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Technology Policy for a future-oriented Social Market Economy in Russia

Technologiepolitik fur eine zukunftsorientierte Soziale Marktwirtschaft in Russland

Alexander V. Ryzhenkov*

Abstract

This report develops the concept of Russia's reindustrialization based on learning and innovation sketched in the previous studies of the author. It explains the Russian great depression as a period of a deepening contradiction between the transitional social and institutional framework and the potential of the new techno-economic paradigm. It is shown, in particular, that the depression has been worsened after the disintegration of the former USSR because of a laissez-faire attitude towards science and technology; a neglect of the world's experience has also contributed to the inability to keep pace with many other countries. The report argues that the inadequate national system of innovations is the greater obstacle for starting catching up again than the technological backwardness. Our analysis suggests concrete forms and instruments of technology policy for building a future-oriented social market economy with a more efficient national system of innovations and a broader range of socially created competitive advantages corresponding to the new techno-economic paradigm. Pitfalls and opportunities of international technology cooperation are briefly characterized too.

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Zusammenfassung

Die vorliegende Arbeit entwickelt das in den früheren Untersuchungen des Autors skizzierte Konzept der Reindustrialisierung Russlands, welches sich auf das Lernen und die Innovation stützt. Die Arbeit erklärt die große Russische Depression als eine Periode von einem sich vertiefenden Widerspruch zwischen den sozialen und institutionellen Verhältnissen und dem Potential des neuen techno-ökonomischen Paradigmas.

Es wird gezeigt, dass die Depression sich seit dem Zusammenbruch der ehemaligen UdSSR verschlimmert hat, vor allem wegen der kurzsichtigen Laissez-faire-Haltung gegenüber Wissenschaft und Technologie. Die Vernachlässigung der internationalen Erfahrungen hat auch dazu beigetragen, dass Russland mit anderen Ländern der Welt nicht Schritt halten konnte.

Der Verfasser argumentiert, dass das inadäquate nationale System der Innovationen ein größeres Hindernis für den Beginn von Russlands Aufholen ('catching-up') ist als die technologische Rückständigkeit. Entsprechend dem neuen technisch-wirtschaftlichen Paradigma schlägt die Untersuchung konkrete Formen und Instrumente der empfohlenen Technologiepolitik im Rahmen eines effektiven nationalen Systems der Innovationen für den Aufbau und Ausbau einer zukunftsorientierten Sozialen Marktwirtschaft vor. Möglichkeiten und ,,Fallgruben“ der internationalen Technologiekooperation werden auch kurz aufgezeigt.

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1. Introduction

German catching up and overtaking Great Britain in the second half of the 19th century was substantially based on superior education and training systems and other institutions catering for advance of knowledge and its dissemination. The Friedrich List and his followers advocacy of national technology strategies was very important for the success of German economic policies and German approach to technology in the early phase of the third Kondratiev cycle in 1880-90s (see Freeman, 1987: 98-101).

The legacy of List's recommendations has been confirmed by the experiences of other nations too. One of the modern disciples of F. List shows, on the example of the best US steel mill, that the whole organization is designed around creation and control of knowledge. The management strategy is organizational learning, which implies investing in formal and informal education; searching world-wide for the best technology and methods, absorbing that knowledge into home operations, valuing employee empowerment, problem solving, and risk taking (see Leonard-Barton).

Learning occurs in all social forms, yet it is conceived in the emerging information societies as the very base for functioning and evolution. Bits of information underpin and feed technological systems, socio-economic relations and institutions. According to the general living systems theory, evolution of societies depends primarily upon accumulation and transmission of learned information. These information processes mean not only acquisition of knowledge but the power of organization as well (see Miller, 1978: 42, 854).

Scholars of technological change distinguish between embodied and disembodied international diffusion of technology. Embodied diffusion is spread of technology in embodied form, i.e. products, especially machinery. Disembodied diffusion is the spread of new technology by other means, including license and know-how purchases, via commercial and non-commercial channels such as personal contacts among technologists, the screening of foreign literature and industrial espionage. It is generally accepted that the commercial import of technology entails a built-in lag; it may narrow technological gaps but will not by itself eliminate them (see, for example, Amann and Cooper).

The former USSR and Japan used 'reverse engineering' as a method of assimilating and improving upon imported technology. This involved trying to manufacture a product similar to one already available on the market but

without direct foreign investment or transfer of blueprints for product and process design. ,,In many Third World countries, on the other hand, the method of technology transfer was very often either through subsidiaries of multinationals or by the import of turnkey plants designed and constructed by foreign contractors. Neither of these methods is likely to result in an intensive process of technological accumulation in the (relatively passive) recipient enterprise" (Freeman, 1987: 44).

Social change as a result of a learning process does seem to occur in societies. J. G. Miller writes: ,,Nations undergoing development now do not pass through all the evolutionary stages by which more advanced societies reached their present stages of development. Instead, they telescope the processes that originally took centuries into a few years of profound alteration of structure and process" (Miller, 1978: 860). Russia can profitably learn not only from own experience but also from experiences of the Western Europe, Japan, the USA, the NIE and of the other countries.

Among major causes of pathology of living systems the theory identifies lacks of matter-energy inputs, abnormalities in internal matter-energy and information processes, which have taken place in the former USSR and the CIS. One should keep in mind that the depth and length of the fall in production in the CIS is unprecedented in an industrial economy in peace time in this century. The successors of the former USSR are facing a fast growing technological gap with the West which is impeding their harmonic integration in the world economy. Voluntary learning and massive transfer of knowledge from the more developed countries to the CIS could provide necessary premises for breaking the vicious circle of inflation, disinvestment and capital flight (Ryzhenkov, 1992, 1994a).

In this paper, I will offer a more elaborated explanation of the Russia's great depression, which in earlier works was mostly a pathological phenomenon, as a period of a contradiction between the transitional social and institutional framework and the potential of the new techno-economic paradigm. (The idea of a 'techno-economic paradigm' has been first advanced by Prof. Carlota Perez. A techno-economic paradigm is a cluster of interrelated technical, organizational and managerial innovations.) ,,Major changes in the international distribution of innovative activities and in the international competitiveness of each economy, can...be associated with emergence of new technological paradigms. The occurrence reshapes the pattern of technological advantages/disadvantages between countries, often demands different organizational and institutional set-ups and sometimes present a unique 'window of opportunity' in Perez's words (Perez and Soete,

1988) for the emergence of new technological and economic leaders" (Dosi et al, 1990: 254).

The need for a change of social behaviour and institutions to suit the techno-economic requirements and the potential of new technologies in Russia is similar to some degree to the necessity to reaccomodate an old socio-institutional framework in the industrial market economies for overcoming prolonged recessionary trends in periods of structural crises. Both the transitional and structural crises are thus the periods of experiment and search, of political debates and conflicts possibly leading to higher forms of production and regulation. These periods may be shorter or longer depending, in particular, on a degree of consciousness in a practical application of socio-economic laws and regularities. This view will not exclude the possibility of new catastrophes if collective learning processes proceed in pathological forms and/or some critical positive feedback (vicious circles) run unchecked.

The shortcomings of industrial innovation in Russia and the resulting technology gaps in major industries within the broader context of accelerating rates of industrial decline represent one of the most serious *political* problems facing the contemporary Russian leadership. Since imports of technology are constrained either by hard currency balances or by only token amounts of long-term foreign investments, the domestic innovative/investment performance has become a matter of fundamental importance. It is not technological backwardness *per se* which is the main problem but, rather, the absence of adequate national systems of production and innovations as well as the weakness of political will for catching up. Finding an optimal combination of market and non-market steering is one of the most complicated politico-economic issues in other countries of the East and Central Europe as well (see Fischer et al).

The participants of the Schwerin International Colloquium have declared: ,,The state cannot decline responsibility for the consequences of the transformation process referring to the functioning of the market forces. It is thus the major importance to achieve a balance between the dismantling of inefficient structures on the one hand and the creation of political, economic and social prerequisites necessary to mobilize existing developing capacities on the other hand. This goes beyond a mere cushioning of the social effects of structural adjustment and includes an active industrial policy" (SEF: 265-268).

After the second world war, the governments of industrial countries supplemented the patent system, technical education, and the promotion of

basic science (the three main elements of technological policy) by a rich collection of measures and instruments aimed at overcoming market imperfections, creating dynamic competitive advantages, adapting to the rapidly changing political and business environment. At the same time, these countries differ with regard to the concrete forms of institutions (government policy, educational system, legal framework, managerial attitudes towards risk, etc.) influencing technological change.

Mostly successful was the Japanese government that provided domestic producers with a R&D assistance directed towards strategic technologies, which were likely to result in the new industries of the future (microelectronics, biotechnology, energy technology, communication technology) or which were able to regenerate existing industries (chemical industry, metallurgy, etc.). It is well-known, that Japan has not only closed the old technological gap of the 1950s and 1960s, but she is opening up a new technology gap of her own. This makes the experience of Japan especially instructive for late industrializers.

Chris Freeman has reasonably argued that the exceptional Japanese progress in catching up with the world's technological leaders and drawing ahead in some areas was attributable to the development of an institutional and social framework - a national system of innovations, which differed in important respects from the prevailing in other OECD countries. Some of the main characteristics of the Japanese system were described by him: the role of MITI; the role of company R&D strategy in developing a new integrated approach to the design and development of production systems; the role and scale of education and training; the role of social innovations in motivating, training and controlling the labour force; and, finally, the development of an industrial structure particularly favourable to long-term strategic investment in marketing, training and technological activities.

It has been shown further that the Japanese policy-makers followed List's prescriptions of assimilating the best available technology of the day, improving upon it, organizing novel linkages through good design management between science, technology and markets, identifying and exploiting new technological trajectories and coping with the long-term strategies of tangible and intangible investment which all of this implied (see Freeman, 1987).

We will make use of Freeman's definition of national system of innovations as a network of institutions in the public and private sectors of the economy whose activities and interactions initiate, import, modify and diffuse new technologies (see Freeman 1987: 1). ,,The national system of innovations

may enable a country with rather limited resources...to make very rapid progress...On the other hand, weaknesses in the national system of innovations may lead to more abundant resources being squandered by pursuit of inappropriate objectives or the use of ineffective methods" (Freeman, 1987: 3). National system of innovations is both a result and a dynamic component of national system of production (see Chesnais: 26).

For Russia, initiating domestic capital/technological accumulation, (re)building national production/innovation system becomes the top politico-economic priority which determines priorities of technological, foreign trade and investments policies. The deregulation, quasi-privatization and premature liberalization of foreign trade by the authorities within the framework of the shock therapy have seriously impaired the national capacity to manage the transitional crisis and to adapt to vigorous changes in the world economy.

Interacting with global oligopolies, the most significant suppliers of products and know-how in the world economy, could potentially lead Russia not so much to desirable technological transfer in favour of domestic producers as to outsourcing of ,,techno-trophies" and the loss of many attributes of economic and political sovereignty (see on this subject the papers of Chesnais and Hudson). The prevailing now reactive type of industrial policy is not the proper answer for the internal and external challenges. It may lead to rebuilding of the damaged economy on the basis of outmoded technology at the time when most advanced countries are undergoing a technical revolution.

2. Technology policy in the USA

Capitalist, profit-oriented, economy has the inherent abilities to initiate, diffuse, and adjust to technical change. Unlike previous modes of production with their conservative technological base, industrial capitalism is characterized by evolutionary and revolutionary technological transformations based on a systematic and wide-scale usage of theoretical and applied knowledge (mostly natural sciences). On the one hand, technological progress disturbs market equilibrium, on the other; it exerts a stabilizing influence on economic dynamics and income distribution.

Under the existence of non-market and para-market relationships between economic agents ,,the ,,Schumpeterian entrepreneur" is a ,,system" made up

of a set of inter-related firms and institutions involved in a complex mix of competition and co-operation" (Chesnais: 19). Such entrepreneurs perceive management of technology as a hidden competitive advantage. The effect of investment in one sector on the profitability of investment in another sector, via increased demand or reduced costs, has been called by Scitovsky a ,,dynamic external economy". The imputation of these economies to the originating sectors may seriously affect the estimate of competitive advantage" (Chenery: 21).

Market prices transmit information (money talk). The incentives and threats of capitalist economy transmitted by market prices during the dynamic process of competition lead to the discovery and dissemination of new knowledge. The Schumpeterian entrepreneurs not only reveal already-existing information embodied in the economic conditions and relations, but also create/store new (synergetic) information via decision-making. In particular, they keep in mind the choices of techniques, by giving preference to the definite connections between different technologies among a broader set of possibilities, and develop new behavioural algorithms, tending to achieve a higher functional efficiency and better coordinated states of society.

Among the critical subsystems of society, as a living system, there are Associator (education, R&D, etc.) and Memory (data banks, scientific information service, libraries, museums, etc.) which enable accumulation of knowledge in socially concentrated and integrated forms (see Miller: 766-768) in spite of the dispersal of individually possessed knowledge. This information processing subsystems are used by government, entrepreneurs and other economic agents on an increasing scale. The unfolding revolution in the military sphere, with due respect of its lead time against the civilian production, shows this tendency especially distinct: the army is moving, according to Brig. Gen. Edward Anderson of the US Combined Arms Command, from being ,,people organized around weapon systems" to „people organized around information" (quoted from (Ricks)). Technology infrastructure plays a critical function in production and dissemination of knowledge. ,,The technology infrastructure consists of science, engineering, and technical knowledge available to private industry. ...More specifically, technology infrastructure includes generic technologies, infra-technologies, technical information, and research and test facilities, as well as less technically-explicit areas including information relevant for strategic planning and market development, forums for joint industry-government planning and collaboration, and assignment of intellectual

property rights. A characteristic of technology infrastructure is that it depreciates slowly, but requires considerable effort and long lead time to put in place and maintain" (Tassey: 347).

Governments of industrial nations provide main elements of diverse technological infrastructure. Among them there are universities, government-funded laboratories and research associations contributing to inventions, to exploratory development, to the demonstration of technical feasibility of new products and processes, to 'debugging' of difficulties experienced by firms, and to introduction of new technology in industry (see Rothwell and Zegveld; Tassey).

It is known from economic theory, that market forces will not necessarily lead to optimal investment decisions because present prices do not reflect the cost and demand conditions that will exist in the future. A reliance on market alone cannot lead to socially satisfactory results; in particular, apparent underinvestment in R&D is typical for a capitalist economy if market incentives are not supplemented by government policies and regulations. In the other words, state can improve an economic performance by adopting policies that, in particular, facilitate and increase investments in R&D and enhance the national innovative capabilities. ,,These public policies recognize that, for certain kind of activities essential to: technical progress, external economies and uncertainties tend to drive a wedge between private incentive and social return, and for others scale requirements may dwarf the capabilities of unaided private incentives. To compensate, policies have evolved to increase private incentives, or to increase private capabilities" (Nelson et al 1967: 159).

The state intervention in the processes of technological genesis, growth, diffusion and obsolescence uses two interwoven approaches. The first promotes the ability of innovators to obtain higher profits via strengthening intellectual property rights (patents, copyrights, legal protection for trade secrets, preferential taxes) and thus provides an economic agent with additional stimuli to invention and innovation rather than imitation. The second approach assumes that authorities select/support specific technology projects by subsidies and undertake them in state-owned laboratories, research institutes and universities.

Both approaches have limitations. The first one may establish non-efficient monopolies or impede diffusion of new products and processes. „The patent system raises the returns to invention and innovation by increasing the cost and difficulties of imitation. It makes private property out of what otherwise would, in the absence of secrecy, be in the public domain ... over the long

run, the effect of a dominant patent may be to slow significantly the pace technological progress" (Nelson et al, 1967: 160, 162). On the other hand, because of the uncertainty of technological advance and the difficulty of an effective monitoring of the R&D process by the state, the second approach gives no guarantee that just the best technologies and projects are picked. A lot of forecasting activity and social interaction are needed to uncover hidden tendencies and anticipate future trends.

„In the past, a political consensus for federal R&D was achieved by pursuing both approaches and by treating them as substitutes. Technologies in which private industry could hold a reasonable secure intellectual property right were expected to be backed by business, whereas the new knowledge emanating from government-supported R&D was to be non-proprietary and widely disseminated" (Cohen and Noll: 60).

This distinction between two approaches shows that assigning property rights to inventors and innovators within the scope of capitalist production relations is a substantial instrument of public policy. Assigning property rights, R&D subsidies and other main forms of government influence on technical innovation (innovation-oriented procurement, laws and regulations, programs aimed at broad scale support for certain kinds of activities, like basic research and scientific education, etc.) is viewed by policy-makers as a part of an overall strategy of technological and industrial development.

The 'Austrian' economists L. von Mises, F. Hayek, I. Kirtzner and other, deeply opposed to government intervention, claim, with complete free entry entrepreneurial competition becomes an upward spiral leading to ever higher standards of living (see Prowse). I think that the premises of this syllogism are not realistic in view of the concentration and centralization of production, R&D in the modern market economies. Moreover, completely free entry is incompatible with monopoly rights of inventors and innovators, which provide strong incentives for technological innovations and hence for the tendency to ever higher standards of living, which is wished for.

I agree with Rothwell and Zegveld that innovation does not just involve R&D. It includes prototype production, production start-up and learning, and marketing as well. These latter aspects of innovation often are more costly, and can involve greater uncertainties, than *R&D...Government should offer 'innovation', as opposed to 'R&D', subsidies"* (Rothwell and Zegveld: 239). The premise that the only major finding role of government is to support basic research has been sharply criticized in the USA as a simplistic and inaccurate model partially responsible for the slow evolution of a comprehensive US competitiveness strategy (see Tassey). Innovation policies are becoming a point of convergence between industrial policy and science and technology policy, containing elements of both, but at the same time opening up totally new perspectives and avenues of policy. In the US, with a few exceptions, such as agriculture, the federal government was not seen as having a role in technological development before 1940s. The second world war essentially marks the beginning of government policy in science and technology directed to the development and production of various weapon systems and the building of a massive manufacturing infrastructure. Later on additional national missions deemed worthy of federal assistance (most notably space exploration, nuclear energy, and medicine) were added (the launching of the first Soviet sputnik and cosmonaut whipped the USA into the cosmic race). Pentagon was the main driver of the federal technological policy during the cold war. „Over these fifty years, the US technology policy has taken a number of forms. Prominent among the federal activities are (1) funding of R&D; (2) direct procurement/investment; and (3) subtler measures aimed at co-operative research and technology transfer. Whatever the form, policies have been overwhelmingly mission-oriented, with the primary mission being national security" (Schafer and Hyland: 600).

The end of the cold war opened the way to a new technology policy. In the USA, international competitiveness as the theme for federal support of R&D has been emphasized together with the other national priorities (such as defence and security). The establishment of the Advanced Manufacturing Technology Development Program, the major technology bill - the National Competitiveness Act of 1993, the National Information Infrastructure (Nil) legislation initiative and other measures are focused on specific technology areas deemed critical to the nation's competitiveness (see Cohen and Noll: 59).

The Clinton administration is planning allocation of federal resources at a larger scale for pre-competitive projects of commercial relevance targeting on potentially radical innovations (the first and best-known of these is the Microelectronics and Computer Technology Corporation, a consortium of about 35 companies). The US government is utilizing its significant purchasing power to stimulate the demand for technological innovations (a federal commitment to a number of the next-generation technologies: information superhighways, 'smart' highways, high speed rail, alternative-fuel vehicles, new generations and arts of armaments, etc.). Regulatory changes have been designed to improve the climate for technological

development; fiscal policy has been turned to commercial technological ventures.

The federal government is facilitating the transfer of defence technologies and capabilities to commercial firms. For example, superlight materials which were developed for modern armament systems will be used for assembling a new car that will consume less than three litters of gasoline per 100 km. The project, which is financed by the federal government and by Chrysler, General Motors and Ford companies, is to be finished to 2003. It symbolized a new form of partnership between companies and the government (see Tenbrock).

Policies toward small and medium-sized firms deserve special mentioning. They focused on reducing market entry risks by providing would-be innovative small and middle enterprises with innovation-oriented procurement, by offering them risk capital, high-level technical assistance, market information, especially export market information. Government itself takes a role of venture capitalist. ,,What do Intel, Apple Computer, Cray Research and Federal Express have in common?" - The Financial Time asks its readers rhetorically and answers: ,,A11 are now Fortune 500 companies. But in their youth they also all received financial help from a hybrid venture capital program that brings the private sector together with the US government" (the Financial Times, August 30, 1994: 6).

According to the newspaper, the Small Business Investment Company program was set up in 1958. Led by the Small Business Administration, the SBICs have invested more than $10 billion of private and public funds in 73,000 small businesses. The SBICs are privately owned and run. But before every dollar the private sector commits to them government provides up to three. Now the SBA has direct access to President and the seat on the National Economic Council. The SBA's largest offering, the Loan Guarantee Program, is particularly helpful if a SBIC cannot get a bank credits (see the Financial Times, August 30, 1994: 6).

Thus, the tendency to link up technology (innovation) policy with policies for industry and for the economy more generally characterizes the economic policy in the USA after the end of the cold war. National defence has given more place to international competitiveness as the theme for federal support of R&D.

3. On the USSR'S rise and fall

Soviet Russia (and the USSR later) started from a position of technological inferiority further aggravated by devastations of the civil war. An extraordinary emphasis was put by the leadership to technical education, R&D, and industrial innovation in order to close the gap in productivity. The industrialization drive of the 1930s in the USSR was directed by J. Stalin for closing the productivity gap with the West and to build a strong base for military power. Under the impetus of the five-year Plans the Soviet people went on to combine replication, modification and scaling-up of existing Western models with heavy investment in their own scientific and technical research and training programs. In addition to advanced technologies, the USSR imported skilled workers, technicians, and engineering consultants in these years.

According to some estimates, the pace of industrialization in the USSR has been slower than in Japan, but apparently of comparable speed of that experienced in Western Europe and faster than in the US. ,,In Soviet industry, the trend rate of growth of output per man-hour in the years 1928-75 was about 5.5 % according to Soviet data and some 4% according to Western estimates. This is lower than equivalent growth rate for Japan, but comparable with that for Western Europe and higher than the rates in the United States and United Kingdom in the same period" (Gomulka, 1990: 96). During the period 1928-76, the USSR reduced its distance from the US from about 70 years to about 35 years with reference to per capita consumption, and from about 70 years to about 26 years with reference to per capita GDP (see Table 1).

These comparisons show that a considerable catching-up had been taking place up to mid-70s. Without closing his eyes on the ,,price" of this success, S. Gomulka writes: ,,This remarkable quantitative progress has been accomplished despite unusually high human and material losses that Soviet economy sustained in the war years 1914-1923 and 1941-5, as well as those from the massive government terror, especially in the 1930s" (Gomulka, 1990: 94-95). The USSR was also successful, according to Gomulka, in building up, in a short period of time, a vast education sector which was supplying at the end of 80s about twice as many technicians, engineers, and scientists as the US sector, although the qualitative differences in favour of the USA were marked.

The USSR was supporting one of the largest national R&D effort in the world. ,,...In 1990, for instance, Russia had the equivalent of 992,571 man-

years of full-time researches, scientists and engineers, according to the OECD, that is about the same level as in the US and perhaps a third more than in the West Europe, according to UNESCO figures" (Hudson: 18). This huge scientific-technical potential is concentrated in Moscow, St. Petersburg, Novosibirsk, Nizhniy Novgorod and in more than 50 scientific towns created in 1930-70 with the purpose of transforming the USSR in a leading technology and military state (for ex., Chernogolovka is the locus of Noginsky scientific centre with a population of 21 thousand people) (see Pravda, 30.9.94: 2). These cities and towns may become locations of techno parks connected with domestic and multi-national companies. The organizational structure of the Soviet innovation system was basically formed in 1930s. Heavy concentration of resources on industries and technologies, which the leadership considered to be of vital strategical importance, and the creation of specialized and centralized R&D networks in each branch of industry were conditioned by scarcity of skilled manpower and resources. GOELRO plan of electrification of the 1920s, the nuclear weapons, missile-space programs, endorsed by the political leadership and thus received a high relative priority in resource allocation, may be recalled as examples of programs which achieved their ends.

At the same time that system created the long term problem of a rift between science and civil industry. ,,While the Soviet Union was in an earlier stage of catching up with the West and depended to a large extent on a replication of existing foreign designs, these potential obstacles to innovation were not critical. They become critical from the mid-1950s onwards when Soviet economic policy attempted to bring about a transition from copying and direct foreign purchases to indigenous innovation"(Amann and Cooper: 20).

The largest proportion of industrial R&D outside the defence sector was carried out by specialist institutes which were separate in both an organizational and geographical respect from industrial enterprises, their ultimate customer. In the Soviet system, ,,much of the responsibility rested with central research institutes or Project Design Bureaux. This meant that much of the 'technological learning process' took place there, rather than at enterprise level, and acute problems were experienced in the transfer of technology from the special R&D institutes to factory-level management" (Freeman, 1987: 44).

The absence of strong feedback from the customer, organizational fragmentation and bureaucratism, underprovision of the development phase and some other factors retarded technological progress in R&D establishments and in the industrial enterprise sector. The concentration of resources in priority areas had an unintended consequence of creating cumulative technological lags in others.

The diffusion of innovations in industry was far more slower than in the West. One of the best documented examples is steel-making. ,,The rate of diffusion of new steel-making technology has been markedly slower in the USSR than in the West. The first oxygen converters were introduced in the USSR, the US, the FRG and Japan in the period 1954-7; by 1974, oxygen steel as a proportion of total steel output was 23 per cent in the USSR, compared with 56 per cent in the US, 69 per cent in the FRG, and 81 per cent in Japan" (Gomulka, 1990: 109).

These shortcomings in the social fabric (including the low static efficiency) was not inconsistent with a relatively high overall innovation rate and growing dynamic efficiency until a high growth rate of investment still permitted rapid increments in the volume of all newly-introduced products and processes (see Gomulka, 1986: 52).

The attempts to eliminate these shortcomings in 1960-1980s years via new management structures (science-production associations and other forms of linkages between research, industry and final users with a greater role of industrial enterprises in R&D), stronger emphasis on long-range plans, complex programs and forecasts, the efforts to improve the planning of major inter-branch/inter-regional scientific and technical problems, etc. were surely correct. Yet these institutional innovations proved to be insufficient to overcome the bureaucratism - a crucial obstacle to industrial innovation in the USSR (see for details Amann and Cooper).

Especially promising was the idea of a complete cover of the life-cycle of the given technology by long-range programs for the creation, assimilation and wide diffusion of new technology in the economy, advocated by V.D. Motorygin and other specialists. These programs would represent more detailed elements of the general Complex Program of Scientific and Technical Progress and would form an important component of the long-range plan of economic development. We will return to this idea below, in sections 6 and 7.

The emergence of the new techno-economic paradigm based on information technologies in the 1970s required different organizational and institutional set-ups. The modern technology increasingly demanded a better motivated, educated and trained labour force with a higher degree of self-control, hence new methods of economic mobilization were needed. The necessary timely

provision and broad dissemination of information, which became absolutely vital for the diffusion of the new technologies, were not possible without democratic political reforms, a greater flexibility of public institutions and a better communication infrastructure.

The Soviet society could not properly reform itself before entering into the phases of decelerating economic growth, stagnation and crisis. With diminishing amount of surplus labour, the available reserves were in ever more short supply. The system could not keep its components adjusted to one another or to the environment, while they were competing with each other for increasingly limited resources with intensifying aggressiveness. As a result of the prolonged pathology, the processes of decline, termination and disintegration proceeded.

An absolute decline of investment was one of the fundamental economic defects for 20 last years of the USSR existence. Production investment in real terms, measured in natural units (not in so-called constant prices which were marked by hidden inflation), were declining in the USSR from the middle 1970s (see Table 2).

The following international comparison may be useful. In 1960-1988 the investments in the former USSR and in the FRG were approximately equal in toto, still in the FRG 4.7 times higher than in the USSR per head. Russia's population has been 2.4 times greater than in the FRG while the total investment in the former has been 40% lower than in the latter. It is no surprise that industrial production in the FRG matched the USSR level at the end of 1980s (see Valtukh, 1994: 18).

Stagnating or declining of production capacities in the industry in 1974-1988 because of declining investment has been also well documented by B. Lavrovsky (see Lavrovsky). These dynamics determined the delayed stagnation and decline of the USSR industrial production. The technical quality of fixed assets in the USSR was steadily deteriorating from the beginning of 1970s . On the average, the worn-out rate of equipment in Soviet industry was : 1970 - 26, 1975 - 30, 1980 - 36, 1985 - 41, 1988 - 44 per cent (see Lavrovsky).

The continued decline in the rate of economic growth in the 1970s onward dragged down with it the rate of growth of R&D expenditures, the annual average number of newly created types of machinery, the annual reported number of new products assimilated by industry and the number of withdrawn obsolete products. The share of R&D in national income turned down too. The overall industrial output targets for the 10th five-year plan (1976-1980) and the following ones were underfulfilled. The plans became even more and more modest. Excessive delays in capital construction projects set off a chain reaction of bottlenecks through the economy and seriously retarded the rate of diffusion of new technologies. The innovation rate was declining over the period 1975-1990. A slowdown in the growth rate of labour productivity followed.

Morally and physically obsolete technology and capital stock (mostly in a civil sector of the economy), increasing destruction of environment because of an ever greater substitution of surplus labour by barbarous exploitation of nature, huge losses in production, a hidden mass unemployment in the industry and agriculture, weak motivation of workmen and deteriorating labour morale, an overexpansion of the military-industrial complex, high deficits of the state budget and balance of payments have marked the last years of the existence of the USSR. The society did not cope with the conscious management of social and technological development and found itself in the atmosphere of growing and destructive anarchy in production and other spheres. In spite of the beginning of the structural crisis and downward phase of the fourth Kondratiev cycle in the West in the 1970s, the tendency to catching up was replaced by the tendency of falling behind.

The Soviet Union turned into a pathological system in which important variables remained for a significant period of time beyond their ranges of stability, therefore the costs of adjustment processes were significantly increased. The system's control was lost because its information transmissions were full of noise or very slow. Its bureaucratically controlled economy failed for, in part, it turned out to be impossible to control centrally the dynamics *and* vast detailed complexity of the Soviet economy. The arms race also overburdened the less effective economy of the two super-powers (cf. Senge, 1990: 395).

The stagnation and decline exposed the parasitic groups and layers of bureaucracy, which instead of promoting conditions that could have encouraged the extension of greater resources depleted the state resources. At the same time, the Soviet society shacked up by *glasnost* (partial and rather contradictory reforms towards political liberalization) and *perestroika* (similar reforms towards economic liberalization) was not capable to create an efficient public administration.

In agreement with the general living system theory, a pathological system which has not restored negative feedback by itself and is not in a parasitic or symbiotic union with more capable systems should eventually decompose in components. The Commonwealth of the Independent States was founded in

December 1991. It has assumed control of the remaining parts of the USSR. The anti-reforms have worsened the pathology.

4. Russia's De-Industrialization and Falling Behind

4.1 Pseudo-privatization

Adepts of shock therapy claim that privatization is the great success of the past three years. It was believed that privatization would create a genuine capitalist class and strong management incentives to restructure, that it would reduce cross-subsidizing/redistribution of profits, introduce a tight budget constraint on managers and so on.

The first wave of privatization, including exchanging shares for vouchers through auctions, has ended on June 30, 1994. More than 15,000 large and medium-sized enterprises (or 64% of the total eligible) and some 95,000 small firms (or 70% of the total) have been formally privatized (Rubinfien: 14-15). By the end of June 1994, mass privatization have seemingly put 70%; of Russia's industry into private hands. The new wave has been started - ,,money" privatization with selling the remaining shares that were not given away in exchange for vouchers. The private sector now produces 58% of Russia's official GDP, according to the Economist (The Economist, October 8, 1994: 24), or 40% of GDP, according to Central European Economic Review (Autumn 1994). Some Western journalists believe that in this phase Russian and foreign investment will begin to restructure companies (see, for example, Lloyd, 1994a: I).

It is likely that more than 90% of properties are still under direct or indirect state control (this estimation has been made by L. Makarevich, the expert of Russian banks association, see Finansovye Izvestiya, October 11, 1994: II). This estimation may be not very accurate. According to other sources the mafia's control extends over 40 per cent of production assets, more than a half of money circulation is not controlled by the state (see Pravda, May 18, 1994: 4).

In any case, ,,it has become virtually impossible to transfer ownership of state-owned enterprises (other than those engaged in petty manufacturing production or small-scale services) to genuine capitalists - buyers with 'capital', broadly defined to embody technology and human skills as well as financial resource. ... As for foreign investors, expectations about their enthusiasm to invest in Eastern Europe in the first five years of the transition proved highly exaggerated" (Amsden et al, 1994 (forthcoming)). The fact that privatization was rapid in Russia means that employees and managers often directly own large chunks of equity, minimizing the extent to which outside shareholders can influence the direction of the company, privatization, though its first stage is formally accomplished, has mainly made quasi-private monopolies of what were previous state monopolies - that is, less under any kind of control which might have moderated their predatory and incompetitive behaviour" (Lloyd, 1994a: I). Mass privatization was not driven, as in many countries, by government desire to raise revenue by selling state firms. ,,This implies an idiosyncratic market capitalization for Russia's 14,000 largest companies of around $12 billion - only a touch more than Kellogg, an American cereal firm" (The Economist, May 14, 1994: 68). The international comparisons also hint at the undervaluation of Russian assets assigned for privatization (see the Table 3).

The Chernomyrdin government, trying to push pseudo-privatization even further, has turned off the subsidized-credit tap, leaving many managers desperate to find investors, even at the price of handing over control (see The Economist, May 14, 1994: 67-69). According to the governmental criteria based on current solvency, 70 % of enterprises could be declared bankrupt (see Skokov and Glazyev). Under these unfavourable conditions for domestic enterprises, one could not but expect that acquisitions rather than ex novo investment will be the source of growth in foreign control of TNCs in Russia (cf. Chesnais: 15). This means that the idea that ,,foreign investment appears to be Russia's best hope for restarting growth in its manufacturing sector" (Boulton: II) is not well grounded (see below). Privatization, deregulation and trade and investment liberalization have seriously impaired the capacity of Russia's government to use industrial and technological policies to enhance the structural competitiveness and social cohesion. ,,...lf one ,,grants" market freedom without discipline, the result is high inflation, speculation, and irresponsible stripping of assets" (Yergin and Gustafson, 1994. 118).

4.2 Unemployment and income distribution

In December 1993, the ratio of all fully unemployed persons to the economically active population was *5%*, partial unemployment - 5.4%, total unemployment -10.4% (see Izvestia, December 21, 1993: 2). ..According to Goskomstat. the ratio of all fully unemployed persons to the economically active population was 6% in July, partial unemployment - 5%, total unemployment -11% with an expected growth to 14-15% at the end of 1994 , in some regions it will amount to 25%" (Skokov and Glazyev). Distribution of national income between the social groups becomes more unequal. The share of wages and salaries in total income of population has declined from 67% in the first half of 1993 to 56% in the first half of 1994 (see Skokov and Gla2yev).

The hidden large-scale unemployment is, undoubtedly, a serious obstacle for effective privatization. Its ratio was near 25% of the labour force at the end of the 1980s. Production declined by roughly 50% afterwards. If the current output and resources were concentrated on mostly efficient genuinely private enterprises, the ratio of unemployment would be greater than 50% after these enterprises had laid off superfluous workers. The society with so high undisguised unemployment could not exist. Thus doubling die quantity of the efficient jobs as well as creating the socially safety net are among preconditions for capitalism (see Valtukh, 1994).

4.3 Drop of industrial production

The Russian GDP slumped in 1993 at least by 38-40 per cent on 1989 (see Valtukh, 1994: 12). A further 16 per cent decline in GDP has marked the first nine months of 1994 (the Financial Times, October 22, 1994: 2). Industrial production is ever more strongly feeling hard demand constraints. The expected decline of industrial production in 1994 - 25 %, in machine-building and metal processing industry - 50%, in chemical and timber; complex, in light industry, and in the production of construction materials –

30 %. The production of many kinds of automatic equipment, electronic and electro-technical machinery will be ceased, the output of many kinds of consumer electro-technical goods, of agricultural and transport machinery will be many times lower than in previous years. In particular, the output of lorries during the first five months of 1994 has been three times lower than

in the respective period of last year; in summer 1994, the output of machine-tools has been reduced to 32 per cent of that in June 1991, of presses - to 26

per cent, the output of computer numerically controlled machines has been reduced from 23, 000 to 500 a year (Sveshnikov: 4, Sautin: I).

The vice-prime minister of Russia's government A. Shokhin says: ..Preserving and strengthening scientific-technical and industrial potential is the highest priority of current government policy" (Vek, No. 26, 1994). Yet the rates of decline for high-tech and research-intensive manufactured articles are higher than of industrial output as a whole, despite the eliminating of profit taxes in part spent on investment (in 1993) and allocating of some preferential credits to high-tech industries.

,,The research intensive branches of Russia's industry are dying. Some of them are already dead. Only those who were able to enter the world market can hold their ground. They are not numerous, especially in the research-intensive branches" (Skokov and Glazyev). In the vehicle industry, in particular, there is a strong tendency to substitute short-term projects for long-term research-intensive projects. A similar tendency in machine-tool making industry, where the rather simple machine tools are substituting output of computer numerically controlled machine tools. Ironically (or tragically), lathes, which replicate those produced in 1930s under the slogan to catch up and overtake the USA, are now among them again (see Sautin).

In 1991-1993, a number of product innovations in machine-building were reduced by a factor of 1.5, whereas a number of obsolete items removed from production were reduced by a factor of 2.2. The national economy is losing fast and irreversibly the technological backlogs as well the potential for their reproduction. So the strategical foundation for efficient modernization of machine-building and the national economy as a whole have been undermined.

Production of armaments in 1992 was shortened by more than 60% (Frankfurter Allgemeine Zeitung, December 13, 1993: 15). According to O. Soskovets, first deputy prime minister, federal expenditures for the defence sector have been reduced by 70 per cent in the past two and half years (Lloyd, 1994e: 2). Yergin and Gustavson writes: ,,In 20 provinces of Russia, military-industrial enterprises account for up to 60% of all economic activity, and in 1 or 2 cases up to 80%. Many of these enterprises are giants, employing up to 30,000 workers apiece" (Yergin and Gustavson: 115). There have been 3 m employees in assembling of armaments. 1.5 m highly qualified employees have left the military-industrial complex (MIC) (Frankfurter Allgemeine Zeitung, 13.12.1993, p. 15).

The share of military equipment in the output of the MIC has been reduced from 56 % in 1988 to 20 % in 1993 (see Livshits). It has produced 95% of computers, 88% of diesel engines and generators, 33% of cargo railway carriages, 28% of boring-machines for oil and gas fields, 92% of equipment for the light industry, 83% of medical instruments, and 76% of equipment for manufacturing of agricultural materials (see Faltzman et al, 1993). Not only the part of the MIC producing weaponry but the complex as a whole is hit j the overall industrial crisis.

4.4 Large-scale stoppages of production

The number of enterprises standing idle for a long period of time is twice as higher as at the beginning of 1993. Among 4892 enterprises of Russian industry staying idle in June 1994, the share of enterprises of machine building and metal-processing branches has been greater as one third (see Sautin). Some of macro-economic indicators reflecting the deepening of the transitional crisis in the first half of the year 1994 are given in the Table 4.

There are excess capacities as a result of the protracted slump. At the end of 1993, the operational rate in the Russian industry was near 90 % - at 10%, 51-89% - at 57% , lesser than 50% - at 31%, lesser than 30% - at 8% o: the enterprises. ,,It is not already a crisis. It is destruction" (Livshits). The operating rate in the industry as a whole is dropped to 40-45 %, on the average, in manufacture - td 30-35%, in some manufacture branches - 5-15% (see Skokov and S. Glazyev, Pravda, October 18, 1994: 1).

Production capacities are reduced by 15% on the 1990. The remaining part of production assets is degrading fast (the worn-out rate of equipment Russian industry increased from 46% in 1990 to 52% at the beginning 1994. The economy has been thrown at least 10 years back because of investment crisis" (Skokov and Glazyev).

At the end of 1994, the structure of Russian economy is characterized by sharply increased share of raw materials branches and by disappearance the majority of research intensive branches of machine-building. Without implementing efficient industrial policy Russia appears to be condemned to a long-term chronic depression with high structural unemployment, degrading scientific-technical and social intellectual-moral potential, strong dependency on other countries.

Downsizing can create a vicious circle that deepens and prolongs downturn (the Keynesian consumption multiplier reflects this positive feed-

back loop). The former central banker Viktor Gerashchenko told the Duma: We cannot but be concerned by the fundamental weakness of the economy, brought about by the collapse in production" (The Guardian, October 15, 1994: 3).

4.5 Disinvestment and Savings

The Russian economy has been a repeller rather than attractor for capital. Whereas value added by the economically active population was equal to some Rbsl60 billion (at prices of 1990) in the year 1993, the consumption fund was approximately Rbs235 billion. So economic surplus, necessary for the existence of capitalism, became negative (see Valtukh, 1994).

The 1993 level of investment was at least 2.7 times lower than in 1990 (investment in the production sphere- material and nonmaterial - were at least 3 times lower), the 1994 level is 4 times lower (Valtukh, 1994, Pravda, 18.10.94: 1). There is a critical situation - near physical decay - of production capacities in metallurgy, electroenergetic, timber processing, chemical, transport engineering industries (see Faltzman: : 26, 34). On the average, in 1994, investment in machine-building, light industry, construction, agriculture are 10-15 % of the 1990 level. The fixed assets degrade steadily for lack of investment. Ageing and worn-out of fixed assets, disinvesting are thus the painful characteristic (investment are not providing even simple reproduction; in fact, the country is investing only 25 per cent of the national amortization fund (see Nezavisimaya Gazeta, December 23, 1993: 4).

Russia's nascent stock market is still notoriously illiquid (see The Economist, May 14, 1994: 67-69), banks are still weak (according to Literaturnaya Gazeta, October 12, 1994, the capital of a middle Japanese bank is larger than capital of all Russian banks taken together). Russia's domestic savings have been wiped out by inflation. At the beginning of July [19]93, households had 1.6 trillion roubles (then worth $1.5 billion) on deposits at banks; at the beginning of July 1994 they had 14.8 trillion roubles ($7.4 billion) (see The Economist, October 8, 1994: 24).

Different kinds of savings (small if compared with the most urgent Investment and consumption needs) are not practically used for long-term investment projects. Long-term loans of commercial banks (3.5% of the total sum) are diminishing in real terms. Despite Russia's hunger for investment finance, banks avoid lending within the country - except to clients which *earn* hard currency and are well-known to them - due to a lack of

mechanism to ensure repayment. I would like to notice in this respect that German and French private companies gather two-thirds of their investment financing from long-term debt instruments, according to the Bank of International Settlements (see Roth).

Russia has had some of the highest interest rates in the world for the past 12 months. This has helped the rouble appreciate against dollar in real terms (i.e., after allowing for differential inflation) but discouraged from domestic savings for investment even further. Some joint ventures draw on Western banks credits at a lower interest rate than those provided by Russian financial institutions in order to be internationally competitive.

,,The decline of production was twice and decline of investment three-times higher than it was expected at the 1994 budget projecting. Instead of ,,investment-oriented" manoeuvre, approved by the President and Federal Assembly by adoption of the budget there is apparent great failure" (Skokov and Glaziev).

The main cause: the state has almost declined responsibility for investment duties, whereas private capital, capable to take over this responsibility, been virtually non-existent. At the same time, ,,people privatization" and price liberalization have creating conditions for a ,,waging" not only enterprises' incomes but of previously accumulated wealth as well. "The main investor in Russia for a period of several 5-year periods can be nobody else but the state" (Valtukh, 1994: 18).

Russia must raise the level of investment to modernize the capital stock, find provision for the environmental clean-up, make additional investment in transportation related to the geographical problems associated developing Siberia and the Northern territories. The volume of investment is declining, contributing thereby to shortages and to the need to retain obsolete productive capacity. The reindustrial spurt would put increasing strains on consumption levels the lower the base from which reindustrialization started.

The period of stagnating and declining investments is stretched already over some 20 years. There was no 15-years-long, even no 3-years long, absolute reduction of investment in any developed capitalist country. Countries which were catching up the US invested per head systematically more, than the US, although their starting levels of production and consumption were lower (see Valtukh, 1994). The growth of Russian economy is constrained not only by the low saving/investment capacity but by unfavourable foreign exchange requirements as well (see below).

4 5 Foreign investments

The number of joint ventures at the end of 1993 was around 12,000 (70% of them are engaged in trade and intermediate sphere, including advertisement, and in transportation of foreign commodities over the Russian territory (transit) between Europe, Northern America and Pacific Rim, including storage. According to the Economic Ministry and Chamber for Trade and Industry, foreign direct investment were equal to: 1992 - 290, 1993 - 140, 1994 - 160 ($ million). The share of joint ventures in industrial production increased from 1.8 in 1991 to 2.4 per cent in 1993 (see Leonov).

Among large (mainly American) companies, setting up production bases in Russia, there are Caterpillar, which is undertaking two joint ventures with Russia's biggest engineering companies, ZIL and Uralmash, Polaroid and Bayer, which is just started making Aspirin in Moscow (see Lloyd, 1994b). German firm Siemens has shares in ten joint ventures in Russia, mostly in telecommunications; one of its goals is to participate in the construction of the 50 thousand km long fibre-optic cable network that will connect Moscow and Khabarovsk, in particular (see Finansovye Izvestiya, October 27, 1994: II).

Although the large foreign corporations are increasingly making token investment, there is little sign of large-scale strategic investment by foreigners, as the Table 5 shows. Only ABB Brown Boveri, the power engineering company, has taken a (still unique) decisions to locate much of its production in the CIS (perhaps in view of the machine-builders' experience in production and exporting superpower presses as well as machine-tools for production of very large details; see Lloyd, 1994d: XXVI).

Some of the biggest Russian companies are now seeking to improve their access to international markets by issuing global depository receipts. I will give few examples.

Western investors are already estimated to own 16 per cent of Russia's United Energy, an energy company which controls more than 90 per cent of Power generation and transmission and incorporates 69 regional utilities, Powerlines and other systems. It was established as a joint stock company in December 1992.

Foreign investors also estimated to own 6 per cent of Norilsk Nikel, a "tiling company which produces about a fifth of output of nickel and cobalt, [3] 2 per cent of the world's copper production, 42 per cent of the world's Platinum production (see the Financial Times, September 29, 1994: 26).

Among Russia's blue chips the outstanding place belongs to Gasprom. This company has decided to sell 9 per cent of its shares to foreigners. Kleinwort Benson Deutschland GmbH is entrusted with this deal. Gasprom has 40 per cent of the world's market of natural gas, its gas reserves are put to be equal to 48 billion cubic meter, or 40 per cent of the world's sum total (see Frankfurter Allgemeine Zeitung, September 1, 1994: 23).

Portfolio investment in the Russian economy, spurred by the low prices of many Russian stocks, has been flowing into the country at the rate of more than $200m a month with numbers rising sharply in the last few months before the fall of the rouble exchange rate on the ,,black Tuesday" (11.10.94). See(Lloyd, 1994f; Lapper and Halligan). The rock-bottom prices of Russian shares have been proving increasingly attractive to portfolio investors which have found that many of shares, especially in the energy sector, utilities and telecoms, are among the world's best bargains (see the Table 3). The abrupt fall of the rouble exchange rate has made potential investors more cautious.

To tap into Russia's superior technologies the western corporations and defence contractors are buying prototypes, licenses, rights to commercialize technology outside the former Soviet Union or founding joint ventures with Russian partners. Westerners spent more than $100 million last year buying technology and funding research in Russia (see Hudson: 18). Still the high-tech enterprises have not attracted foreign investments at a substantial scale. Foreign investment will most likely be concentrated in the nearest future in the extraction of raw materials, such as natural gas, petroleum, and gold, rather than being focused on high-tech branches or broadly invested through the Russian economy.

4.7 The Federal State Finance

The government is holding the budget deficit within the 10 per cent of GDP set by the IMF, compared with average government budget deficits in Europe near 6.1% of GDP (see Lloyd, 1994b, Roth). Still, according to (Skokov and Glazyev), during the first half of 1994, the federal government has collected only 64% of the planned taxes and payments. Wide-spread tax evasion and capital flight deprives the state of huge amounts of tax revenues. As the result, the financing of the most important federal programs have been undermined. The real financing of the state investment has been equal to 64%, of science - to 68% of the planned expenditures in the first half of 1994 (Skokov and Glazyev).

,,The central government became the main defaulter and the main source of non-payments. The state is the main generator of the non-payments crisis. A sharp (more than 40 per cent) decline of the state incomes' share in the GDP under a simultaneous increase of the tax burden testifies a deep and fast progressing disorder of the state finance. As a matter of fact, we may speak about a financial bankruptcy of the government and pilfering of state finance" (ibid.). Another area ,,in which the government has been shirking its duties is in its failure to design a safety net for the inevitable losers from reform" (The Economist, October 8, 1994: 24).

The vicious circle of declining production in the state sector and officially registered private sector - diminishing state revenues - declining state outlays - declining production has not been broken. ,,The government has cut down heavily on credits, but this meant that workers have not been paid, investment has been postponed and debts between enterprises have rocketed to vast levels" (Lloyd, 1994d: XXVI).

As I have already noticed, the interest rate of the Russian Central Bank has been among the highest in the world in 1994. The Financial Times has come to a conclusion that high interest rates, in forcing more producers into bankruptcy, fuelled the constant pleas for assistance from agricultural and industrial producers which policy makers were already in a weak position to resist. ,,...high rates also cost the government dear, by raising the cost of servicing government debt. The longer they prevail, the more likely it is that the government will resort to further inflation in order to lower that burden" (the Financial Times, October 13, 1994: 17). Enterprises will become even less inclined to make investment in the production sphere if the interest rates for loans become higher.

4.8 The Collapse of the National Financing of Science

The national financing of science and education is reduced not only absolutely (in real terms) but relatively too (measured as a percentage of the GDP). R&D investment accounted for 2.1 per cent of the GDP in 1990, fell to 1.4 per cent in 1991. Of the estimated 950, 000 people working in R&D in Russia (excluding space research) in 1991, 200, 000 - 300, 000 people left the system with further cuts expected (see OECD, 1993; the Financial Times, October 13, 1993: 3).

According to some estimates, real financing of the Russian Academy of Sciences is declined by 20-30 times on 1990 at fixed prices (Pravda, September 30, 1994: 2). Russian experts have estimated the ratio of

international financing to the volume of Russian expenditures on science to be between 3 and 9 per cent in 1992-1994, OECD experts believes that this ratio is around 15 per cent (see Nezavisimaya Gazeta, October 25, 1994: 6). The financing provision by the International Science Foundation and other international bodies is important, but it cannot substitute internal sources. The continuation of industrial crisis makes extremely more difficult financing of science and social protection of scientists. The state should elaborate new efficient forms of support, abandoning its residual financing. The government has cut down on domestic expenditure for R&D in relative terms (as a percentage of GDP) too: 1990 - 2; 1992 - 0.75 , 1993 - 0.6, 199 - 0.5 (sources: Hudson: 18, Izvestiya, October 13th 1994: 2). At present, expenditures on science are ,,eight times lower than on defence, almost five times lower than on public administration! Exactly here in our country, collapse, more dangerous than that of the currency exchange [on ,,black Tuesday" 11.10.94], is waiting to occur" (Otto Latzis in Izvestiya, October 13, 1994: 2).

4.9 Inflation

Inflation that was running at nearly 30 % in August 1993 has been squeezed to around 12 % in December of that year (The Financial Times, January 7, 1994, p. 2). Inflation has been down to a monthly rate of 4 per cent in August 1994 (Lloyd, 1994b: 10). Before the collapse of the rouble on ,,black Tuesday" (11.10.94) inflation has remained at the lowest level since August 1992.

These have given some food for the following interpretation. ,,Mr. Chernomyrdin has not only refrained from diluting the radicals' program, he has actually advanced it - retaining a tight squeeze on credit, keeping down inflation, forcing the central bank to impose more discipline and keep real interest rates high, approving (in Russian conditions) very tight budget with low expenditure on the military and protecting remaining reformists in the government" (Lloyd, 1994c: VI). But what about private capital? ,,Instead of going into hard assets, money flees inflation by going into arbitrage, speculation, foreign currency, conspicuous consumption, or Swiss bank accounts" (Yergin and Gustavson, 1994: 267).

In my view, the lowering of the inflation rates to 5-8 per cent a month reflects the industrial deepening decline, the sharpening non-payments crisis (the state itself is the main debtor) rather than higher efficiency of monetarists methods of regulation (see also Skokov and Glazyev). Internal

are impetuously approaching the world level and often even exceeding it.

4. 10 Russia's Foreign Trade and Indebtedness

The world economy is characterized by competition, co-operation and co-ordination. They shape specifically the Russian economic relations with foreign states and companies.

The general export-import turnover is moving downward, in spite of a substantial (200-300%) of the export of rare and non-ferrous metals in the last 2-3 years. As in the hierarchy of production sites Russia is falling behind, the structure of its international trade is also worsening. Raw materials, energy are the main items of the export, consumer goods and - to a far lesser scale - equipment for the fuel-energy complex is the main items of import. Whereas raw materials and energy provide 80% of Russia's total export, their share in China is already 20 % (Frankfurter Allgemeine Zeitung, 27.5.93, p. 17). Development and diffusion of radically new technologies, directed at abrupt increase of the country export potential in the fields of research intensive output is a necessary condition for a turning of this unfavourable tendency.

Because of low competitiveness, domestic producers have lost many positions on the internal markets (in branches of light industry, consumer durables, metal-processing equipment, in particular). At the same time, the share of imported consumer goods in the retail trade increased during the last few years from less than 20 per cent to 50 per cent (the 10 per cent points increment only in the first half-year 1994 (see Skokov and Glazyev). For consumer durables, the import share is already 70-80 per cent (Pravda 18.10.94: 1). In particular, Russia is losing internal market for second-hand foreign autos.

It is the military-industrial complex that has mostly lost its markets for foreign rivals. (The enterprises of this complex produced 66% of washing-machines, 72% of vacuum cleaners, 98% of playing recorders and refrigerators, 100% of TV sets, sewing-machines, photo cameras, video recorders (see Faltzman et al 1993).) This performance impedes the efficient conversion of the complex for the peaceful ends.

The fuel-energy complex has a strong export potential that stimulates an inflow of foreign capital even under generally unfavourable situation in the economy as a whole. A high export potential is also typical for extraction

and dressing of ore in ferrous metallurgy, processing of scrap, production of cast iron. Some Russian economists believe that foreign investments will provide industries with a high export potential with most technical retooling (see Faltzman et al: 86).

The government introduced protective tariffs to foster the new import substituting industries. Lagging exchange rates is the other protection. Such a protection could favour industries with high requirements of imported inputs and machinery and serve as prerequisite for subsidizing industrial investment and expansion. The subsidy is paid, in fact, mostly by exporters of raw-materials and energy. High protective tariffs against competitive imports are thought also as a pre-condition for foreign direct investment (for example, into the car industry).

There are also more or less successful attempts to organize import substituting production. For example, the Moscow car producer AZLK brought down the share of imported details in its car from $900 to $350 in 1994 substituting Russian suppliers for foreign suppliers (see Sveshnikov). An IBM joint venture near Moscow produced 15,000 PCs last year, and is slated to make 50,000 this year; because of Russian import duties and other taxes, it costs 10 per cent less to make the PCs in Russia than to import them (see Hudson, 1994b). Atommash, which have produced reactors for atomic power stations, will deliver equipment for a consortium called Rossshelf, which includes Gasprom, the state natural gas monopoly, and a nuclear submarine shipyard (it won a deal in developing a vast natural-gas field under the water of the Barents Sea). A conversion of the military-industrial complex is one of the most prospective fields for the import substitution and export promotion policies.

In open economy, domestic production could also become a substitute for consumer goods that were imported at first. It is known, that in some developing countries with open economy, increased domestic incomes originating in export agriculture or mining caused imports of various consumer goods to reach a volume that made domestic manufacture economically attractive. Eventually some of these goods would be exported, so that the countries in question ,,tend to develop a competitive advantage in the articles they *import* (Hirschman, 1958: 122). Russia's government seems to expect that this linkage will eventually ,,work" in Russia too.

The state could raise tax on income accruing to the exporters, or it could impose new tariffs on the imported articles on which a good part of the export-related incomes will be spent; the resulting fiscal receipts would be used

to finance investment projects. This fiscal linkage with the investment sphere has been used by Russian government on a very restricted scale.

In the atmosphere of primitive accumulation of capital", the foreign trade became the main field for plundering the national wealth: according to some estimates, up to 40% of import and 10-12% of export are not registered, the illegal massive outflow of hard currency is taking place as before. Capital flight is believed to be around $1 billion a month (see Skokov and Glazyev). ,,The national economy is at a threshold of uncontrolled growth of foreign debt; the service of the debt is carried out mostly at the account of new foreign credits. Whereas at the beginning of 1993 the foreign debt was equal to $80 billion, it has amounted to $85 billion in the mid-1994 in spite of substantial excess of export revenues over import outlays (which was equal to $10 billion for the January-July 1994)" (ibid.; The Deutsche Bank Research Review shows similar data, see Central European Economic Review, Autumn 1994: 8).

4.11 Depreciation of the National Currency

A unified commercial rate for current transactions was introduced for the first time on November 1, 1990 at a level 1.8 R = 1$ vis-a-vis the official rate of 0.6 R = 1$. It made easier the repatriation of profits by joint-ventures. Currently, dollar rather than rouble is one of the most common stores of personal wealth. The cross rate: Dollar = 1229 Russian Roubles (The International Herald Tribune, 11-12.12.93, p. 11), Dollar = 2,631 Russian Roubles on 28.9.94. The rouble has lost 16.5 per cent against the dollar in September 1994 (the Financial Times, 29.9.94: 1). To my knowledge, the government has not yet accepted a suggestion of the IMF to introduce a fixed exchange rate thought by the latter to be a nominal anchor for prices.

4.12 The Falling Efficiency of the Economy

Russia is endowed with the substantial economic and technological potential which has not been properly used. The country has a narrowing scope of competitive leads, mainly in the extractive industries, in traditional handicrafts and in a few high-tech industries (modern armaments, air/space and atomic equipment, scientific instruments, dressing of uranium and other ores, and other). Sharply focused capital advancing and well-elaborated international co-operation in these industries could provide relatively high export revenues and profits.

Among industries which originated after 1945 there are two industries that are especially high positioned - atomic energy and space industry. Russia still owns the world's most powerful rockets (Khrunichev Enterprises, the big Russian rocket maker, rocket-thrusters in Kaliningrad); the other ,,pearls" could be named: a prototype space-based nuclear reactor, ,,Topaz", from a gallium-arsenide thyristor (an unusual type of semiconductor, developed by the Ioffe Institute in St. Petersburg); the best technology for isotopes separation and extraction of the purest gold at the dispose of the Ministry for Atomic Energy (see Hudson, 1994a: 18, Moskau News, October 1992, No. 10, p. 11); top technologies (smelting of metals by explosion and many others) have been developed in the Siberian Branch of the Russian Academy of Sciences (Novosibirsk is its centre). A pioneering European Space Agency-Russian mission at Mir cosmic station carried to it by the Soyuz TM-20 is undoubtedly the case of co-operation at the highest level (see the Financial Times, October 4th 1994: 12). A more active participating of Russian scientists in other similar international R&D projects may be recommended.

Yet the whole technological system is morally and physically obsolete. Semiconductors and bio-industries, other modern industries, and such carriers of technological advance as communication and transportation infrastructures are underdeveloped. The ,,old" industries - steel and machine-building, traditional electrotechnique, traditional chemical industry, car industry - are not at a top technological level, like in Germany, but rather far from the world technology frontier.

The decline of Russia's industry manifests itself in a drop of labour productivity, in growth of material and energy intensity (inputs per unit of output). The following illustration may be helpful. In spite of an energy price growth, input of energy per unit produced posted in 1992-1993 34 % increase. Whereas the GDP in 1992 was 20 % lower than in 1991, consumption of energy was only 4% lower (see Izvestiya, September 1, 1993: 4).

In the fuel-energy complex, the technical level is declining. The input of fuel per unit of electrical energy, produced at electrical power-stations of a general usage, is increasing. Only 10 per cent of oil is extracted applying modern technologies, as a result the rate of extraction from oil fields is around 40-50%. In chemical industry, the share of progressive materials and products in the general output is 2-3 times lower than in developed countries, the share of output produced by obsolete technologies equals 60%. Substitution of technological generations takes place every 20-30 years,

compared with 7-8 years in more developed countries. In the machine-building complex only 20% of equipment corresponds to the world technological frontier, at least 26% should be substituted. A deteriorating potential of the basic industries is also characterized by a declining number of new prototypes of equipment, machine-tools, instruments, means for automatization: in 1986-1990 by 35% on 1981-1985, in 1991 by 23% on 1990). The share of new prototypes at the world level is declining uninterruptedly (see Faltzman et al., 1993). Five years ago Russia was among leading producers of machine-tools, yet now it is placed in this industry on the 24 position among 30 countries (see Sautin).

According to the head of Russia's Union of Industrialists and Entrepreneurs A. Volsky, only 16 % of Russia's production capacities (mainly in the production of modern weaponry and in the space industry) could be able to bear international competition if the Russia would completely open itself to the world markets, but 28% of enterprises would be inevitably bankrupt (see Frankfurter Allgemeine Zeitung, 16.11.92, p. 1). In order to come closer to the world technological frontier it is necessary to convert the rigid energy-intensive mass- and flow-production system, created along principles of Fordism, to flexible lean production, based on information-intensive products and processes.

The above facts are crying for a necessary transition to a new technological system, but the inconsistent economic reform delays solving this fundamental problem. ,,The liberalization of prices and tariffs has failed to create competitiveness. The government made free prices the core of its policy, but this policy is inefficient in the monopolized economy", - a Russian weekly writes in an editorial article (BWW, 1993, No. 45, p.2). The rigid stabilization policy pursued by the Russian government was one of the reasons for the decline of industrial output and national income. The policy of passive adaptation to economic decline aimed at balancing budget deficit, and solving ideological problem of destroying state sector in the economy brings about the deepening crisis. The government policy does not satisfy the expectations of the society (see, in particular, an article of S. Glazyev in Nezavisimaya Gazeta, 21.4.94).

The heterogeneity of the Russian technological structures implies that its different branches and enterprises have specific structural needs for policies affecting the pattern of economic signals (including relative prices and relative profitability), emerging from the international market. Whereas the extractive industries are, as a rule, in favour of undisturbed pricing, industries behind the world technological frontier seek a protection from

unconditional free trade (this need is the greater, the greater is the distance of a particular industry or enterprise from the technological frontier).

4.13 The Broadening Technological Gap

Within the United Nations program of comparative studies, Russia's statisticians have compared magnitudes of GDP [at purchasing power parity] in-different countries for the year 1993 (see a comparison between Russia and the USA in Table 6). Judging by the volume of the GDP, Russia has entered the group of ten developed countries, according to the Russian statistical bureau. (The World Bank more sceptical estimation based on GDP at PPP (1992) puts Russia before Brazil and Mexico on near the 20th position in the international ranking, after the US, Japan, China, Germany, France, India, Italy, Britain, etc. See: A Survey of Global Economy. The Economist, October lst -7th , 1994: 4.). On the GDP per capita basis, Russia has been among the sixth ten countries, whereas in 1990-1991 Russia was among 30 most developed countries (see Kuznetzov).

K. Valtukh has estimated that the US needed 90 years to arrive at their present level from the level roughly equivalent to that of present Russia (see Table 7). Russia can do it faster, this Siberian economist believes, because she still preserves substantial part of her educational, scientific and cultural potential, accumulated up to the beginning of 1990s, which is, indisputably higher than that of the US at the beginning of the century. She can also use the results of the scientific-technical development in the whole world instead of copying the history of the US technological transformations. It is indisputable that solving this problem requires enormous investment - the annual amount is greater, the shorter is the duration of the transition wished for (see Valtukh, 1994: 16).

This conclusion is qualitatively supported by an analysis of other experts: „... if the former Soviet republics can replace an outmoded economic system and modernize their capital stock, they have potential to reverse the decline in output and then to grow faster than economies at equivalent or higher levels of development and narrow the gap in production and living standards between themselves and industrial economies...Even those who take an optimistic view accept that this process will not be easy and will take several decades to achieve" (Smith: 219).

5. A hypothetical underlying Structure of the De-Industrialization Process

In striking contrast to early neo-classical expectations, investments have not arisen in Russia naturally and optimally as the result of profit seeking by entrepreneurs. Practical attempts to return to pattern of the 19th century capitalism are a historical anachronism. The [neo-classical] idea of 'shrinking state' has been particularly detrimental for public investments and supply of public goods (see Wohlmuth, 1993: 11). Imperfect and incomplete markets, thin and limited insurance markets, disturbed prices may be blamed for the investment failure. Instead of accepting this simplistic explanation, I have sketched in the previous papers the hypothetical underlying structure of the de-industrialization which, in my opinion, is still valid and thus deserves to be reproduced with some additional comments based on the new facts from the previous Section. I apply the system dynamics concept of the closed loop of causal influences and the heuristic of Prisoner's Dilemma Game (see Table 8), which enable me to visualize complex social phenomena and advocate the rational therapy policy for tackling the complex social problems of Russia.

The heuristic of the Prisoner's Dilemma Game helps us to understand the reluctance of enterprises to step up output or make investment in the periods of economic stagnation. Comparing future returns and probable costs is a usual procedure of an investment projects evaluation (see for example (Sell)). G. Hill suggests that investment decisions of firms in such situation resemble a Prisoner's Dilemma: firms are less willing to risk investment individually, although each firm would probably benefit from increased sales if other firms invested. There are three possible solutions how to start economic recovery: first, lowering the interest rates in order to make it for an individual firm worthwhile to invest; second, raising state investments and thereby reducing the risk individual firms face; third, negotiating a contract among firms in which all agree to invest simultaneously (see Hill). Forming a long-term attitude, promoting interdependent decisions, introducing centralized common structures may promote cooperation, in my view, too.

Russian firms, in particular, perceive their demand schedules to be rather inelastic where an expansion of output is concerned. Those who would increase their operating rate or invest in new capacity could lose if other had chosen the opposite behaviour. The dominant non-cooperative strategies of this game are such that only small-scale investment are made.

Moreover, as the economy declines and standard of living goes down, tremendous political and social pressure is growing to devote what little wealth is produced to current needs - above all food (see Yergin and Gustavson: 267). The Russian government will probably raise taxes on conspicuous consumption of the rich in order to release the necessary resources for investment being under growing social pressure of groups with lower incomes.

Up to October 11 1994, the government and Central Bank pursued the policy of lowering interest-rate, whose level has been still far higher than in the West. This has not been a sufficient inducement to stimulate the necessary flows of output and investment. State investments have been too small for triggering private investments. The mounting overdue debts of enterprises to each other and to banks make Hill's third option very difficult to implement without such a radical measure as cancelling debts.

Although the West can help facilitate economic recovery (by supporting the transition at critical points, by opening markets, offering training, technology and know-how, setting up local R&D activities by multinationals, etc.), foreign direct investments at this stage cannot be a fundamental solution too. „The history of direct foreign investment in other late-industrializing countries suggested that typically such investment lagged rather than led growth; it entered when a growth momentum had already started and then accelerated it" (Amsden et al, 1994 (forthcoming)). Because foreign direct investments cannot be the decisive form of technology transfer in the nearest future, assimilating and improving upon foreign technology by the home enterprises is far more likely to take some forms of „reverse engineering".

The facts from the previous Section reflect the fundamental technological imbalance in the global economy that is the underlying reason for the gaps between the living standards in the USA and in Russia. This imbalance brings about, often in a round-about way, the politico-economic uncertainty/instability in Russia and the CIS as a whole. The growing discrepancy with the world technological frontier takes off the factor-oriented cost advantages and makes output morally obsolete and unsatisfactory for consumers.

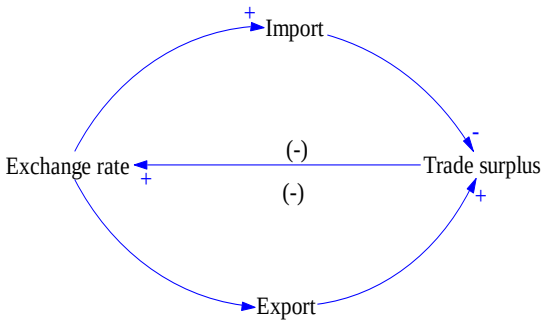
I believe that total costs of production of a social use value in Russian manufacturing industry are usually higher than internationally socially necessary: an efficiency of any indigenous firm is heavily depreciated by the general low technological level and poor infrastructure in spite of low labour cost. This discrepancy and the distorted structure of the internal prices in

relation to the international one transforms incentives for an entrepreneur to invest in manufacturing on the Russian territory in their opposite - to disinvest, to consume or to convert value in trading/interest-bearing capital at home or abroad. This still dominate tendency undermines the very base of social cohesion and consensus. The unstable politico-economic situation raises the private interest in a short-term profit.

According to estimates of Ju. Skokov, the Chair of the Federation of Russia's Commodity Producers and former secretary of Russia's security council, the average profit rates in the spheres of circulation and production were 600-700 and 20 per cent, respectively (see Frankfurter Allgemeine Zeitung, 17.7.1993, p. 10). The mostly attractive spheres for private capital (often interwoven with corrupt bureaucratic groups) are the real-estate and shares speculation, protection rackets, unregulated exports (including armaments), instant fortunes through currency exchange, etc.

We think that institutionally and structurally unprepared opening of the Russia's economy to the rest of the world at the beginning of 1992 caused the higher economic and social cost of the transformation that the objectively necessary. The big bang theorists built their recommendations on the self-balancing mechanism of exchange rates and trade surpluses (see Figure 1). Still other important relationships did not receive a sufficient attention.

Figure 1. The foreign trade balancing feedback.



Note: here and on similar figures below the symbol „ +" means that a change of a variable is enhanced by an increment in another variable, the symbol „-" means that a change of a variable is negatively affected by an increment in another variable.

The detrimental effects of the unsound economic strategy and of expectations of a further Rouble devaluation are reflected in Figures 2 and 3.

Figure 2. Detrimental effects of inflation on the exchange rate.

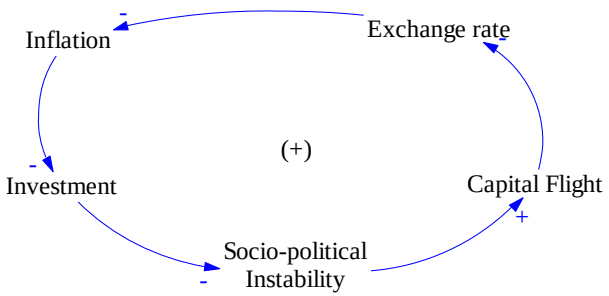
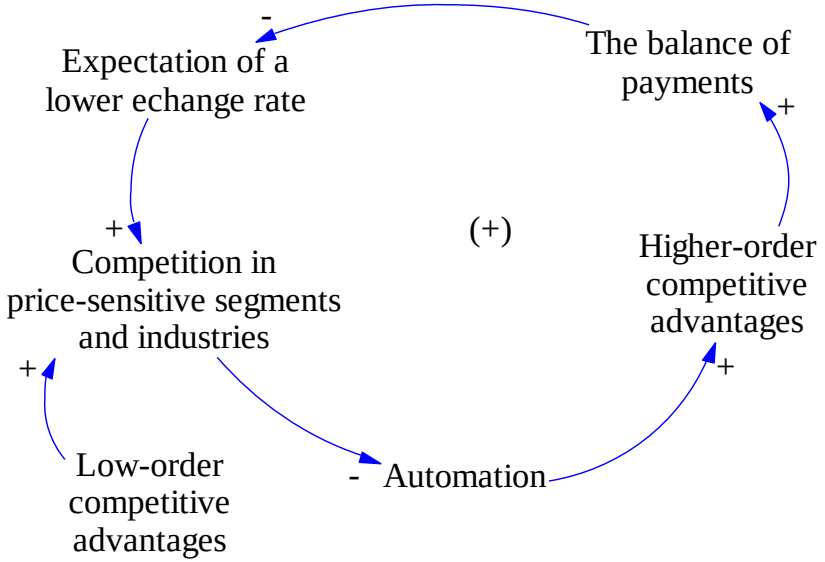


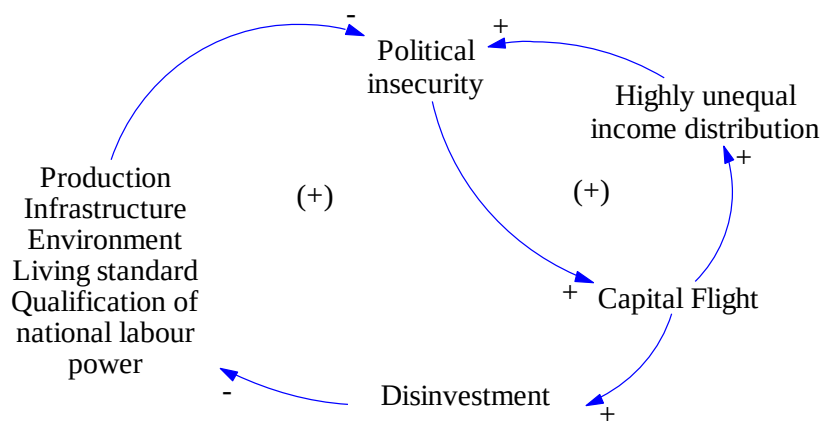
Figure 3. Self-fulfilling prophecy of a weaker national currency and of national industrial decay (based on Porter, 1991: 641-642).



We have seen that the speedy reform of the foreign economic relations has contributed to the macroeconomic destabilization: in particularly, the weaker control of foreign transactions on the microeconomic level led to the growth of the foreign debt, to capital flight and to the foreign trade structure which is even worse than the initial.

Capital flight is a symptom of dysfunctional economy. Russia desperately needs the capital that is now fleeing. There are strong vested interests of some exporters, commercial banks, central/local bureaucrats, and of the mafia to preserve the present situation (which they find very healthy). The relative and absolute deteriorating of the living standard of the majority of Russia's population explains the absence of consensus concerning the content/direction and pace of the transformation. This politico-economic instability, induced by inequality, is making weaker trust and certainty about property rights, contributing to capital flight that enhancing instability and inequality further (see Figure 4). Social policies that increase inequalities would have very damaging effects. Russia's President has emphasized that „ it is necessary to develop and begin to implement the national anti-poverty program in the next months" (Izvestia, July 21, 1994).

Figure 4. Investment and political security spiralling downward.



The high degree of monopolism, low elasticity of commodity and capital flows against price, budget deficit, devaluation of the national currency are most important immediate factors of the inflation. Saying more generally, Russia's technological system is providing conditions for sellers' market instead of buyers' market, hence steadily growing prices. Because of the chronical shortage of the means of circulation and payment, typical for periods of high inflation, many production units are delaying or are not paying wages and salaries to employees for months (hence strikes and hunger-strikes). Notice that inflation is not the single factor of disinvestment. Too austere measures directed to the lowering the inflation rate may provoke social protests and destabilize political and social relations with further detrimental effects for investments.

Whereas inflation contributes to unequal distribution of income, it promotes inflation, in its turn, inflation may be expected to be lower in economies with more equal income distribution (other things equal) due to lower pressure for government expenditures, and lower presser in wage bargaining... the more equal the income distribution, the more the state can pursue developmental goals rather than distributional goals..." (Amsden, 1993: 18). It has been shown elsewhere that in a closed capitalist economy growth of labour productivity typically promotes a steady state labour bill share and employment ratio, although irrationality or myopic rationality in bargaining, disregarding regularities of the whole system, may be detrimental (see Ryzhenkov, 1994b).

The continuation of the present pathological situation would require pumping of consumer goods from the West in exchange for raw materials and fuels from Russia under worsening ecological conditions and with a high likelihood of wars, ecological/nuclear catastrophes.

Figure 5. The vicious circle of declining investment and (hyper-) inflation.
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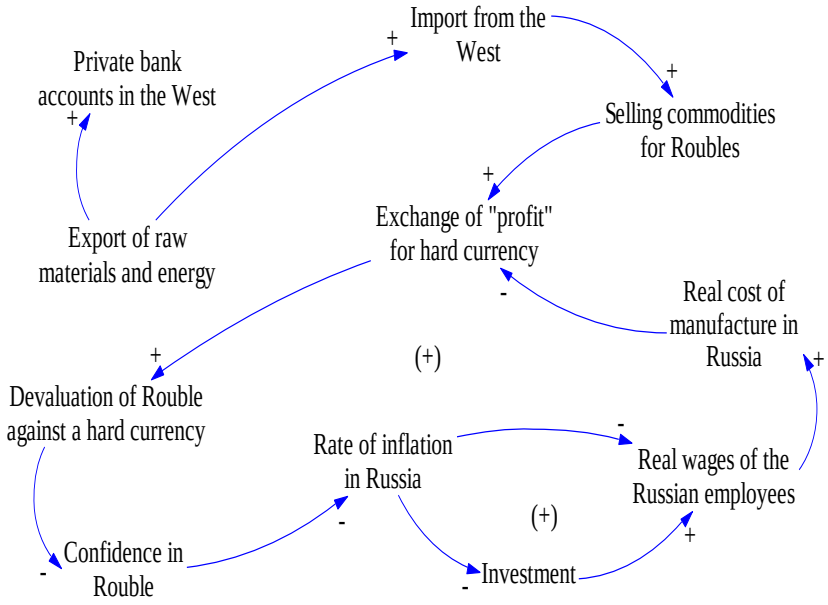

Figure 5 provides us with a fragmentary logical scheme (some important reinforcing/balancing feedback and delays are not shown).

Figure 5 shows that individual rationality does not imply collective rationality. The contradiction between individual and social interests, typical for a market economy, has achieved a very acute degree. This vicious circle, containing seeds of its own destruction, should be converted to a virtuous circle of expanded reproduction (the negative influence of the declining investment on the production of fuel and raw materials as well as on the competitiveness of the Russian economy is not shown explicitly). The total gains of partners in the West and in the East would be raised and sustained, the social climate would be substantially improved.

The attempt to introduce autarky will fail without sufficient internal production and without serious public support, whereas a ,,clever"

protectionism and gradual liberalization (if necessary conditions have been provided) seem to be more acceptable. This moderate protectionism would not be very detrimental toward foreign producers and may be even favourable for foreign investors interested in long-term benefits at the Russian market.

The above vicious circles are not running completely unchecked as the government and the Central Bank have been taking some steps to control and halt the negative tendencies (providing the positive real interest rate beginning from December 1993, trying to introduce a more restricted regime of foreign trade with a harder state control over export revenues and import taxes, etc.). The attempt to strengthen control over national economy is a step in the proper direction. Yet the experience has shown that the entrenched disproportions and instabilities cannot be cured by the monetarist and other methods without implementing institutional reforms and policies directed to the fundamental evolutionary factors.

The overreliance on the static comparative advantages in the government policy has become one of the crucial determinants of the emergence of vicious circles in national patterns of evolution. The pattern of Russia's specialization in the world economy is mainly determined by the relative size of the sector-specific technology gaps (or leads). The growing technological gap with the West is both the consequence of this policy and the factor that preserves it.

6. A Rational Therapy Policy

The negative tendencies to broadening the socio-economic crisis, expanding a criminal-monopoly market, swelling bureaucracy and bureaucratization of the state, increasing social inequality, destitution of a considerable part of population were stronger than positive tendencies. These negative tendencies have been amplified in Russia because of the shock therapy policy.

Professor K. Valtukh and his colleagues from the Institute of Economics and Organization of Industrial Production, the Siberian Branch of Russia' s Academy of Science, have shown that a path towards economic recovery is very stern and steep (see Table 9). Their optimistic scenario envisages reviving investment (their level of 1990 could be attained in 1995 again) for

- the restoration of the economic potential of the year 1990 to the year 2000,

- stronger environmental protecting and
- conversion of the military production.

The private consumption could be raised to almost 80 % of the pre-critical level (i.e., of the year 1990) in the year 2000 (62.3 % of this level in 1995).

The Siberian economists argue that the above macro economic forecast is based on tactical and strategical requirements, in particularly:

- arranging economic connections destroyed in the last years,
- resuming interrupted production,
- mobilizing food resources for the non-agricultural population,
- initiating first steps in reconstruction of the national economy;
- mobilizing - very limited - resources for technical renovation and extension of production capacities of the investment sector,
- creating new branches in this sector,
- beginning the general technological reconstruction,
- creating minimal necessary conditions for substantial socio-economic reforms and handling social problems,
- the formation of an efficient administration capable for centralized guidance of technological transformation,
- creating technological system that guarantees buyers' market,
- privatizing the main part of the economy and liberalizing prices (see Valtukh, 1993).

The working group of the third congress of the Federation of Russia's Commodity Producers, headed by Yu. Skokov and S. Glazyev, has arrived at similar conclusion concerning the necessity to promote investment, innovation and demand by the state. This group believes that overcoming the great depression requires, in particular:

- preserving operating rate at the level not less than 50-60% that is absolutely necessary for restructuring, renovation and technical modernization;
- protecting internal market against competitive import, especially for machine-building output;
- accumulating internal financial resources, sufficient for renovation of production; creating macro-economic conditions for profitability growth and for financing industrial capital investment,; mobilizing bank resources for investing;
- protecting and using scientific-technical potentials;

• the formation of institutional investors, first of all, big corporations, capable for efficient mobilization of economic resources (see Skokov and Glazyev).

After the disintegration of the former USSR, Russia has managed to establish only a system of pseudo-capitalism. ,,Let us at long last recognize that so far we have a weak state and that there is no elementary order in the country" (Boris Yeltsin's speech to the Duma on February 24 1994). Falling real incomes of population, excessive deepening of income disparity between social groups and falling behind other nations in the world economy have undermined the dominant frame of mind for capitalist transformation that existed after the defeat of the State Emergency Committee (,,GKChP") in August 1991. Russia is looking for its specific way again.

The lack of well-designed policies and instruments of intervention is one of the main reasons of Russian especially poor performance in the last three years, although economic science has developed a satisfactory theoretical understanding of the nature of innovation in the transition and mixed market economies. The (re)construction of the national production, innovation and regulation systems, creation of competitive advantages are, in my view, the content of the necessary economic reform and the only possible escape from the vicious circles displayed in the previous Section. This approach appears to be the true foundation for solving the central problem of getting growth started by inducing investment in the economy.

Russia's President has said: ,,The government could not stop a backward movement of Russian industry, including its most valuable part. ... The efficient structural policy has not been worked out... Long-term signposts and priorities should be formulated and reflected in economic policy, beginning from the 1995 budget. We need anti-inflationary, foreign trade and investment strategy. The main purpose of our reforms is Russia's transformation in a developed country" (Yeltzin).

The chairman of the Economic Policy Committee of the Duma adds: ,,The main direction of the actual policy - contrary to all the declarations - deindustrialization of the country. It is necessary to concentrate the political will on realization on implementation of main directions of economic policy proclaimed in the Presidential address to the Federal Assembly and government obligation upon the Civil Accord Agreement. Still such a will is not observable" (Glazyev in Nezavisimaya Gazeta, August 16, 1994:1, 4). S. Alexashenko, the deputy finance minister responsible for the budget, says: ,,The most dangerous problem is that we have no strategic thinking in the government" (see the Financial Times, June 27, 1994: II).

What the country has got instead of the declared policy is a scenario described by some Western economists and journalists as Muddling Through or Muddling Down, depending on a degree of their optimism. (The reader may remember that optimists perceive the glass as half-full, while pessimists perceive it as half-empty.)

A Financial Times correspondent in Moscow, for example, belonging seemingly to optimists, writes: ,,Muddling Through - which might describe much of the policy this year - has the attractiveness to the governing elite and to many others of implying no radical change...the government does not fully control the economy but is not so weak as to lose power entirely" (Lloyd, 1994a).

The ,,pessimists" add that stagflation is the best economic performance this scenario can achieve. ,,In response to people's needs, the government is too weak to do more than improvise day by day. The country's social and physical capital degrades steadily for lack of investment..." (Yergin and Gustavson: 137). In any case, the muddling down or through is grasped by both groups of experts as a transition phase.

In the previous report (Ryzhenkov, 1994a), we have elaborated the sustainable development scenario as the alternative to muddling down and national decay. In this scenario, the institutions of the mixed market economy are gradually built on the basis of society's needs top-down and bottom-up under state direction.

The policy-makers should be able for anticipatory (pro-active) control of the dynamics complexity of the socio-economic system in view of his advantages over the myopic (reactive) control in its present form. On the other hand, they should not resuscitate the old attempts to control a vast detailed complexity; as the experience of central planning in the USSR demonstrated, that could only lead to excessive decision delays and information input overload in die centre. Moreover, economic agents could not keep authorities fully informed about circumstances even if this were their goal, as F. Hayek noticed long ago. So I would advise to pursue a strategy of unbalanced growth that implies an active role for the state, especially in solving long-term inter-sectoral and inter-regional problems, together with a relatively high degree of decentralized decision-making.

Russia's state should provide a general production and market guidance towards high-tech-high-wage economy. With evaporating competitive advantages for radically new products and processes government guidance becomes necessary much greater than even three or four years before. The

implementation of the mobilizing strategy, based on an increase of surplus labour and on technological advance, appears to be the only possible escape from the current great depression.

The state can promote investment/saving within the national territory via:

- reducing uncertainty by setting national priorities, developing long-term programs and plans for the national and regional economies, striving for sharing of a common vision by the economically active population;
- subordinating mercantile and money trading capital to industrial capital,
- socializing risk attached to long-term investment (for example, freeing from taxes profit allocated for investing and for R&D);
- investing in fixed assets, infrastructure, human capital, R&D;
- steering allocation of the scarce economic surplus by firms towards socially effective projects;
- arranging finance and investment through taxes, via new banking institutions, emerging under the governmental control and with the state capital sharing.

Development of shared vision, long-term complex program of scientific and technical progress and more detailed programs on the regional, industrial and firm levels would represent a decisive step towards anticipatory control and would form an important component of the long-range planning of economic development. This long-range forecasting and planning would help to extend available resources and better combine existing supplies to satisfy needs of the population. At the same time, revealing social priorities would enable to improve a configuration of the property relations in the society (for example, by putting reasonable limitations on monopoly rights of inventors) in favour of general well-being.

The concept of developmental state has prompted some other necessary conditions for the effective governance: a strengthened state, politically secure government, accepted as legitimate; professional, competent and prestigious administration; continuity in governmental officials; state's autonomy vs. business (see Amsden, 1993). A developmental state cooperates with business and disciplines business; it invents and builds an environment that supplements competition by institutions of co-operation and coordination; the developmental state grants property rights, certainty of the legal framework and legal structures compelling the obligations of ownership to be discharged.

A strategical reorientation towards the fundamental evolution factors should be a prerequisite of a socially efficient privatization, under strict social

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control. The developmental state with a capable bureaucracy will not decline its responsibility of the main owner of the means of production and will collect enough internal revenues to begin increasing investment, on the basis of government programs. Aiming development efforts at key industries and technologies with strong linkages to other parts of economy could stimulate an overall favorable dynamics, although shorter life cycles and more participants in technology-based markets have substantially increased risk for investments in any single technology or in any particular stage in a technology life cycle (see Lundvall).

Infrastructural, technological and organizational conditions are to be created for the efficient change of property relations. This implies the usage of regulated rather than pure markets. For at least 10 years the government ought to remain a principle stockholder in the strategic sectors, such as energy, transport, telecommunications and the other. It is likely that direct, central coordination of investment is now necessary to start the very process of technological accumulation. Offering subsidies may be a complementary solution.

For coping with the challenges of the information age patterns of behaviour and policies should adapt themselves to the global, dynamic and probabilistic nature of the scientific-technical progress (scientific-technical and educational cycles stretch over continents/countries and centuries/decades; investment in visible and invisible assets become more and more expensive and are risky, etc.). Long-term steady capital intensity and productivity growth is the only solid foundation for well-being of the present and future generations that fosters, in its turn, the capital accumulation and technological progress (see for details Ryzhenkov, 1993).

The state is to bring up capital that is able to wait for gains for a long time. Unless patient capital is not brought up and capital market is not effectively operated, the state together with its banking institutions should carry out all the necessary policies and strategical decisions and should set values of the main control parameters (the exchange and interest rates, a general price level) essentially determining development and functioning of the national economy.

The government can consolidate national entrepreneurs and achieve a synergy effect by facilitating financial-industrial groups, based on relatively closed technological chains and/or united by a common production goal. The Japanese *keiretsu* appears to be the most suitable organizational form for such groups. The development of small and medium-scale enterprises (especially of technologically oriented venture capital) is to be promoted too.

The state ought to foster different forms of corporatism (chambers and associations of industrialists, producers' and consumers' unions, parity commissions, etc.). These organizational and institutional forms could facilitate contracts among firms and reduce their investment risks in line with the third solution suggested by G. Hill for overcoming economic stagnation (see p. 32 above).

A state-based financial system is to be able to sustain a high debt/equity ratio under the close government control. This system should be properly designed in order to prevent chain reactions of bankruptcies and insolvency. The banking system ought to provide a relatively high interest rate for savings and credits (positive in the real terms) and a relatively low interest rate for loans allocated to debtors with assigned priority - the difference is to be covered by state subsidies.

Approaching sectors and branches on a selective, regularly revised basis, the state has to protect major industries, particularly, offering preferential loans to infant export industries, initiating restructuring of ailing or declining industries, ceasing state intervention in industries, prepared with the help of Western technology transfers to compete. In a speech to parliamentary deputies on February 24th 1994 President Boris Yeltzin has said that state aid should be given in the next few years first of all to a range of strategic industries, highly competitive on the world market and socially significant for Russia - ,,the more so since experts say this is not more than 10 per cent of Russian enterprises" (see the Financial Times, February 25th 1994: 3). The government have to impose strict and observable performance standards on subsidy recipients.

The report, ,,Socio-Economic Transformation in Russia: the Contemporary Situation and Renewal of Strategy," prepared by L. Abalkin, N. Petrakov, S. Shatalin and other Russian economists, proposes two to three years to get Russia's economy stabilized, and 12 to 13 years before Russia enters the world economy as a full competitor. The first stage aims to stop the fall in production by active industrial policy and slow inflation by prices control. The next ten years will be a stage of restructuring the economy in preparation for entering the world market (see the Wall Street Journal Europe, January 31, 1994: 4).

The developmental state will emphasize import of foreign technology together with its adaptation and improvement, limiting the degree of foreign participation in key industrial sectors; ensuring the compatibility of such investment with national programs and plans; on the other hand, the state will provide export credits and assist Russian companies to win large

contracts. A sophisticated system of import restrictions, domestic content requirements, foreign exchange controls, conditions on the admission of foreign investment, export incentives, technology incentives, and the like should be carefully elaborated and effectively applied. It should be transparent for a public control.

The state should avoid overreliance on devaluation of the national currency (rouble). The post-war history shows, that such a reliance rarely leads to long-term productivity growth, but often deteriorates a nation's living standard. National firms expecting a lower exchange rate prefer price-sensitive segments and industries and neglect automation and other form of technological progress, induced by a high labour bill share in value added (see Section 5 above).

In order to compete against more advanced economies Russian enterprises must sharpen managerial and organizational skills, shorten their learning period. ,,The shop floor becomes the strategic battleground" (Hikino and Amsden: 292). I agree also with the thesis that „ a real catching-up process can only be achieved through acquiring the capacity for participating in generation and improvement of technologies as opposed to the simple ,,use" of them" (Perez and Soete). In order to create alternative employment for workers of inefficient branches and factories (retraining and educational programs should be organized on a broader scale.

Yergin and Gustavson attract attention to other potential sources of growth: a temporary excess of capacity of many raw and semi-processed materials (fertilizers, energy, metals, etc.); abundant and low-wage scientific and engineering personnel, trained and literate industrial manpower, excess capacity in many industrial plants, pipelines, railroads, etc. (some of capital stock is new and relatively efficient); unexploited managerial energy and talent; enormous pent-up demand for consumer goods and services; the incalculated benefits of the new ..enabling technologies" - such as fax, personal computers, and telecommunications - that will allow Russians to plug into the world economy. Still ,,there is great danger that these various advantages could dissipate... Unless they receive investment, the extractive industries...and manufacturing facilities, as well as a good deal of the ...infrastructure...will run down and excess capacity will vanish within a decade or less. Similarly, unless money is put into social capital, health, and environment, the quality of the workforce itself will decline markedly" (Yergin and Gustavson: 191).

The present technological system could only put Russia in generally unfavourable position in a would-be-free-trade-world. Being below the

technological frontier, Russia is good advised to promote technological capabilities of domestic companies, and regulate the access of foreign companies and countries to its most advanced technologies. The state should lay the foundation for the advanced technological system and initiate a progressive structural transformation of the national economy as a whole.

7. Russia's Window of Opportunity

We have seen that Russia draws its competitive advantages mainly from such factors as the abundant natural resources, low cost labour and the devaluated currency. Experience teaches us that this strategy is the poor base for satisfying social needs and vulnerable to challenges by other nations. It is also detrimental to the environment. Under the present conditions, this strategy may be used only as a symptomatic solution of the immediate problems for gaining time and resources for a fundamental solution via investment/innovation oriented strategies.

This year's World Competitiveness Report issued by the Swiss-based International Institute for Management (IMD) and the World Economic Forum argues that competitiveness does not depend simply on relative labour costs. ,,Soft" factors such as a skilled labour force, high quality communications and transport infrastructure, government policies, research capabilities and so on all count for more and more as countries move up the development ladder. With few exceptions such as electronics, most overseas investment, it says, is designed to exploit natural resources and newly markets rather than labour-cost differences (see the Financial Times, 30.9.94: VIII).

Hikino and Amsden shed some light on limitations of low wage as competitive advantage: ,,As wages tend to rise in the course of industrialization, labour-intensive industries lose their competitiveness to still lower-wage countries. Perhaps more important, even labour-intensive industries may not serve as a cash cows because low wages alone may not be an adequate competitive weapon against the higher productivity levels of more advanced countries. ...relatively low wages do not translate into relatively low unit-labour costs and do not serve as an entree into world markets" (Hikino and Amsden: 288). It is essential to develop dynamic competitiveness based on technological innovation. Consequently, it will be necessary to support and further develop the existing technological know-how.

Still some economists defend the opposite strategy. ,,The main point is the country's de-industrialization. The industry is more and more heeling over the raw materials, but this does not testifies its degradation. Rather, it is possible to speak about greater conformity of the home production with our relative competitive advantages in the world economy" (Russia's economy in 1993. Moscow, the Higher School of International Business, 1993, p. 10, in Russian). We agree with Professor M. Porter that policies ,,that convey static, short-term cost advantages but that unconsciously undermine innovation and dynamism represent the most common and most profound error in government policy toward industry" (Porter, 1991: 621). The focus on raw materials and labour-intensive products has squandered the heavy investment already made in scientists, engineers, and skilled labour.

I would recall that in the immediate post-war period Japan rejected a long-term development strategy derived from the traditional theory of comparative advantage that advocated a 'natural' path of industrial development in labour-intensive industries such as textiles, based on Japan's relatively low labour costs. The Japanese government decided - seemingly in conflict with a short-run, static view point - to establish capital/technology intensive industries that in consideration of comparative cost of production should have been inappropriate for Japan at that time. This long-term strategy began to receive its payoff in the late 1960s (see for details Freeman, 1987: 35; Guoli: 46).

To proceed with the theme of catching up I would recall the highly relevant idea of A. Gerschenkron. He regarded catching up as a process of evolutionary", ,,eruptive" spurts, with backward countries promoting ,,those branches of industrial activities in which recent technological progress has been particularly rapid" (Gerschenkron: 9-10) instead of specializing on labour- and/or material-intensive branches favored by the conventional wisdom. Could this strategy be applied in the modern Russia? This strategy has become very difficult, if not impossible, for two reasons (cf. Hikino and Amsden).

First, over the last years the gap between the most advanced countries and Russia has grown tremendously up to the gap existed immediately before the first world war. The distance to the world technology frontier, measured as the percentage of the US GDP (or national income) per capita, changed from approximately 83 per cent in 1913 to 76 per cent in 1993 (according to Goskomstat) or some 90 per cent (according to (Valtukh, 1994)). So at the end of 20th century the distance seems to be almost the same as it was at its beginning.

Second, ,,with the rise of global enterprise possessing organizational capabilities" based on a core technology..., Gerschenkron's idea of leaping to the world technology frontier could no longer work. The institutionalization of R&D in such enterprises allowed them to erect entry barriers around their technology family, which kept newcomers out. The only economy in the 20th century to attempt to leapfrog to the world technology frontier ended in failure - namely, Russia - which was Gerschenkron's primary analytical concern" (Hikino and Amsden: 290).

Agreeing with the two authors that under present conditions and relations, the catching up and leapfrogging are extremely difficult, I incline to argue that it is too early to judge Gerschenkron's idea as futile for modern Russia and other late industrializes, on the following ground.

Both the diffusion of technological change and R&D intensity are important for catching up, while investment activity is the crucial factor (see Verspagen: 86-87). Due to better communications, technological change tends now diffuse more quickly than in the past. ,,After the industrial revolution took hold in about 1780, Britain needed 58 years to double its real income per head; from 1839 America took 47 years to do the same; starting in 1885, Japan took 34 years; South Korea managed it in 11 years from 1966; and, more recently still, China has done it in less than ten years" (The Economist, October l-7, 1994: 8). ,,Speed is no doubt a relevant aspect, but history is full of examples of how successful overtaking has been primarily based on running in a new direction" (Perez and Soete: 460).

Besides the better communications, late industrializes have other advantages of backwardness". Being a late starter means that a country can adopt the most advanced branches of industry with the latest technology (for example, fibber optics and satellite-based telecommunications) skipping over outmoded technologies and product generations (for instance, copper-wire phone systems). Russia does possess original technology which if supported by massive investments and state procurement could become a field for ..revolutionary", ,,eruptive" spurts.

Backwardness at the onset of (re)industrialization tends to be associated with 'organized direction' of industrial development by state and by investment banks activity. According to Gerschenkron, the very backwardness of a country makes it necessary for that country to find substitutes for the internal demand, productive factors or institutions which the backward country lacks. Thus in Russia in 1880-1890s the state was a 'substitute' for the entrepreneurial and financial facilities found in more advanced areas.

In this role, the Russia's state created conditions for a greater role in the industrialization for home and foreign entrepreneurs in the late 19th century and early 20th century. ,,As a result of the protective tariff of 1891, foreigners who wished to do business in Russia had to do it through direct foreign investment. ...the tremendous opportunities for profit had a great appeal for the foreign investor. In 1890s, foreign capital accounted for almost one-half of all new capital invested in Russian industry. In 1900 foreigners owned more than 70% of capital in mining, metallurgy, and engineering. This foreign investment greatly expanded the capital stock of Russia" (Guoli: 29).

Modern Russia, being not (yet) a host to TNCs, is involved in the world trade on the unfavourable terms mostly to the extent it supplies raw materials and energy. It could also act as second or third tier subcontractor increasingly depending on the major technology agents (for example, a St. Petersburg joint venture company is producing base frames and other components for Caterpillar, the world's largest producer of construction equipment; see the Financial Times, October 25, 1994: 19). To resolve the pervasive bottlenecks in Russian industry of low quality and out-dated technology, it is necessary, in particular, to nourish enterprises to scale sufficient to compete against world's leading oligopolies.

Although entry barriers to modern industry are rising, mostly in the forms of high R&D expenditures and investments in advanced capitalist countries, it is sometimes possible for late-comers to leap-frog to the world technological frontier converting their backwardness to advantage. The seminal paper (Perez and Soete) provides us with some missing elements in the logical chain.

This paper identifies, first, the importance of the timing of entry in terms of individual technologies, second, introduces the interrelationships in complex technology systems and, third, returns to the notion of changes in techno-economic paradigms (specifically, to radical discontinuities in overall technology evolution). These authors come to the conclusion that catching up involves being in a position to take advantage of the window of opportunity temporally created by such technological transitions.

It is assumed that, besides basic and applied science research, a path of successive product innovation leads from introduction (Phase I) to early and late growth (Phases II and III, respectively), to maturity (Phase IV) and eventually to withdrawal. It is shown that Phases I and IV provide the easiest-to-attain threshold conditions for new entrants, but with radically different costs and requirements: in Phase I with little capital and

experience, but with the relevant scientific and technology knowledge plus an adequate provision of locational advantage or compensatory 'help' by state; in Phase IV with considerable amounts of investment and technology purchase funds depending on traditional comparative and local advantages (low unit labour costs and the other).

On the one hand, the experience of a number of industrializing countries which were innovators or imitators in such technologies as digital telecommunications, electronic memory chips, etc. appear to verify the advantages of the early entry, if it was followed by massive investments. On the other hand, it is likely that the success of export-led industrialization achieved on the basis of manufacturing mature traditional products supports the strategy put forward by product life-cycle trade theory developed by Vernon and his followers.

New entrants affect both market share and profits of pre-existing producers (see for details Ryzhenkov 1991a, 1991b) hence there are conflicting interests and different options of behaviour, innovators will choose to sell or not to sell the relevant innovation-bound knowledge and experience as well as whatever equipment was directly designed for the innovation and is therefore not available in the market. Imitators will compare the cost of buying the technology with cost of developing it themselves, if they can" (Perez and Soete: 471).

As TNCs and other potential supplier of technology face the Wollf law of diminishing returns to investment in incremental innovations, they could chose concentrating on other innovations. In relation to the maturing innovation, these firms may relocate some of their own plants even from the end of Phase III or to sell their expertise in the form of licenses and 'know-how' contracts. Perez and Soete reasonably argue that this practice could eventually result in a buyer's market if there are competing suppliers. ,,Thus, in the final or maturity phase of technology the threshold of entry comes further down even though the actual costs of entry may still be high" (Perez and Soete: 474).

I will illustrate such an entry on the example of purchasing of a license for production of the Mercedes-Benz bus 0 303 by Russian Golitzyn Auto Enterprise (GolAZ). Gasprom has underwritten the deal. German banks provided credits. 100 employees have upgraded their skills during their probation in Mannheim. Yet the enterprise has got only Rbs 2 billion of state investments until recently. The plant is planning to produce 60 buses in the second half of 1994, 2500- in 1997 (among them there are four basic models and more than 10 modifications).

Exploitation of 5, 000 buses M-B 0 303 a year, compared with would be usage of ,,Icarus" models (Hungary), could save current costs around Rbsl67 billion and enable to serve a greater number of passengers (see Vek, No. 32,1994: 13).

Yet despite the benefits of buying technology for mature products in each case, the late comers are confronted with a risk of getting 'fixed' in a low wage, low growth, development pattern if mature products that exhausted their technological dynamism are their dominant specialization. While Germany (Western) had the highest labour costs in the manufacturing sector (including non-wage cost, $25 per hour) in 1993, Russia was placed by the WB behind China, India and other countries at the 22nd position (less than $1 per hour) followed by Indonesia (source: The Economist, October I*-?*, 1994: 16).

The fact that the competitive advantage of low wages is eroding, as capital costs, R&D and marketing increase in importance, is recently confirmed by The Economist report on the world economy. According to it, direct labour cost account for only 3% of total costs in semiconductors; 5% in the manufacture of colour TVs, and 10-15% of costs in car industry. So even if a firm can achieve the same labour productivity in a factory in Mexico, say, as in America, its lower unit-labour costs may easily be swamped by others cost disadvantages thanks to developing country inferior infrastructure. Labour costs are, however, more important in clothing and footwear (see The Economist October I*-?* 1994: 29).

Perez and Soete (1988) have shown that the notion of life cycle of technology systems is more relevant for development strategies than that of single product cycle. ,,The problem now becomes whether the endogenous generation of knowledge and skills will be sufficient to remain in business as the system evolves. And this implies not only constant technology effort but also a growing flow of investment...to establish interrelated technology systems in evolution, which generates synergies for self-sustained growth processes" (Perez and Soete: 476). In their view, the present transition period identified with a change in techno-economic paradigm is characterized by reconverting and redesigning of mature industries and products, by emergence and growth of new industries giving rise to new technology systems based on other sorts of relevant knowledge and requiring and generating new skills and new locational and infrastructural advantages.

Having missed the early entry into the new technology system in the 1970s, the USSR lost the crucial ingredients of the process of catching up. Russia's window of opportunity is narrowing, but it is not yet too late to climb on the

bandwagon. Using a substantial number of emerging and strategic technologies which have been or are under development, it is possible to diversify risk, broaden the future industrial base and achieve economies of scale and scope. R&D, design, management, production and marketing should be increasingly linked into one integrated system beginning from the level of a firm.

One of the most important task of Russia's technology policy is facilitating development of the investment complex, first of all machine-building. According to Russia's specialists, heavy, especially metallurgical, machine-building, tool-making, machine-building for power engineering, electro-technical machinery, auto-tractor and agricultural machine-building, production of welding equipment could be internationally competitive only under the condition of more intensive R&D and renovation (see for detail Faltzman et al). It presupposes a technological and organizational restructuring of machine-building, conversion of defence industry. The need for a stronger state support for technology spin-offs from the defence sector into civilian industry has been recently accented by Russia's President (see Yeltzin).

V. Faltzman and his colleagues suggest that the state should support mostly those spheres of science and technology where Russia has competitive leads (airspace, new materials, biotechnology, etc.). In the spheres, where Russia is lagging 10-15 and more years behind, like microelectronics and computers, it will be more efficient, in their view, to rely mainly on assimilation of foreign technological achievements by preserving the necessarily minimal level of home R&D which is absolutely necessary for learning in these fields (see Faltzman et al.).

The economic actors should be connected by transport, information and logistic networks, as they used to be in the USA, Singapore, Japan and other most competitive economies. Ready access to information infrastructure is essential for training the workforce needed for high-tech industries. One should not forget that high-tech edge gives US firms global lead in computer networks that, in its turn, is a key to establishing leadership in many industries built upon the benefits of information factories, data bases and computer networks (see King).

The US vice-president Al Gore has written recently: ,,The information infrastructure is to the US economy of the 1990s what transport infrastructure was to the economy of the mid-20th century. Approximately 60 per cent of all American workers are ,,knowledge workers". Computing and information networks have made US companies more productive, more

competitive and better able to adapt to changing conditions. They will do the same for other nations...There are those who say the lack of economic development causes poor telecommunications. I believe they have it backwards. A primitive telecommunication system causes poor economic development" (Gore).

The national government should help to organize the networks of user-producer relationships, disrupted in the last years. This process will combine top-down initiatives with processes of self-organization. Adoption of the new technology system is requiring not only restoration of previously existed efficient linkages, but their transformation, overcoming inertia and vested interests, closely associated with the prevailing structure, as well.

An efficient national system of innovations should be built to promote both, revolutionary and evolutionary, components of scientific-technical progress, including introduction of strategic technologies from abroad. Only such a system would provide a satisfactory flow of scientific advances in fundamental and applied sciences, support a search for new technological innovations and their adoption. R&D subsidies, innovation-oriented procurement, scientific education, training measures for employees, promoting venture capital, technological parks and other establishments for disseminating new technologies are among instruments for carrying out technology policy.

Overcoming the rift between research and civilian production, strengthening direct producer-user relationships in the high-tech field, making political choices concerning socially desirable new technologies are also important. Russian industrial enterprises are to play a greater role in R&D than now or in the Soviet epoch. Expanding human resource development, building technology infrastructure and providing incentives and avenues for advance of technology are also issues of a strategic priority. The ranking of science, technology and education units in the distribution of budget expenditures is to be enhanced; the status of the Academy of Science, of the Ministry for Science and Technical Policy should be raised. These priorities may be reflected in laws that regulate innovation activity by legislation.

The Economic Ministry, the Security Council, the Economic Policy Committee of the State Duma, and some other forward looking bodies and councils should in my view, provide society with the vision and expertise to promote the wider-ranging reforms required for long-term growth than it has been done before. They could promote productive cooperation and generate a consensus for national economic strategies. (For example, Malaysia has a strategic plan, „Vision 2020", to become a fully developed

nation by the year 2020. This fast growing country is apparently primed for technology competitiveness and has set five priority areas for technology policy (advanced materials, automated manufacturing, biotechnology, microelectronics, and information technology and energy technology) at the core of the new techno-economic paradigm. See for details Scientific American, April 1994, vol. 270, No. 4).

8. Conclusions

This paper explains the Russian great depression as the period of the deepening contradiction between the transitional social and institutional framework and the potential of the new techno-economic paradigm. It is shown, in particular, that the depression has been worsened after the disintegration of the former USSR because of the laissez-faire attitude towards science and technology; the neglect of the world's experience has also contributed to the inability to keep pace with many other countries. The report argues that the inadequate national system of innovations is the greater obstacle for starting catching up again than the technological backwardness. Russia's experience supports the relevant model developed by B. Vespagen, which assumes that countries lagging far behind the world technology frontier and/or having a low intrinsic capability to assimilate spillovers fall (even further) behind (see Verspagen).

This viewpoint gives impetus to the anticipatory control, long-term feed forward policies and better governance for my country. The look at the way Germany, Japan, the USA and the NIE promotes indigenous technological capabilities and innovative networks as a source of learning has helped us to suggest concrete forms and instruments of technology policy for building future-oriented social market economy with a more efficient national system of innovations and a broader range of socially created competitive advantages corresponding to the new techno-economic paradigm.

A transition from the basic factor-driven stage to the investment/innovation-driven stages of socio-economic development is not to be taken for granted at least without a basic reorientation of the society toward the fundamental evolutionary factors. The scientific-technical progress should become the core of management and controlling at macro- and micro-levels of the national economy. The significance of this factor is underestimated by the big bang transition strategy and policy of shock therapy suggested for Soviet-like economies. On the other hand, ,,it is not true, that such reforms

mean a return to economic mechanism of the late 1980s: at that time the state economic management was almost totally atrophied. The state ,,fell asleep" untimely. There was a even more and more acute necessity of strengthening the role of the state in solving long-term inter-sectoral and inter-regional problems of technological and social progress" (Valtukh, 1994: 20).

A substantial contribution from the West can make much more easier the difficult task of Russia's evolutionary stabilization and upward development. Our analysis speaks in favor of a massive transfer of knowledge from the more developed countries to this country, especially in the forms stimulating voluntary learning, in order to change the pathological patterns of behaviour, indicated above. ,,In the long term, the Western needs to develop new instruments to 'buy' security in a volatile region [of the former USSR. - A. R.]. Assistance in the region of a single percentage point of the GNP of the OECD countries may appear relatively small when compared with western defence budgets in the cold war period" (Smith: 238).

The following elements appear to be particularly important for an overall concept of efficient co-ordination of Western aid with the assistance of the recipients, especially in the light of the experiences made in the Third World:

- opening markets for manufacturing goods,
- debt relief,
- better terms of trade,
- access to capital and know-how (technology transfer),
- tax breaks for certain industries, etc.

Economic relations with the West should be refocused from conventional trade transactions toward direct investment materialized in high-technology. Especially prospective field for international partnership is at the micro level - at the level of the firm, the town, the university. The international partnership can address the above bottlenecks (particularly in food distribution and storage), with special emphasis being placed on the efficient commercialization/ privatization of the marketing, processing and distribution networks, using, where possible, the conversion of military production units. It may enhance upgrading of skills and development of the appropriate support infrastructure, including credit and banking facilities.

An access to the newest developments in technology may be provided for Russian partners under suitable charge. Recipients should participate in further development of technology, know-how and new products within the

frame-work of long-term partnership. The mighty scientific potential of the former Soviet Union should be mobilized in forms that are more beneficial for its successors than the present ,,brain drain".

The structural change and economic growth, development of the Russian own forms of organization and communication (the social cohesion, strengthened, developmental state, investment/innovation orientation, production and market guidance, technological reconstruction, voluntary co-operation, advancing ability to learn and produce genuine novelty, technological catching-up) are the most essential premises for the progressive social evolution in the long-run as well. Starting catching up again will require Cizifus' enduring courage, still without this virtue any peak is beyond reach.

9. Tables

Table 1: **Soviet catching-up**

	1913	*1928*	*1955*	*1976*
Russia's per capita national income as the percentage of the US national income				
in rouble prices	16.8		28	40
in dollar prices	40			60
Russia's per capita consumption as the percentage of the US level	23	32		48

Source: (Gomulka, 1990: 96)

Table 2: **The USSR Industry: introduction of production capacities per year, on average**

(1971-1975 = 100)

1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1988	1989	1990
18	33	57	80	100	100	72	56	70	53	40

Source: (Valtukh, 1994: 17).

Table 3: **Indicative enterprise valuations* of Russian companies, March 1994, S**

	Unit	*North America*	*Western Europe*	*Russia*
Telecommunications	access line	1,637	848	69.97
Electricity	megawatt	372,000	650,000	2,260
Oil	barrel of proven reserves	7.06	3.58	0.17
Tobacco	cigarettes	5.61	4.07	2.42
Cement	tons	144	162	1.92

• * Valuation per unit of production = market capitalization of leading companies in sectors divided by volume of production. Source: CS First Boston (The Economist, May 14,1994: 68)

Table 4**: January - June 1994 as the percentage of the same period of the previous year**

GDP	83
Investment	73
Industrial production among others	73
research-intensive branches	50-60
civil machine-building	45
consumer goods	72
vodka	50

Note: The drop of industrial output for 96 per cent of most important items has exceeded 30 per cent. The decline of civil machine-building has been even deeper than that of military equipment.

Source: (Glazyev, S. in Nezavisimaya Gazeta, 16.8.94:1,4)

Table 5**: Foreign investment in Russian industry, $ bln, 1990-1993**

Branch	*Value of FI*	*Number of deals*
Oil and gas	5.93	91
Electronics, computers and telecoms	1.5	124
Leisure and hotels	1.15	32
Cars, aerospace, shipping	0.9	72
Property	0.9	25
Food processing and beverages	0.25	41
Tobacco	0.1	6
Consumer products, pharmaceuticals	0.1	35
Other	0.6	330

Source: East European Investment Magazine (see The Economist, May 14, 1994: 68).

Table 6: **Russia's GDP vs. the US GDP**

	1990	*1993*
Russia's GDP ($ bln)	1268.4	868.1
Russia's GDP per capita ($)	8555.7	5838.2
Russia's GDP as the percentage of the US GDP	23	13.6
Russia's per capita GDP as the percentage of the US per capita GDP	38.7	23.6
Purchasing power parity of rouble against dollar	0.52	204.85

Key:

1993 - Estimated Nominal GDP per capita adjusted for Purchasing Power Parity (PPP), the average nominal exchange rate $1 = Rbs932, the average exchange rate at the PPP $1 = Rbs205.

Source: (Kuznetzov)

Table **7: The levels of Russia's and the US economic development**

Russia, 1990	**Population, Million**	**148,2**
	GDP	
	R, bln 1990	**644,0**
	$, Trillion 1990	0.6
	$, Trillion 1972	0.2
The US, 1916	Population, Million	102.0
	GDP, $, Trillion 1972	0.2
The US, 1990	Population, Million	249,9
	GDP, $, Trillion 1990	5.5
	GDP, $, Trillion 1972	1.9
Russia, 1993	Population, Million	148.6
	GDP, R, bln 1990	355.0
	GDP, $, Trillion 1972	0.12
The US, 1900	Population, Million	76.1
	GDP, $, Trillion 1972	0.12

Source: (Valtukh, 1994:16)

Table 8: **Prisoner's Dilemma Game (a payoff matrix)**

		Player B: Co-operating	Player B: Defecting
Player A	co-operating	(3,3)	(0,5)
	defecting	(5,0)	(1,1)

R - a payoff by mutual co-operation (reward) (3),
P - a payoff by mutual defecting (punishment) (1),
T - a payoff for successful one-sided defecting (temptation) (5),
S - a payoff under rejected co-operating (sucker's payoff) (0).

A payoff matrix represents the Prisoners' Dilemma under the following conditions:

1) $T > R > P > S$,
2) $(T + S)/2 < R$.

Note: co-operation is possible if players can help each other and a partner's co-operation advantages exceed another partner's co-operation costs. Then both players benefit from reciprocal co-operation. Still it is difficult to preserve co-operation from defection, since a short-sighted player is interested in getting co-operation benefits „free of charge". The non-cooperative solution of the prisoner's dilemma (Nash equilibrium) is not Pareto-optimal (each player gets P units as a payoff). The tragedy of commons generalizes this dilemma for N> 2.

Table 9: **An optimistic scenario of Russia's Economic Development**

Macro forecast of some main economic indicators Billion Rouble 1990

	1990	*1995*	*2000*
GDP	593	431	585
Investment (brutto)	136	136	224
Defence	43	20	20
Environment	7	20	30
Private consumption	345	215	271
Wages, salaries, income in kind	280	163	189

Source: (Valtukh, June 30,1993: 5).

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