western technologies concealed in fact a much deeper and large-scale process of reconfiguration of the techno-economic network taking place in the non-market economies of classical socialism. Before having made serious investments in its own science and technology, before having developed an industry of its own, which would be able to incorporate the relevant scientific and technological knowledge, a country like Bulgaria was not able at all to utilize the existing codified scientific and technological knowledge - for country's economy it was not "public good" but rather remained a private possession of **an oligopoly** comprising several advanced industrial nations.