HIGHER SCHOOL OF ECONOMICS
NATIONAL RESEARCH UNIVERSITY

Ivan Boldyrev, Olessia Kirtchik

THE CULTURE OF MATHEMATICAL ECONOMICS IN THE POST WAR SOVIET UNION

Working Paper WP6/2013/05
Series WP6

Humanities

Moscow
2013

УДК 330.42
ББК 65в6
В74

Editor of the Series WP6
"Humanities"
Irina Savelieva

Boldyrev, I., Kirtchik, O. The culture of mathematical economics in the Post War Soviet Union
В74 [Text] : Working paper WP6/2013/05 / I. Boldyrev, O. Kirtchik ; National Research University Higher School of Economics. – Moscow : Publishing House of the Higher School of Economics, 2013. – 24 p. – (Series WP6 "Humanities"). – 150 copies.

This paper attempts to delineate the main features of the Soviet mathematical economics by looking at its epistemic culture and comparing it with the cultures of the postwar American economics. It turns out that many general tendencies characteristic for the Western story were reproduced on the Soviet side of the Iron Curtain. In particular, both disciplines were increasingly mathematized, had a contested status within the political landscape and economics profession, and were in part institutionally defined by the anti-Semitism.We further distinguish between the two groups of the Soviet mathematical economists: one more attached to the "economic cybernetics" movement, preoccupied with the optimization techniques, dealing mainly with the production sector and hoping to improve centralized planning; and another group that emphasized decentralization, was more comfortable with Western techniques and did not see any perspectives in the general optimal plan for the economy. We further define more closely the institutional sites and disciplinary identities of the two subcultures and provide tentative answers to the question why, despite the excellent technical training and various overlaps with the comparable American case, Soviet mathematical economists failed to develop a sucessful and competitive research programme.

УДК 330.42
ББК 65в6

Boldyrev Ivan – Associate professor, National Research University Higher School of Economics (Moscow); visiting scholar, Humboldt University (Berlin); E-mail: iboldyrev@hse.ru.

Kirtchik Olessia – Leading Research Fellow, Poletayev Institute for Theoretical and Historical Studies in the Humanities, National Research University Higher School of Economics (Moscow); visiting scholar, Institute for Advanced Studies (Paris); E-mail: okirchik@hse.ru

This study comprises research findings from the "History of the general equilibrium theory in 1960-1990s in Western Europe and US, and of the Soviet mathematical economics" carried out within The National Research University Higher School of Economics Academic Fund Program in 2013, grant No 12-05-0021.

Препринты Национального исследовательского университета
«Высшая школа экономики» размещаются по адресу: http://www.hse.ru/org/hse/wp

© Ivan Boldyrev, 2013
© Olessia Kirtchik, 2013
© Оформление. Издательский дом
Высшей школы экономики, 2013

The introduction of mathematics constituted a turning point in the history of economics in the middle of the 20th century.[1] Mathematical modeling as the main tool for theory building profoundly changed the nature of economics, separated it from other social sciences and crowded out more discursive and empirical traditions. In the United States and, with some lag, in the Western European countries mathematical economics[2] quickly became the *mainstream* of the discipline, and transformed the academic curricula and the way of practicing economics.[3] The axiomatization and formalization of the General Equilibrium Theory (along with the introduction of game theory, operations research and activity analysis) were the core elements in the formation of modern mathematical economics.The history of the Western developments in this discipline has largely been written.[4] However, the historians and sociologists of economics have only recently started to consider the respective developments on the Soviet side.

The mathematical economics was often presented, at least in the West, as universally relevant and neutral with respect to ideological differences and economies'designs. The radical version of this claim would imply that mathematization may actually overcome the dependence of economists on their ideological milieu and provide the pure and universal language to deal with such issues as the logic of choice and theory of rational behavior. Since Pareto and the socialist calculation debate, the general equilibrium analysis was considered to be applicable to market as well as to planned economies. More recently it was claimed that both Western and Eastern European mathematical economists were working on similar problems and had an interest in each others'work contributing to the common endeavor of mathematical (neoclassical) economics.[5]

---

[1] See [Weintraub, 2002; Yonay, 1998].

[2] By "mathematical economics" we mean a plethora of approaches in the postwar economic theory that were characterized by relying on formal models. In contemporary economics this characterization looks a bit outdated since the meaning of the term is much more narrow nowadays. However, this term is relevant for the postwar context when describing the mathematically oriented approaches to economic theorizing.

[3] See, e.g., [Duarte, 2013].

[4] See [Weintraub, 1983, 1991, 2002; Mirowski, 2002, 2004; Giocoli, 2003; Rizvi, 2003; Hands, 1994; Leonard, 2010].

[5] This view is expressed in [Bockman, 2007].

A universalistic rhetoric of the Cold War mathematical economics relying on the use of presumably neutral mathematical language could have been a strategy to assert scientific autonomy against the ideological pressure and thus to overcome the cleavage normally present in the other fields of social sciences. Mathematics would then be the way to escape the ideological biases and cultural differences between nations.

Nonetheless, a tentative comparative analysis of the development of mathematical economics in the West and in Soviet Union brings up a question of intellectual and institutional particularities of the national disciplinary fields. In other words, was mathematical economics the same discipline on both sides of the Iron Curtain? Did the local contexts matter and if yes, then how and to what extent? In order to answer these questions, we explore the problem of disciplinary identity and culture of the Soviet mathematical economics which emerged and developed mostly during the Brezhnev era. Indeed, mathematical economics was one the most successful of the social sciences in the USSR, especially given the traditionally high level of mathematical training and ingenuity for which the Soviet scholars were quite well-known. But many of the general features of this discipline still remain unclear, and in order to produce a balanced judgment one needs a more differentiated view than we have to date. Was the Soviet mathematical economics a marginal sub-discipline or a part of mainstream of the Soviet economic science? Was it "only"a domain of applied mathematics? What were the theoretical and ideological backgrounds of the Soviet mathematical economics?

These questions lead us to consider the institutional development of mathematical economics, but also the epistemic culture[6] and disciplinary identity[7] of the Soviet mathematical economists. The first term, epistemic culture, refers to representations of goals, premises, rationality and "truth"-finding devices such as analytical tools, theories, etc., while the second one brings into light the issues of disciplinary self-identification and borders constructed and maintained by members of an academic community vis-à-vis other scholarly domains, and within broader academic and political cultures. Based on interviews with Soviet mathematical economists and their published work, we try to reconstruct a disciplinary history of this community characterized by rigorous mathematical foundations, innovative research methods and objects, and (sometimes) opaque political position. A comparison of Soviet mathemat-

[6] The term is coined by [Knorr Cetina, 1991].

[7] See the discussion of this term in: [Lamont and Molnar, 2002].

ical economics with the neoclassical economics in the West is insightful as far as it allows attributing some specific features to the local contexts in a more distinct way.

The mathematical economics on both sides of the Iron Curtain: an outline for comparison

In the United States, which have been the leading country in mathematical economics after the WWII, as well as in the Soviet Union, the development of this field was a part of the larger planning and "cybernetics movement".[8] It represented a quite heterogeneous field at the intersection of operations research, game theory, decision theory, theories of optimal control, etc. The development of these methods was boosted during and after the WWII, first and foremost, by the needs of the military-industrial complex and strategic considerations of the Cold War. The crucial role of the military and public funding has been stressed by Philip Mirowski.[9] The RAND Corporation in the United States is a particularly salient example of this nexus of military and research. Similarly, in the Soviet Union applied mathematics was heavily used for the military and strategic purposes (from army logistics to calculation of the missiles flight paths), and was mostly developed in closed spaces of classified research. Even if we do not currently possess enough evidence to assert the institutional dependence of the Soviet mathematical economics on the military funding, it seems quite reasonable to conjecture that the very possibility of using the relevant models for the military planning may have motivated the Party officials to tolerate mathematical methods in economics despite their being politically suspect.

Both in the US and in the USSR, the development of mathematical economics produced strong tensions, at least during its constitutive period, within the economics discipline. In the United States, it was an object of the heated critique and sometimes rejection on the part of the institutionalists and, notably, the Chicago school.[10] In the Soviet case, many political economists persistently suspected mathematical economists as being in opposition to the

[8] See [Gerovitch, 2002].

[9] [Mirowski 2002].

[10] See [Yonay, 2003]; cf. one of the first postwar controversies in [Clark, 1947]; [Novick, 1954] and the contributions of Klein, Duesenberry, Chipman, Tinbergen, Champernowne,

Marxist-Leninist dogma, though the latter were most often trying to legitimize their work as fully compatible with the principles of socialism.[11]

Both cultures also shared a systemic academic *anti-Semitism* which was an important, although often omitted/suppressed, part of the institutional and human histories of applied mathematics and economics. For instance, the anti-Semitism of the most prestigious ivy-league universities might in part explain the rise of the MIT in the American economics.[12] Similarly, in the Soviet Union mathematicians of Jewish origin most of the time could not be either enrolled or hired by the most prestigious mathematical departments such as the Mechanics and Mathematics department of the Moscow State University.[13] Consequently, a lot of talented mathematicians, among which Jews were over-represented, were coming, during the sixties, into various fields of applied mathematics, including mathematical economics. Newly created institutions in both countries proposed a lot of new jobs which required advanced technical expertise and were less sensible to the racial or religious origins of their employees.

However, apart from these contextual similarities, the fields of mathematical economics in the Soviet Union and in the leading Western countries had followed quite different paths. Let us elaborate on some most obvious differences.

Firstly, in the United States mathematical economics came to be viewed as a part of mainstream economics as early as in the end of the 1950s after the publication of seminal works by Paul Samuelson, Kenneth Arrow, Gérard Debreu, Lionel McKenzie, Leonid Hurwicz, David Gale, Tjalling Koopmans, Wassily Leontief and others. In the Soviet Union, the "economic-mathematical methods" were to develop and institutionalize with a considerable delay as compared to the United States and other leading Western countries. This delay was to a less extent due to the initial theoretical or methodological backwardness, but mostly to ideological reasons. Applying mathematics to economic problems was officially prohibited in the Soviet Union until the late 1950s. This situation may be perfectly illustrated by the history of the pioneering work done by Leonid Kantorovich on linear programming realized in the

---

Solow, Dorfman, Koopmans and, finally, Samuelson in the same issue of the *Review of Economics and Statistics*.

[11] This tension was important, for example, in the debates and intrigues around the Lenin prize awarded to Kantorovich along with Novozhilov and Nemchinov in 1965.

[12] [Weintraub, 2012].

[13] See, e.g., [Frenkel, 2012].

late 1930s. While the first results were published in 1939 ("Mathematical Methods of Organizing and Planning Production"), a book "The Economic Calculation of the Best Use of Resources" appeared only twenty years later. By that time Kantorovich's work was no more "the last word" in optimization theory and mathematical economics, as the linear programming techniques were independently discovered and developed, as "activity analysis", in the West (by Koopmans, Dantzig et al.).

Secondly, while in the Western academia mathematical economics (general equilibrium theory, social choice, game theory, etc.) became the core of the economic mainstream, "mathematical methods in economics" were considered in the Soviet Union as a domain on the margin of general economic science (a "circum-economic domain"). And it had only a limited influence at the economic departments and in the main academic institutions in economics.

Thirdly, and most importantly, unlike in the West, we find very few *theoretical* developments in the Soviet mathematical economics. Although Soviet mathematical economists often had very advanced mathematical skills, they generally abstained from economic interpretation. As we argue elsewhere,[14] the Soviet mathematical economics, even in its "purest" form (such as developments in general equilibrium modeling and related domains), was practically and technically oriented. A few attempts to create a comprehensive theory of the socialist economy (theory of optimal planning, system of optimal functioning of the economy known as SOFE) were after all quite disappointing. In other words, the Soviet mathematical economics didn't succeed to develop a legitimate autonomous theoretical discourse that would be both a starting point and the interpretive goal of the mathematical modeling *per se* which does not possess a transparent normative meaning.

According to our hypothesis, two series of factors are accountable for this theoretical void: institutional (development on the margin or outside of the "official" institutions of economic science) and ideological (the unshakable authority of Marxism-Leninism and socialist political economy).

Crucial in this context is that the Soviet mathematical economics was far from being homogenous. Its institutional and intellectual organization can be represented as a continuum between the two poles, with the more official "economic cybernetics", on the one side, and a more Western-style mathematical economics, on the other. These two poles correlate with two quite differ-

[14] [Boldyrev, Kirtchik, 2013].

ent epistemic cultures and professional identities that will be analyzed in the following sections.

The "economic cybernetics": an attempt to create a national school of mathematical economics

The economic cybernetics emerges as an academic discipline during the sixties. The term is putatively introduced in the early 1960s by Vassily Nemchinov, one of the pioneering figures of the application of mathematics in economics in the Soviet Union, but was also used by Oscar Lange and some other Eastern European economists. The institutionalization of this concept is not ideologically neutral; according to our hypothesis, it reflects an aspiration of the Soviet officials to demarcate the socialist mathematical economics from the ideologically dubious, "bourgeois" marginalism and neoclassicism. What were the institutional and conceptual particularities of this discipline vis-à-vis its Western counterpart?

In the Western terminology, research carried out in the Soviet Union and the satellite countries under the label of "economic cybernetics" would be most commonly referred to in the context of systems analysis, operations research, activity analysis, and management science (decision theory).[15] Soviet scholars engaged in these various fields drew heavily on the Western research (though Soviet mathematicians had priority in some domains of applied and theoretical mathematics). First translations of Western works on these topics clearly met the demands of the military (for instance, series of books edited by the publisher of technical literature "Soviet radio", etc.). By the middle of the 1960s, translations of some Western seminal works followed applying these analytical tools to economic issues.[16]

During the 1960s, departments of economic cybernetics were established at the key state universities of the Soviet Union (Leningrad, Moscow, Kazan,

[15] [The Great Soviet Encyclopedia, 1979] gives two definitions to the economic cybernetics, a "narrow" and "extended" one: "A scientific field concerned with the application of cybernetic ideas and methods to economic systems. In an expanded and not entirely accurate sense, economic cybernetics is often taken to mean the field of science that has developed at the junction of mathematics and cybernetics with economics, including mathematical programming, operations research, mathematical economic models, econometrics, and mathematical economics."

[16] E.g. [Karlin, 1964], etc.

Kiev, Kharkov and others), and in some engineering and technical institutes. Along with the departments of economic cybernetics, this domain included laboratories of the Central Institute of Mathematics and Economics of the Academy of Sciences of the USSR (CEMI), the Institute of the Economics and Organization of Industrial Production of the Siberian Division of the Academy of Sciences of the USSR, the Institute of Cybernetics of the Academy of Sciences of the Ukrainian SSR, and the Economic Research Institute of the State Planning Committee of the USSR.

By the 1970s, the curriculum of economic cybernetics typically included some basic econometrics, models of optimization and of optimal growth, input-output models (including quite complex interregional and intersectoral models), forecasting of the social and economic development, theory of socialist management and decision-making, and automated systems of control (*ASUs*).[17] With a slight variation, the curricula could be more focused on transportation optimization problems or game theoretic modeling.[18] In general the mathematical apparatus taught to the students of these departments was mostly limited to the methods of linear programming.

While in technical terms economic cybernetics was similar to what was going on at the same period in the West, the ideological frame was very different. Viktor Novozhilov and Leonid Kantorovich, who were the leading figures of the Soviet "mathematical-economic movement", made efforts to legitimize their work as an integral part of the political economy of socialism. In their writings they consciously used the conventional concept of "socially necessary costs" which would be compatible with the Marxist understanding of value. Both Novozhilov and Kantorovich recognized the regulatory role of prices in balancing supply and demand. But at the same time they did not share the premises and terminology of neoclassical economics because they were deemed incompatible with the labour theory of value: "Marginal concepts of *mathematics* [italic in the original text] are not to be confused with 'marginalism'as a particular current in the economic science".[19] Novozhilov criticizes the systems of general economic equilibriumfor the all-too "narrow"

[17] [Kobrinski, Maiminas, Smirnov, 1975]. This is a handbook recommended by the Ministry of Education of the USSR for the students of "economic cybernetics".

[18] For instance, such was the orientation of the economic cybernetics department of the Leningrad Economics and FinanceInstitute (founded by I. Syroezhin, a disciple of Kantorovich). See the handbook of Economic cybernetics edited by this institution in 1974: *Ekonomicheskaya kibernetika*.

[19] [Novozhilov, 1967: 427].

formulation of the problem of economic optimum, in "isolation from the analysis of labour", and therefore from the "reality" of economic relations.

The critique of general equilibrium theory demonstrates some important ideological limitations of the Soviet "economic cybernetics". The concept of general equilibrium is considered as a part of a "bourgeois", and consequently erroneous, economic theory which has to be refuted in relation not only to socialist, but also to "real capitalist" economies. We find no echo of earlier debates about the general equilibrium and economic planning (going back to Pareto and Walras) in the literature under consideration. The most common argument against general equilibrium models, mentioned in the Soviet literature, posits that these models are only relevant for analyzing markets with perfect competition, and hence unrealistic.[20] They are, of course, not suitable for the socialist economy best described by "proportionality" (*proportsional'nost'*) and "balancedness" (*sbalansirovannost'*). The difference of meaning might seem tiny, but it has tremendous, both practical and methodological, consequences.

Applying mathematics in economics was justified only insofar as it could help solve problems of planning and management of the national economy. As one of the leading mathematical economists of the 1960s put it: "In the Soviet Union mathematical modeling [of the economy] was considered in view of its practical use, otherwise it was dismissed as an anti-Soviet activity".[21]

In this context a quite specific culture of modeling emerged, as described by some Western mathematical economists who had a chance to have exchanges with Soviet colleagues. As rightly noticed by Robert Dorfman upon contacting a group of Soviet mathematical economists at a joint Moscow seminar, there was a clear conceptual difference in modeling practices.[22] Soviet economists developed their planning models building mainly upon the notions of balance, technology and production sector without any considerations of demand and incentives structures. This technocratic orientation was crucial for the general development of Soviet mathematical economics, based on the engineering background of its protagonists, but also on general ideological underpinnings of input-output analysis, optimal growth theory, and mathematical programming. The supply side was always considered as primary, and the general aim of economic analysis was to provide optimal decisions for the

[20] [Kobrinski et al., 1975: 151-152].

[21] Interview with Emil' Ershov, Moscow, 12.04.2013.

[22] [Dorfman, 1976].

design of production sector compatible with the state interest and usually with some vague notion of the consumer sector and its planned needs.

Thus, the great majority of Soviet mathematical economists were dealing almost solely with practical problems (input-output tables, solution of linear optimization problems for single shop floors or plants, solution of transportation problems, calculations and computation algorithms). Nonetheless, some theoretical ambitions of the economic cybernetics can be found in the attempt-sto create the "theory of optimal planning" (a term by Kantorovich) which was very broadly defined as an application of economic-mathematical modeling (mostly linear programming) to the economy "taken as a complex system".[23] In particular, the theory of optimal planning was, during the 1960s, the central project of the newly created (in 1963) Central Economic-Mathematical Institute (CEMI) of the Academy of Sciences.[24] Ambitious as it might have been, this domain of research had major conceptual and practical difficulties. One of the most important conceptual difficulties for designing one integrated model of the national economy was to identify a unique *optimization criterion* for the whole Soviet economy. In its most conventional form, it was supposed to have an hierarchical, multiple-stage structure: planning problems had to be approached on the level of an enterprise, then of an an industry, a region, and finally a coordination of different industries and regions, at least in theory, could be achieved.

There were also attempts to elaborate theories of optimal planning and of optimal functioning of the Soviet economy using some elements of neoclassical economics. For instance, in the CEMI a group coordinated by Aron Katzenelinboigen was working on the system of optimal functioning of the economy (SOFE) based on some axiomatics and using a language of neoclassical economics (scarce resources, individual preferences, marginal utility, and so on).[25] The normative idea behind this work was to take into account interests of different agents, to foster the development of "horizontal" or "market" relations in the national economy (a relative decentralization), in accordance with the spirit of the Kosygin reform announced in 1965.[26]

---

[23] [Kobrinsky et al., 1975: 3-5].

[24] In the 1960s, the Sectors of optimal planning and of economic planning along with the Sector of economic forecasting composed the most important Department of the CEMI.

[25] In the end of the 1960s and the beginning of the 1970s the SOFE project was supported by the director of the CEMI, N. Fedorenko, and some other prominent personalities. It was associated with a reformist movement stemmed from the discussions preceding Kosygin reforms.

[26] See also: [Fursov, 2013].

Another example of a "reformist" approach to the Soviet economy could be found in the work of the laboratory at the Institute of the Economy and Organization of Industrial Production in Novosibirsk directed by Alexander Granberg and working on inter-regional models of the Soviet, and even global, economy. These models considered different regions as autonomous entitie shaving their interests, and the planning as a process of coordination (balancing) of these interests, and used some elements of the general equilibrium theory and cooperative game theory.

However, many mathematical economists and other critical voices were skeptical even about the possibility of optimization on a level higher than an enterprise. The tenants of the theory of the optimal planning were, in particular, confronted with antagonism of the planning authorities.[27] Another major problem was a lack of reliable statistical data on the whole industries and sectors of the national economy (especially related to the military-industrial complex and foreign trade) which made irrelevant the calculations of an optimal plan for branches or for the whole economy. All these difficulties made the project to create a general mathematical model (and a comprehensive theory) of the Soviet centralized economy illusory.

To sum it up, though the Soviet "economic cybernetics" had some obvious overlaps with the Western mathematical economics (optimal allocation of resources), yet there were important differences of goals (centralized planning and management of the national economy), and of the underlying ideology (Marxist-Leninist doctrine, in the Soviet case). The handbooks and published works in economic cybernetics could contain references to relevant Western literature, but they were fragmentary and superficial,[28] and they were always evaluated in the light of the Soviet political-economic orthodoxy. Mathematical economics thus constituted a curious hybrid type of knowledge, combin-

[27] The State Planning Commission, *Gosplan*, was more or less overtly opposed to the idea of optimal planning, as far as the planning routines at work since the 1930s had a rationality of their own not always compatible with mathematical optimization ("rational economic thinking"). In practice, the process of planning in the Soviet Union resembled negotiations between different actors including *Gosplan*, ministries, and large industrial units competing for rare resources. Representatives of different branches and state enterprises could make use of mathematical models and calculations for justification of their claims fore more resources (Interview with Emil' Ershov, Moscow, 12.04.2013.). But no single mathematical model was ever used for planning the whole of the Soviet economy.

[28] For instance, Kobrinski et al., authors of the handbook "Vvedenie v ekonomicheskuyu kibernetiku", briefly describe what they refer to as the Condorcet-Arrow "voting paradox" [Kobrinski et al., 1975: 258), but they do not mention the impossibility theorem at all.

ing optimization techniques, applied computation methods, input-output models, elements of neoclassical doctrine and a heterogeneous, often self-contradictory planning ideology.

An important difference in the development of mathematical economics on both sides of the Iron Curtain was also due to a lag in timing: in the USSR, the economic cybernetics was in its peak in the 1970s, while in the West there was a decline of interest in this type of analytical and practical tools, and the ideas of planning and cybernetics, with their overt interdisciplinary, ran definitely out of fashion as the profession was moving away from the theoretical pluralism towards the new syntheses.

Liminal spaces of mathematical economics (latent neoclassics) in the USSR

By the end of the 1960s, along with the more conventional economic cybernetics, a few sites of a more "Western style" research in mathematical economics appeared in the Soviet Union that we identify as "latent neoclassics". This work was done mainly in the fields of general equilibrium theory and related domains (Arrow-Debreu classical models of GE, models of equilibrium growth, disequilibrium models, computable GE models) and in game theory. This research was mostly practiced in liminal spaces outside of the universities. Among these "alternative" institutions were: Economic-mathematical Section at the Institute of Mathematics of the Siberian branch of the Academy of Sciences (founded in 1960), Department of Mathematical Economics at the CEMI (created in 1967); Institute of Control Sciences (founded in 1939, first work in mathematical economics appeared circa 1968); Department of mathematical economics at the Chief Computer Center of the Academy of Sciences (founded in 1968).

As the dates of the creation of these subdivisions suggest, the mathematical modeling of economic processes was established as a legitimate domain of research among mathematicians in the Soviet Union in the late 1960s. It was stimulated by a practical interest in social matters stemming from the spirit of cybernetics. Nonetheless it remained quite marginal[29] and attracted

[29] The bibliographical analysis of the literature on the GET and related fields in the Soviet Union shows that although the first works using the GET appeared in the 1960s, their number grew more significantly during the 1970s and attained its peak by the mid-1980s, but the share

only a minority of scholars in mathematical and physical sciences, not least because economics was considered as a much less prestigious (and less advanced) discipline.

Why was this "Western style" mathematical economics practiced in institutions specialized in mathematics and engineering, rather than in economics? Apparently, they were less exposed to ideological constraints (as compared to social science institutions). But most importantly mathematicians and engineers employed by these institutions possessed advanced mathematical skills that conventional practitioners of economic cybernetics and economics in the Soviet Union generally did not have. Convex analysis, topology, functional analysis and other advanced mathematics were commonly used by leading mathematical economists in the West, but were not familiar to most Soviet economists.

Another reason why mathematical economics developed mostly outside of the prestigious university departments comes from the organization of the Soviet science. The basic research and the higher education (universities) were most often disjointed, and had little links (with exception of the so called *base subdepartments* which provided graduates to their partner research institutions[30]). Unlike in the US, where a typical career of a leading mathematical economist would lead him from a (relatively marginal for the profession, at least immediately after the war) research center (Cowles commission, RAND) to a prestigious economics department, in the Soviet Union scholars specialized in this field of applied mathematics stayed most of the time at their research institution of origin.

A generation of mathematicians who entered the field during the second half of the 1960s and in the 1970s and their students who started to publish

---

of these papers in the overall flow of the economic-mathematical literature never surpassed 4%. See [Malkov, forthcoming].

[30] One of a few, but very successful, examples of the teaching/research symbiosis is represented by the mathematical department at the Novosibirsk State University and the Laboratory of mathematical economics of the Institute of mathematics of the Siberian branch of the Academy of Science; the close collaboration between the two gave rise to a Novosibirsk school of mathematical economics, one of the leading in the Soviet Union. For instance, Valery Makarov, a younger collaborator of Kantorovich, was dean of the subdepartment of theoretical cybernetics at the University and director of the Laboratory of mathematical economics at the Institute of mathematics (after Kantorovich moved to Moscow). "[In the end of the 1950s] the University was conceived especially to produce scientific personnel [for the research institutes of *Akademgorodok*] … graduates almost immediately became researchers […]" (Interview with Valery Marakulin, 10.04.2012, CEMI, Moscow).

in the 1980s were less ideologically constrained than their older colleagues like Kantorovich, Nemchinov, and others.While the research in mathematical economics was motivated by practical considerations, the scholars employed in these institutions had more theoretical ambitions and interests, and most of them were aware of research conducted in the West. Within this professional culture we can roughly distinguish two main epistemic identities: a "pure mathematician" and a "social engineer".

The first profile, that of a "pure mathematician", can be characterized by small preoccupation with any ideological or pragmatic considerations of economic modeling. As a good example we can consider a cohort of bright mathematicians who entered the Department of mathematical economics at the Central Institute of Economics and Mathematics during the second half of the 1960s[31]. In particular, some of them (Danilov, Movshovich, Polterovich, Zak, and more recently Koshevoy) made some work on classical general equilibrium models, as well as on disequilibrium and optimal growth, which had an extremely technical character and was primarily aimed at resolving a mathematical problem, while bearing a very limited (if any) economic interpretation.[32]

Mathematicians employed at the Novosibirsk Institute of Mathematics (Makarov, Marakulin, Vasil'ev and others) had a very similar professional identity and culture. Being employed at mathematical-economic departments for years or decades, most of them still continue to identify themselves as mathematicians (publishing in both mathematical and economic-mathematical journals, belonging to mathematical learned societies, dealing with purely mathematical problems, and so on). The examples of mathematicians-cum-economists or of effective conversions into mathematical economics, especially during the Soviet period, are scarce and far between.[33]

---

[31] The department's head, Aron Katsenelinboigen, was not himself a mathematician, but was a strong proponent of mathematical methods in economics and an excellent administrator who mastered well the complex power relations of the Soviet academia. He emigrated in the early 1970s, as well as a big part of the Department's employees (Mityagin, Dynkin, Katok, Moishesonand others), the Department was reorganized, but research in mathematical economics did not stop [Katsenelinboigen, 1980].

[32] A shift from linear optimization models to the models of general equilibrium had an implicit normative interpretation as an argument for a decentralization of the Soviet economy and a socialist market. But these claims could not be openly discussed until the later Soviet period [Boldyrev and Kirtchik, 2013].

[33] We study in detail a case of Viktor Polterovich who gives an example of such a successful conversion in: [Boldyrev and Kirtchik, 2013]. Some other cases might be mentioned as, for

The identity of a "social engineer", more concerned with the economic meaning of the models, can be found in engineering and technical institutions. It can be exemplified by the Department of mathematical economics at the Chief Computer Center of the Academy of Sciences founded in 1968 on the initiative of Nikita Moiseev, a powerful member of the Academy of sciences and the dean of the department of control and applied mathematics at the Moscow Physical and Technical Institute. This department recruited graduates of this department, and developed a quite different culture of modeling. Moiseev and his colleagues were not satisfied with classical GE models, but not for ideological reasons. Scholars employed in this Department aimed at elaborating models which would more "realistically" describe the functioning of the economy.[34] The first works were dealing with dynamic productive models, and later with models similar to those known in the West as Computable general equilibrium (CGE) models. In the 1990s, they built computable general equilibrium models describing the transition economy (commanded by the Central Bank and regional authorities)[35].

Another example is a group of scholars at the Institute of Control Sciences led by Emmanuil Braverman, a recognized specialist in image recognition algorithms and machine learning. In the late 1960s he got interested in mathematical modeling of economy, first drawing on classical equilibrium models and later developing disequilibrium models of productive systems with fixed prices. In the following decades, an important work on disequilibrium modeling was done by other Soviet mathematical economists, notably by Viktor Polterovich, during the 1970s and 1980s. Nonetheless, this work was not considered at the Institute as the principal preoccupation of Braverman and his colleagues, but rather as a "hobby".[36]

The research in mathematical economics conducted by these mathematicians and engineers had a certain relevance for the international community

---

example, Valery Makarov (the actual president of the CEMI), economist by his first training who also studied mathematics. Both are members of the Econometric society since the Soviet period.

[34] Interview with Alexander Shananin, 18.07.2012, the A.A. Dorodnitsyn Computer Center of the Russian Academy of Sciences, Moscow.

[35] However, at that time, according to the interviews, members of these departments were not aware of the work done by [Herbert Scarf, 1973] and other developments of computable equilibrium modeling in the West.

[36] Oral communication by Marc Levin at the seminar of the Research and educational group for social studies of economic knowledge, National Research University Higher School of Economics, 23.03.2012.

and was occasionally recognized in the West (as testified by a few publications of Soviet scholars in leading American journals, international collaborations, and memberships in Econometric society during the Soviet time). But most of the time Soviet scholars worked in institutional and intellectual isolation from the Western academia (they had very little, or often no, opportunity to meet foreign colleagues, to publish in American journals, attend the conferences, etc.). The doors for a greater cooperation and integration into the international community were finally open just before the fall of the Soviet Union. For many Soviet specialists in mathematical economics the invitation to the International congress of the Econometric society in Barcelona in 1990, partly financially supported by the Soviet state, was the first possibility to present their work and to communicate with peers from outside of the socialist bloc.[37]

But even today, many specialists in mathematical economics have difficulties in publishing abroad. Papers co-authored with Western colleagues have much better chances to be published. We could suggest that these difficulties are due to a specific epistemic culture acquired during the education and socialization in the Soviet academia. In the hostile environment in which mathematical language was an intellectual refuge and a self-defense from ideological assaults, being unable to find any practical application of their theoretical work, mathematical economists developed a very abstract and technical style, which was much closer to mathematics *tout court* rather than economics. Even the most "realistic" and "reformist", by their intention, pieces are written in a very abstract mathematical language free of any interpretation. This is a direct consequence of the theoretical void we referred to above. Without a general framework and systematic training in (contemporary or even classical) economics even the brightest minds had either to delve into technical problems taking the "Western" theoretical framework as given or to abandon theory.

In this sense, specialists in the "economic-mathematical modeling" in the Soviet Union were not (mathematical) economists in the "Western" sense of the term. As one of the interviewees (born in 1956) told us:

"Only during the second half of the 1990s did I begin to consider myself more like an economist than a mathematician… It was important to understand that economics is a worthy thing… that it is a complex field, and not

[37] Interview with Valery Marakulin, 10.04.2012, CEMI, Moscow.

only in terms of mathematical analysis… but also in terms of its economic content… It does not immediately come to one's head, and no one taught us this. I believe it's one of the most important problems… That's why you had to learn all this by yourself".[38]

A very similar account on his experience of "becoming an economist" was given to us by Sergei Guriev, one of the most internationally recognized contemporary Russian economists. He began his career at the department of mathematical economics in the Chief Computer Center of the Academy of Sciences where he worked on theory of optimization and later on the models of general equilibrium. As he sees it today, the articles he published at that time (in the 1980s and in the beginning of the 1990s) belonged to the realm of applied mathematics, and not economics. A turning point in his career was a fellowship at the MIT in the mid-nineties where it occurred to him that "economics is a science where complex equations are not the most important thing".[39]

Conclusion: professional identity of Soviet mathematical economists

The early development of the mathematical economics in the USSR and in the US shares a number of common features: internal tensions within economics profession, Cold War sources (state funding, role of the military), and anti-Semitism as an external factor determining the institutional configuration of the discipline. The Cold War political climate was relatively favorable to planning, mathematization, and general rationalization of the social sciences on both sides of the iron curtain. However, compared to the US, the Soviet mathematical economics was developing with a certain delay which can be explained by the absolute monopoly of the Marxist-Leninist political economy and a general mistrust towards "cybernetic" ideas. At the same time, the presence in the Soviet academia of extremely strong mathematical schools and bright personalities having a national and international recognition,

[38] Interview with Valery Marakulin, 10.04.2012, CEMI, Moscow.

[39] Oral communication by Sergei Guriev at the seminar of the Research and educational group for social studies of economic knowledge, National Research University Higher School of Economics, 23.03.2012.

such as Kantorovich or Pontryagin, paved the way to the Golden era of Soviet cybernetics and optimization theory.[40] The interest in applying mathematics to economics often revealed a technocratic and reformist stance at the same time. Stabilization of a bomb's trajectory, image recognition and optimal planning of the economy were considered by these scholars as problems of similar nature.

The Soviet mathematical economics was undeniably a part of a broader international trend, shared some intellectual references, subjects and tools with its Western counterpart. Yet, the analysis of its disciplinary status and culture suggests that specific institutional and cultural features were also at play. For various institutional and conceptual reasons discussed in this paper Soviet specialists in "economic-mathematical modeling" (on both poles identified as "economic cybernetics" and "latent neoclassics") didn't form a well articulated and unified disciplinary space. Disciplinary identities were fuzzy and disciplinary borders blurred.

Most importantly, in contrast to the US and Western Europe, the Soviet mathematical economics did not create its own theoretical discourse different from the languages of political economy, on the one hand, and mathematics, on the other hand. The orthodox political economy could not give the grounds to such a language, while references to the Western neoclassical economics were not politically acceptable (and could be even dangerous). For these reasons mathematical economics was mostly reduced to applied mathematics, while applied economists did not dare theoretical generalizations. As a consequence, economic interpretation of mathematical formalisms was rarely done, for it demanded an "economic imagination" and "vision" inextricably linked to the theoretical culture of economics as autonomous academic enterprise.[41]

The problems addressed here do not concern solely the history of Soviet mathematical economics. In fact, the roots of a relative theoretical backwardness of contemporary Russian economics are to be found in this story as well. A representative mathematical economist in the USSR, however smart he or she could be in mathematics,[42] still lacked the appropriate theoretical framework and could hardly make any significant *economic* contribution. This backwardness

[40] See [Gerovitch, 2002].

[41] [Schumpeter, 1954].

[42] See, for example, some interesting results in cooperative game theory [Bondareva 1963], demand theory [Mitjushin, Polterovich 1978], and the theory of optimal growth [Makarov, Rubinov 1977].

resulted in the ”catching-up” strategy of the 1990s. In this situation, the most productive economists either moved to the West or began to exploit the local context and to make use of their modeling abilities to analyse the Russian reforms, transition problems etc. Important as they were, these problems rarely led to the interesting theoretical results, and while the new generation of Russian economists is trained in the contact with the older one[43] the new academic culture in economic theory[44] is still to come.

References

Bockman J. (2007) The Origins of Neoliberalism Between Soviet Socialism and Western Capitalism: ‘a Galaxy Without Borders’ // Theory and Society. Vol. 36 (4). P. 343–371.

Boldyrev I., Kirtchik O. (2013) General Equilibrium Theory Behind the Iron Curtain: the Case of Victor Polterovich // Higher School of Economics Research Paper WP BRP 14/HUM2013 (Humanities).

Bondareva O.N. (1963) Some applications of linear programming methods to the theory of cooperative games (In Russian) // Problemy Kybernetiki. Vol. 10. P. 119–139.

Clark J.M. (1947) Mathematical Economists and Others: A Plea for Communicability // Econometrica. Vol. 15 (2). P. 75–78.

Dorfman R. (1976) Preface. In S. Shulman, ed. Mathematical Models in Economics. Papers and Proceedings of a U.S.-U.S.S.R. Seminar. National Bureau of Economic Research, New York.

Duarte P.G. (2013) MIT Graduate Networks: the Early Years // MIT Department of Economics Working Paper No. 2013-08.

Ekonomicheskaya kibernetika (1974) Chast’ 1. Osnovy hozjaistvennyh sistem. Leningrad: Izdatel’stvo Leningradskogo Universiteta.

Frenkel E. (2012) The Fifth problem: math & anti-Semitism in the Soviet Union // The New Criterion Vol. 31. October. P. 4 (Last accessed December

[43] This is the case for the New Economic School and Higher School of Economics, the most significant academic institutions in Russian economics that emerged in the post-Soviet period.

[44] By no means we suggest that mathematical economics is the whole of economics. But other fields of economic research, including more discursive and applied ones, face similar problems. Cf. [Libman, Zweynert, forthcoming].

14, 2013 at: http://www.newcriterion.com/articles.cfm/The-Fifth-problem-math-anti-Semitism-in-the-Soviet-Union-7446).

Fursov K. (2013) Intellectual Movements in the Soviet Economy: the case of the System for Optimal Functioning of the Socialist Economy // Higher School of Economics Research Paper WP ("Science, technology, innovation" N 24).

Gerovitch S. (2002) From Newspeak to Cyberspeak: A History of Soviet Cybernetics. MIT Press, Cambridge, MA.

Giocoli N. (2003) Modeling Rational Agents: From Interwar Economics to Early Modern Game Theory. Elgar, Northampton, MA.

Hands D.W. (1994) Restabilizing Dynamics // Economics and Philosophy. Vol. 10. P. 243–283.

Karlin S. (1959) Mathematical methods and theory in games, programming, and economics. Addison-Wesley Pub. Co. [Russian translation: *Matematicheskie metody v teorii igr, programmirovanii i ekonomike.* Moscow: Mir, 1964].

Katsenelinboigen A. (1980) Soviet Economic Thought and Political Power in the USSR. Pergamon Press, New York.

Knorr Cetina K. (1991) Epistemic Cultures: Forms of Reason in Science // History of Political Economy Vol. 23 (1). P. 105–122.

Kobrinski N., Maiminas E., Smirnov A. (eds.) (1975) Vvedenie v ekonomicheskuyu kibernetiku. "Ekonomika", Moscow.

Lamont M., Molnár V. (2002) The Study of Boundaries in the Social Sciences // Annual Review of Sociology. Vol. 28. P. 167–195.

Leonard R. (2010) Von Neumann, Morgenstern, and the Creation of Game Theory: From Chess to Social Science, 1900–1960. Cambridge University Press, Cambridge.

Libman A., Zweynert J. (forthcoming) Ceremonial Science: The State of Russian Economics Seen Through the Lens of the Work of "Doctor of Science" Candidates // Economic Systems.

Makarov V., Rubinov A. (1977) Mathematical Theory of Economic Dynamics and Equilibria. Springer, New York, Heidelberg, Berlin.

Malkov E. (forthcoming) Konceptualnoe razvitie teorii obschego ravnovesiya i sviazannyh s ney issledovatelskih problem i napravleniy v SSSR // Voprosy ekonomiki. Forthcoming (In Russian).

Mitjuschin L.G., Polterovich V.M. (1978) Kriterij monotonnosti funktsij sprosa [Criterion for Monotonicity of Demand Functions]. *Ekonomika i matematicheskie metody*. Vol. 14. P. 122–128 (in Russian).

Mirowski P. (2002) Machine Dreams: economics becomes a cyborg science. Cambridge University Press, New York.

Mirowski P. (2004) The Effortless Economy of Science? Duke University Press, Durham, NC.

Novick D. (1954) Mathematics: Logic, Quantity, and Method // Review of Economics and Statistics. Vol. 36 (4). P. 357–358.

Novozhilov V. (1967) *Problemy izmereniya zatrat i resultatov pri optimal'nom planirovanii*. Ekonomika, Moscow. (In Russian.)

Rizvi S. A. T. (2003) Postwar Neoclassical Microeconomics. In Samuels W.J., Biddle J.E., Davis J.B. (eds.) A Companion to the History of Economic Thought. Blackwell. Oxford. P. 377–394.

Scarf H. (1973) The Computation of Economic Equilibria. Yale University Press, New Haven.

Schumpeter J. (1954) History of Economic Analysis. Oxford University Press, New York.

Weintraub E.R. (1983) On the Existence of a Competitive Equilibrium: 1930–1954 // Journal of Economic Literature. Vol. 21 (1). P. 1–39.

Weintraub E.R. (1991) Stabilizing Dynamics: Constructing Economic Knowledge. Cambridge University Press, New York.

Weintraub E.R. (2002) How Economics Became a Mathematical Science. Duke University Press, Durham, NC.

Weintraub E.R. (2012) Keynesian Historiography and the Anti-Semitism Question // History of Political Economy. Vol. 44 (1). P. 41–67.

Yonay Y.P. (1998) The Struggle Over the Soul of Economics. Princeton University Press, Princeton, NJ.

Болдырев, И., Кирчик, О. Культура математической экономики в СССР после Второй мировой войны [Текст] : препринт WP6/2013/05 / И. Болдырев, О. Кирчик ; Нац. исслед. ун-т «Высшая школа экономики». – М. : Изд. дом Высшей школы экономики, 2013. – 24 с. – (Серия WP6 «Гуманитарные исследования»). – 150 экз. (на англ. яз.).

В статье рассматриваются основные черты эпистемической культуры советской математической экономики в сравнении с послевоенной американской. По обе стороны «железного занавеса» наблюдались некоторые общие тенденции развития. В частности, в обеих странах экономические дисциплины подверглись математизации, попали под прицел критики политического класса и других экономистов, испытали влияние академического антисемитизма. Далее мы выделяем в советской математической экономике две группы: первая тяготеет к «экономической кибернетике», занятой методами оптимизации, производственным сектором и совершенствованием централизованного планирования; в то время как вторая группа ставит акцент на децентрализации и пользуется аппаратом западной математической экономики. Рассматривая институциональную принадлежность и дисциплинарные идентичности представителей этих двух субкультур, мы делаем попытку ответить на вопрос, почему несмотря на отличные математические навыки и многочисленные пересечения с аналогичными американскими исследованиями, советские матэкономисты не смогли создать востребованной в мировой науке исследовательской программы.

Болдырев Иван – доцент факультета экономики НИУ ВШЭ (Москва); приглашенный исследователь в Университете Гумбольдта (Берлин); E-mail: iboldyrev@hse.ru

Кирчик Олеся – ведущий научный сотрудник ИГИТИ НИУ ВШЭ (Москва); приглашенный исследователь в Институте перспективных исследований (Париж); E-mail: okirchik@hse.ru

Препринт WP6/2013/05
Серия WP6
Гуманитарные исследования

Болдырев Иван, Кирчик Олеся

Культура математической экономики в СССР после Второй мировой войны

(*на английском языке*)

Зав. редакцией оперативного выпуска *А.В. Заиченко*
Технический редактор *Ю.Н. Петрина*

Отпечатано в типографии
Национального исследовательского университета
«Высшая школа экономики» с представленного оригинал-макета
Формат 60×84 1/16. Тираж 150 экз. Уч.-изд. л. 1,5
Усл. печ. л. 1,5. Заказ № . Изд. № 1574

Национальный исследовательский университет
«Высшая школа экономики»
125319, Москва, Кочновский проезд, 3
Типография Национального исследовательского университета
«Высшая школа экономики»