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INPUT-OUTPUT AND SOVIET PLANNING:
A SURVEY OF RECENT DEVELOPMENTS

Abraham S. Becker

PREPARED FOR:
UNITED STATES AIR FORCE PROJECT RAND

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The RAND Corporation
SANTA MONICA • CALIFORNIA

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PREFACE

In recent years the USSR has evinced increasing interest in the application of tools of mathematical economics to Soviet planning and economic organization. This interest constitutes a radical shift from the attitude of bitter hostility characteristic of the Stalin era. Undoubtedly, much of the explanation for the change of heart can be ascribed to a desire to rationalize the cumbersome Soviet economic apparatus. To the onlooker studying the pace and pattern of Soviet economic growth, these developments naturally hold great fascination.

Reflecting The RAND Corporation's continuing interest in the economic foundations of Soviet power and strategy, this Project RAND Memorandum presents a schematic review of the evolution of Soviet activity in the field of input-output studies and a summary analysis of some important issues in the internal USSR debate. It is hoped that this brief, interim survey will contribute to a discussion in the West that has only just begun on a subject that gives every sign of becoming one of the focal points for Western studies of the Soviet economy.

SUMMARY

After a quarter-century of outright rejection, mathematical economics was grudgingly admitted into Soviet economic discussion in the mid-1950's, as part of the post-Stalin liberalization movement. In the first stage of development of Soviet input-output studies, economists were introduced to the fundamental ideas, rediscovered the roots of input-output in the "balance of the national economy" of the early 1920's, and experimented with some simple pilot models. The outstanding feature of the second stage of this development (1958-1959 through 1961), was the completion of two ex post input-output tables of substantial size for the year 1959. As an input-output model, the ex ante table for 1962, the most recent study reported in Soviet sources, shows no advance over the 1959 model. The 1962-plan study was essentially an experimental test of internal consistency of the plan goals and an exercise in transforming the goals into a final demand vector. In large part because of difficulties of information generation, collection, and processing, the 1962-plan study indicated that even a simple static input-output model could not be immediately applied to the task of assuring consistency of plan objectives.

The 1962-plan exercise computed gross outputs using final demand as the starting point. In contrast to their earlier insistence on gross outputs as the starting point, Soviet planners now appear to favor starting with final demand as a general approach. Military outlays and expenditures on research and development can be easily

visualized as ends rather than means. Somewhat less obviously this also applies to consumption, because of its higher priority status under Khrushchev than under Stalin, and in terms of the possibility of maintaining planners' sovereignty by more effective stipulation of the consumption bill of goods.

The role of investment in the question of the planning starting point is less clear. The necessarily long-run nature of any functional relation between investment and output makes it doubtful that demands voiced for enclosure of investment are meant to apply to short-term plans. For long-range planning, presumably, the appropriate framework is some form of a programming rather than an input-output model.

Although not themselves a focus of the debate on pricing principles, the input-output studies have served to underscore the lack of agreement among rival schools in the Soviet Union. Cost-of-production price theorists may concur in viewing the input-output table as a data source for calculating "socially necessary expenditures," but this only emphasizes their lack of agreement on what constitutes correct prices.

The controversy on price policy is closely related to the debate on planning techniques and industrial organization. Among the mathematical economists, a significant body of opinion favors the creation of a giant automated data processing network, linking mathematicized enterprise plans in regional and interregional matrices. A decentralist solution is implied in the proposals of Professor E. Liberman

for establishing enterprise profits as the main success indicator. Official views on the substance of these proposals have not yet been expressed.

It is now clear that the regime will continue to permit experimentation with the tools of mathematical analysis. The direction and outcome of this experimentation will depend on the particular resolutions found for sensitive issues of economic policy.

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I
INTRODUCTION

A decade ago few observers at all familiar with the Soviet scene would have foretold the current tumult of Soviet tinkering with mathematical techniques. The observer would have been justified in his skepticism not only by the intense hostility of the Stalin regime to mathematics in economics but, more importantly, by the denial of a normative function to Soviet economics, which was required to concern itself with problems of organization and management or with descriptions of the economy in terms of Marxist property relations.^{1*} In the 1940's Soviet economists discovered, under official prodding, the existence of "objective economic laws" regulating the economy, but the inherent prescriptive content of such formulas as, for example, the "law of plan-directed,² proportional development of the national economy" was clearly nil. The "objective economic laws" served the purpose of defense against the charge of "voluntarism" (arbitrariness) without implying any dangerous policy guidelines.

This is not the place to examine the reason for the partial unshackling of prescriptive economics in the Soviet Union since Stalin's death. Certainly, at least part of the explanation, as has been widely suggested, is the realization on the part of the new leadership that the growing complexity of the economy required more flexible and sophisticated tools of control than the primitive implements of Stalinism. It is, however, necessary to distinguish form from content, the merely new forms for the conventional mold from the radical recasting in unprecedented patterns. While the

* Numbered notes refer to the list given at the end of this Memorandum.

concepts of macroefficiency and optimum were alien to Stalinist thinking, the notion of "balance," or the correspondence of supply and utilization of output, was the foundation of Soviet planning.³ It has required only the discard of mature Stalinism's misoneism and the return to Leninist principles of "learning from the capitalists"⁴ for Soviet economics to face unflinchingly the mathematicization of material balances. It has been recognized that the construction of a consistent set of material balances is a process, in the words of a Soviet source, "characterized by a large number of similar computational and logical operations, which opens up the possibility of using modern achievements of mathematical analysis and electronic technology, both for easing the pure calculation-technical operations as well as for the task of analysis."⁵ Whether general solutions are sought in inverting a matrix or, for retention of flexibility, an iterative procedure is used,⁶ the systematization of the material balances in an interindustry matrix form seems to Soviet planners merely a methodological improvement, though of a high order, on the traditional approach. There seems to be little controversy on this score.

This is not the case with respect to the notion of optimization, the discussion of which has generated the greatest heat. The truly revolutionary contributions here, as is by now well known, were those by Kantorovich and Novozhilov,⁷ who rediscovered the identity of the allocation and value problems and were severely taken to task for iconoclasm,⁸ for, indeed, suggesting that the Soviet economy is an economy of scarcities.⁹ The controversy here has not yet been resolved.

But the applicability of Kantorovich's "objectively determined valuations" as shadow prices for the whole economy is not the only obstacle that Soviet mathematical planning must overcome. There is a host of issues relating to prices, information flows, principles of organization, and the ordering of planning objectives, on which conflicting views have not yet been resolved. The configuration of Soviet planning will be determined by the outcome of this discussion, and it is with these problems that this Memorandum is largely concerned.

II
STAGES IN THE DEVELOPMENT OF SOVIET INPUT-OUTPUT STUDIES

The history of Soviet economy-wide input-output studies can be summarized as follows:

The first stage may be described as one of orientation in two directions, to the Western literature and experience and to the roots of Soviet planning. Systematic exposure of Soviet economists to the concepts and methods developed abroad can be dated from no earlier than 1958, which saw the appearance of Oscar Lange's 1957 Sankhya article in Russian¹⁰ as well as the translation of Leontief's Studies in the Structure of the American Economy.¹⁰ However, Western writings in the original had already been circulating for a few years before this date, and open discussion of the fundamental ideas can be traced back at least to 1956.¹²

After long neglect, the subject of the so-called "balance of the national economy," roughly the system of national accounts, reappeared in 1954-1955 as a focus of Soviet thinking.¹³ Shortly thereafter, the first such balance in Soviet history, the balance for 1923/24, was restored to a place of honor in the planning pantheon,¹⁴ from which it had been cast out by Stalin in 1929 as a "numbers game."¹⁵ Not the least reason for the restoration to grace of the 1923/24 balance was its usefulness for claiming Soviet priority and Marxist purity for an interindustry model of the economy.¹⁶ The revival of interest in a system of national accounts reached a high point in the presentation by the Central Statistical Administration to a national statistical conference in 1957 of a revised model balance

of the national economy.¹⁷ This is the system of accounts now in use by the CSA.¹⁸

Sometime in the middle 1950's work was begun on input-output methodology, extending to the testing of several small-order experimental tables. The best known of these are two tables in physical units developed by the Economic Research Institute of Gosplan,¹⁹ using data of 1955 and 1957.²⁰

The second stage, beginning roughly in 1958-1959 and extending through 1961, was one of expanding research in a variety of areas of mathematical economics.²¹ At the recommendation of the 1960 Conference on the Use of Mathematical Methods in Economic Research and Planning, the Academy of Sciences set up a council to coordinate the activity of the numerous organizations engaged in the field and adopted a plan of priority tasks.²² First on the draft list of priorities presented to the conference for discussion were the ex post input-output tables, on which work was already in progress. In the course of 1960 the Central Statistical Administration constructed two tables of values in 1959: a table in physical units covered 157 commodities while the table of values was built around an 83 x 83 transactions matrix. The development of the methodology for and construction of the 1959 input-output tables was indeed the outstanding feature of this period.²³

The second priority task on the draft list was the calculation of an ex ante coefficient matrix for an unspecified future planning period. This required updating of the matrix to emerge from the 1959 study, the calculation of the inverse for the planning

period, determination of a final demand vector, and computation of the transactions matrix.²⁴ Input-output tables were in fact constructed for the plan year 1962. A methodological summary and report on the value table, without any data, was published recently;²⁵ nothing has yet been released on the table in physical units.²⁶

The 1962-plan value table represents no advance methodologically over the 1959 ex post table. The same static open model is employed; the intermediate transactions table is of exactly the same size and classification; the coefficient matrix is the same except for updating of the small number of coefficients found to be of primary significance; the treatment of depreciation and replacement is also the same as in the 1959 study. The essential novelty of the project consisted in arranging the 1962-plan goals for final expenditure categories into a systematic final demand vector. The final steps involved inversion of the slightly revised coefficient matrix, multiplication by the final demand vector, and comparison of the computed gross output levels with those given in the plan. More correctly, rates of growth between 1959 and 1962 plan were compared rather than absolute levels of gross output, since there were some methodological incomparabilities between the input-output tables and the plan.

The results, we are told, indicated some divergence between the rates of growth implied by the matrices for 1959 and 1962 plan, on the one hand, and the 1959 realized magnitudes and 1962-plan goals, on the other. No indications are given of the magnitude of the divergence except for metallurgy, timber-wood-paper, and glass-porcelain, where the gaps vary between 0.4 and 1.9 index points.

Summing up the results of the project, the Soviet writers conclude:

Considering the experimental character of the calculations, the errors in the branch distribution of final product and in the direct outlay coefficients, the data of the interbranch balance should not be regarded as an absolute criterion of balance or lack of balance in the national plan. Nevertheless, the divergence between plan and interbranch balance indicators should be considered as signals of the existence of some imbalance in several plan indicators²⁷ and of reserves for additional output of final product.

This exercise, and it is evidently little more, makes it clear that a considerable distance still separates Soviet planners from being able to employ even a simple static input-output model for attaining consistency of plan objectives. The difficulties are largely a matter of information generation, direction, and processing in the Soviet institutional structure. The first discovery in the process of construction of an input-output flow table anywhere is always of the inadequacy of the existing statistical base relative to the data demands of the matrix. Although for a planned and centralized economy this may seem surprising, the Soviet experience was no exception to the rule. The required data for the 1959 matrix were obtained from a sample survey of industrial and construction enterprises; and even here, as has been made clear, the reporting enterprises could not provide the data from standard accounting but were required to make special studies.²⁸ As a source of input coefficients the material balance data have proved inadequate because of incomplete coverage and excessive aggregation of channels of distribution.²⁹ The classification employed in the plan is highly

aggregated, even in comparison with the not too disaggregated (for planning purposes) 83-order matrix of the 1959 and 1962-plan tables. Complaints are frequently made of the rigidity of the information communication network, of the time required to collect, transmit, process, and evaluate data from lower levels.³⁰

A number of authors have been calling for a complete overhaul of the information system. Indeed, in the approved list of priority problems adopted by the Academy of Sciences after the 1960 conference, the first problem is "working out a rational system of primary accounting, reporting, and engineering calculations for the creation of a base of coefficients of plan-economic calculations, using mathematical methods and electronic computers."³¹ The first stage of this project was to have been completed this year. Results have so far not been made known.

The information problem appeared also in connection with the task of drawing up the bill of goods on the basis of the final demand data available in the plan. The major difficulties were encountered in developing the branch-of-origin distribution of consumption, fixed capital investment, and additions to inventories, which, in the plan, appear only in aggregation or in limited subdivision.

It should be noted, finally, that there is no indication of an attempt having been made to compare gross outputs with resource constraints. The current statistical yearbook reproduces a matrix of direct labor outlays in physical units implied by the intermediate flows of the 1959 table published in the 1960 yearbook; labor outlays

on output distributed to final demand are not shown.³² It does not appear, however, that labor requirements were taken into account in the 1962-plan matrix exercise. It would also seem that the corresponding capacity-requirement information did not yet exist.

III

SOME OUTSTANDING ISSUES

THE "STARTING POINT" OF PLANNING MODELS

The 1962-plan matrix exercise may be taken as a convenient marker of the completion of the second stage in Soviet input-output work. This is not to say that all the R&D, so to speak, has been completed and the planners are ready to proceed with quantity production of mathematicized plans. Far from it. There has been only rudimentary theoretical work on dynamic models, for example. The coordinated plan adopted in 1960 called for the development of a capital-requirements matrix embodying construction lags with first-step completion only in 1964. Conclusion of the first stage in the construction of a complete plan integrating labor and capital-requirements matrices is not contemplated before 1965.³³ As has already been indicated, even the open static model has not yet had all the "bugs" removed. But there are a number of issues brought to the surface in the experiments to date which are basic to a consideration of the future directions of development.

We may properly begin by considering the question of the "starting point" (otpravnyi punkt) of planning models, by which term the Russians designate the independent variable in the matrix equation linking input coefficients, gross outputs, and final demand. The impression gained in the West that Soviet planners favored starting with gross outputs rather than final demand³⁴ has not turned out to be correct, at least with respect to the value models. Final demand was the starting point of the 1962-plan experiment and a number of Soviet

participants in the public discussions have favored this approach.³⁵ The writers reporting the 1962-plan experiment declare: "This is the principal advantage of the use of the interbranch balance method in the conditions of the planned socialist economy."³⁶ One of the reasons Western observers have thought gross output would be the more likely starting point in Soviet planning is that gross output targets, or at least a significant subset of these targets, were thought to be politically determined, entering more directly into the regime's objectives function than final demand. The report on the 1962-plan matrix alludes to this problem:

The use of the interbranch balance method in national economic planning and, in particular, the possibility and advisability of determining gross output from the volume and branch structure of final product occasionally encounters objections in principle. Some economists see in this method obliviousness to the basic principle of Marxist political economy on the primacy of production, on the priority growth of Division I of social production; they consider that planning growth "from final product" could lead to deceleration of the rates of growth of the economy.³⁷

The reply made to this charge is essentially threefold:³⁸

(1) It is not necessary to stipulate final demand deliveries of all branches in a model formulation. If there are capacity or other resource constraints in a given branch or, conversely, if there is an exogenously determined requirement for full utilization of the capacity in question, the gross output of the particular branch could be stipulated along with final demand of others. (2) Just as the use of final demand as a starting point in capitalist models does not refute the principle that the goal of capitalism is the maximization of profits, so does the use of the same approach in a socialist model

carry no implications about a "consumptionist" approach. (3) Planning on the basis of final demand is in direct accordance with the requirements of the "basic economic law of socialism."³⁹

On all three counts, this defense appears to be sound. Of course, for the Soviet Union one cannot regard "the purchasing behavior of the autonomous transactors . . . as the driving force of the economy, with the activities of the intermediate sectors a driven mechanism responsive to this expression of human intentions and desires."⁴⁰ But even in Soviet conditions it is possible to regard final demand as the end and intermediate demand as the means.

This would appear to be obviously true of military outlays and the rapidly growing expenditures on scientific research.⁴¹ It is perhaps not immediately so clear that the conclusion also applies to consumption. A characteristic paradox of the planning system that targeted gross outputs and relied on the procedures of material balancing for the attainment of consistency was the absence of methods for determining indirect as well as direct requirements. When imbalances between availability and contemplated utilization developed, it was considered necessary to squeeze low priority uses in order to maintain the rapid pace of growth in favored branches of the economy. Generally, consumers' goods were at the bottom of the priority heap. It can be argued that in recent years the regime has evidenced great reluctance to continue this practice of limiting consumers to leftovers. At the same time, there is no intention of moving toward consumer sovereignty, not only with regard to allocation of resources between consumers' and producers' goods and within the latter, but also with

regard to the structure of consumers' goods output. In the discussion of open versus closed models, for example, it has been made clear that a model that generates consumers' goods production in response to prices and incomes is unacceptable.⁴² Research which has recently been noted in such hitherto suspect areas as elasticity⁴³ is pursued with a view to the more effective stipulation of the consumption bill of goods. The major goal of Soviet consumption analysis appears to be the determination of "scientific norms."⁴⁴ This is certainly in the spirit of the transition to "Communism," at the end of which abundance is visualized as the new Communist man's measure of the quantities and qualities sufficient for satisfaction of needs.

It is perhaps also not generally recognized that the "synthetic" (value) national balance has come to play a more significant role in plan formulation than it did in the Stalin era.⁴⁵ After the ideological rejection of the balances produced in the middle and late 1920's, the planning effort in this area was reduced to a minimum, and even methodologically the over-all result was one of stagnation.⁴⁶ What balances were drawn up were ex post data assemblies. A model ex ante balance was developed in 1939 but realization of the scheme did not occur until 1952, in the balance for the Fifth Five Year Plan. However, this balance appears to have been an exercise without any impact on the formulation of the plan. The first operational planning balances were probably drawn up in 1957-1958, in the period of preparation of the Seven Year Plan.⁴⁷ A description of the methods used in preparation of a planned balance lists three approaches: the first depends on estimates of the rate of investment and capital-output

ratios, the second on the size of labor force and trends in labor productivity, and the third on determination of consumption and relations between production of the two divisions of output on the Marxist two-sector model.⁴⁸ The nucleus of final demand planning has been in existence for sometime.⁴⁹

In Soviet discussions the relation of investment to the question of the planning starting point is less clear. The report on the 1962-plan matrix concludes by declaring that "a static open model of the interbranch balance, in which productive capital investments are stipulated, does not insure the organic unity of the gross output plan with the investment plan. Therefore, it is absolutely necessary to create a more complete dynamic model of the interbranch balance, in which productive capital investment is determined simultaneously with branch output values."⁵⁰

It would seem likely that this requirement is not meant to apply to short-term plans. To the extent that the Soviet economy is now operating under short-term targets which are in turn derived as consequences of a longer-run general plan, and this is the picture Soviet writers portray,⁵¹ it is doubtful that a meaningful relationship between current output and investment could be built into a short-run model. Any relation between investment and output is presumably one drawn from a long-run framework.

But for long-range planning the input-output model is over-confining. It is inconceivable that Soviet planning models would generate investment on the basis of even stipulated consumption. Clearly, this is the domain of programming models.

PRICE POLICY

At this point it is appropriate to mention the single most acute focus of economic controversy in the Soviet Union--prices. The general debate on price policy, under the rubric of the meaning and implications of the "law of value" in contemporary Soviet conditions,⁵² antedates the discussion on mathematics in economics; but there are, of course, intimate connections. For all the cost-of-production price theorists, the input-output table is an obvious source for data in determining what are "socially necessary" expenditures.⁵³ But this is as far as the agreement holds: as Eidel'man dryly noted, the input-output table can be a possible basis for price calculations only when it is decided what constitutes proper pricing,⁵⁴ and within the cost-of-production camp debate is heated. Although formally asserting their adherence to Marx and cost-of-production price, the Kantorovich-Novozhilov school has in fact introduced a sharply discordant note via the shadow prices of linear programming. In the narrow confines of a short-run, static, open input-output model, the meaningfulness of Soviet prices could be brushed aside as largely irrelevant.⁵⁵ This is after all only a particular reflection of the assumptions underlying the static Leontief matrix.⁵⁶ But this is manifestly untrue of long-run dynamic programming situations.

So far the stamp of approval has been withheld from the use of shadow prices as economy-wide indicators of opportunity costs, and Kantorovich has been frequently told to stick to suboptimizing. However, no other consensus has been arrived at either. It is

possible that the resolution may take the form of a variant of the prices-of-production formula: L. Vaag, one of the principal proponents of this version of Marxist price theory, has hinted at a family connection with the "objectively determined valuations."⁵⁷ There is a considerable amount of research being carried out in the field of dynamic growth models⁵⁸ and it is too early to be more specific on the likely shape of the outcome.

CENTRALIZATION VERSUS DECENTRALIZATION

Recent events have highlighted an issue that is almost inextricable from that of price policy. Perhaps the central problem of Soviet economic organization has been the difficulty of transmitting central general purpose and motivation into detailed local execution. The reasons for the dichotomy are both too well known and too involved to be dealt with here. Equally familiar is the standard response--organizational flux and bureaucratic shake ups. The regime has been constantly and uncomfortably shifting position between the horns of the dilemma: centralization, to prevent the distortion of central purpose in local diversion, and decentralization, to dissolve the rigidities created by concentration of decision making far from the locus of execution. The recent plenary meeting of the Communist Party Central Committee (November 1962) rubber-stamped a bewildering array of organizational changes, in both party and government hierarchies, which appear to be an attempt to place the Soviet economy in precarious balance astride both horns.

With the exception of brief mention in Khrushchev's opening

speech to the Central Committee, and equally brief nods in passing by a few of the participants, the proceedings ignored all the discussion on price policy and planning techniques of the last five years.⁵⁹ But since it also implies a centralization-decentralization dichotomy, this discussion has a direct bearing on the Soviet organizational dilemma.

At one pole we may range those elements whose essential contribution is to apply mathematics and electronic technology to streamlining the communication flows of a command economy.⁶⁰ Academician Nemchinov has been in the forefront of those urging a completely new system of information flows in a giant automated data processing net based on the mathematization of enterprise plans and their linking into regional and interregional matrices.⁶¹ In Nemchinov's view the advantage of such a system is that it makes "possible the liberation of the planning apparatus from the labor-intensive computing work on all kinds of economic and planning calculations and the concentration of its attention and strength on the solution of the principal problems of planning."⁶²

At the other pole, it is not yet possible to find in Soviet literature recommendations for a Lange-Lerner type "competitive" solution. However, the original proposals by the Kharkov economist, E. Liberman, for establishing enterprise profits as the main success indicator⁶³ may be interpreted to imply decentralist policies. They have indeed been so interpreted. Professor Liberman has recently

appeared to backtrack somewhat,⁶⁴ but the discussion has just begun and has received the stimulus of a reservation of judgment on the part of Khrushchev at the recent Central Committee Plenum. At any rate, the issue of price policy is central to this kind of solution.

IV
CONCLUSION

On the eve of the Twentieth Party Congress in 1956, which witnessed the dramatic secret speech by Khrushchev and the initiation of de-Stalinization, the veteran Soviet planner, Professor G. M. Sorokin, contrasted two radically opposed views of the methodology of planning.⁶⁵

One, unquestionably the correct position, requires as point of departure for planning the demands of objective economic laws, the objectives of the Party program, and the concrete comprehensive analysis of all the possibilities for the development of each branch of the national economy. The other approach considers it possible to begin by working out a "model" of the plan, based on abstract premises, unsupported by a study of varied experiences and of the paths of development of production and its technology in each branch, and then to fit into this "model" the entire content of the national plan.

As a case in point, he cites the so-called General Plan of the State Planning Committee, developed in the late 1920's⁶⁶ which, in Sorokin's indictment, "was drawn up on the basis of abstract mathematical formulas." He recalls with approval Kuibyshev's denunciation of "this 'statistical arithmetical propensity' in planning."⁶⁷

Only four years separate the appearance of Sorokin's article from the conference convened in Moscow under the prestigious auspices of the Academy of Sciences, attended by a distinguished group of economists, mathematicians and planners, for the purpose of discussing the uses of mathematics in economics. At this conference working sessions were devoted to mathematical growth models, input-output models, linear programming, mathematical statistics, the application

of mathematics to planning and operating transportation, and a variety of applications to other aspects of economic organization and planning.⁶⁸ A phoenix arisen from the ashes, the "statistical-arithmetical propensity in planning" now appears in the approved guise of "planometrics."

It would be premature to declare all opposition vanquished. In an interview published in the Polish press,⁶⁹ the dean of Soviet economists, Stanislaw Strumilin, foresaw no "major possibilities" for the use of mathematics in economics and planning. "There is a fundamental difference in kind between mathematics and economics," he declared. "The laws of economics are connections of a qualitative character, while those of mathematics are quantitative connections." Yet, Strumilin's is now a minority view. To the regime, the application of mathematical techniques to the solution of problems of economic planning has appeared sufficiently promising to warrant extensive research and experimentation. In turn, this effort has proceeded far enough to warrant confidence on the part of the outside observer that it will be pursued with at least as much interest and vigor in the future. Nevertheless, complex and sensitive issues at the level of the most basic problems of social and economic organization remain to be resolved, and the fate of Soviet mathematical planning is bound up with them.

NOTES

¹In his Ekonomicheskie problemy sotsializma v SSSR (Moscow: Gospolitizdat, 1952, pp. 135-194), Stalin sharply criticized the views of the economist, L. D. Iaroshenko. The unfortunate Iaroshenko had declared: "The chief problem of the political economy of socialism . . . is not to study production relations among the people of a socialist society but to work out and develop a scientific theory of organization of productive forces in social production, a theory of planning of economic development." (Ibid., pp. 141-142).

Stalin's reply was curt and unequivocal (ibid., p. 171):

The problem of rational organization of productive forces, planning of the economy, and so forth, is not the subject of political economy but the subject of economic policy of the directing organs. These are two different areas which must not be lumped together . . . Political economy studies the laws of development of production relations among people. Economic policy draws practical conclusions from this, concretizes them and thereon builds its daily work. To burden political economy with problems of economic policy means to ruin [political economy] as a science.

See also Gregory Grossman's interesting brief survey, "Quelques remarques sur les éléments anciens et nouveaux de la pensée économique soviétique," Cahiers du Monde Russe et Soviétique. Vol. II: 3 (July-September 1961), p. 380.

²This would appear to be a more comprehensive translation of the Russian term planomerno than simply "planned."

³See Herbert S. Levine, "The Centralized Planning of Supply in Soviet Industry," U. S. Congress, Joint Economic Committee, Comparisons of the United States and Soviet Economies, Washington, D. C., U. S. Government Printing Office, 1959, Part I, pp. 151-176; and the same author's "Input-Output Analysis and Soviet Planning," American Economic Review, Papers and Proceedings, LII:2 (May 1962), pp. 127-131.

⁴Cf. ". . . the history of Russia is characterized by a continual oscillation between the extremes of isolation and dependence upon the West--between a jealous pride in the native genius and tradition of Russia and an equally jealous desire to profit by the achievements of the West and to surpass them." R. N. Carew Hunt, The Theory and Practice of Communism, New York: Macmillan, 1951, p. 125. A similar reflection may be found in E. H. Carr, Socialism in One Country, 1924-1926, I, New York: Macmillan, 1958, p. 9.

⁵V. P. Zhivin, A. I. Klinskii, "Priroda koefitsientov polnykh zatrat i ikh osobennosti," N. M. Oznobin (ed.), Ocherki po sovremennoi sovetskoi i zarubezhnoi ekonomike, Vypusk I, Moscow: Gosplanizdat, 1960, p. 32.

⁶J. M. Montias, "Planning with Material Balances in Soviet-Type Economies" American Economic Review, XLIX: 5 (December 1959), p. 974. One argument for the flexibility of iterative solutions, the problem of selective changes in the coefficient matrix, does not seem to be a major concern in the Soviet literature. A procedure for handling the problem through an application of partitioning is presented in B. V. Finkel'shtein, "O metode perescheta matritsy koefitsientov polnykh zatrat v sluchae izmeneniia tekhnologii v neskol'kikh otrasliakh proizvodstva," Lineinoe programmirovanie, 1961, pp. 115-119. This is the fourth of seven volumes of Adademia nauk SSSR, otdelenie ekonomicheskikh, filosofskikh i pravovykh nauk, Trudy Nauchnogo soveschaniia o primeneni matematicheskikh metodov v ekonomicheskikh issledovaniiah i planirovanii (4-8 Aprelia 1960 goda), Moscow: Izdatel'stvo Akademii nauk SSSR, 1961-1962. Hereafter this series will be referred to as 1960 Conference.

⁷L. V. Kantorovich, Ekonomicheskii raschet nailuchshego ispol'zovaniia resursov, Moscow: Izdatel'stvo AN SSSR, 1960 and V. V. Novozhilov, "Izmenenie zatrat i ikh resul'tatov v sotsialisicheskom khoziaistve," in V. S. Nemchinov (ed.), Primenenie matematiki v ekonomicheskikh issledovaniiah, Moscow: Sotsekgiz, 1959, pp. 42-213. For an extended review of Kantorovich's book, see Benjamin Ward, "Kantorovich on Economic Calculation," Journal of Political Economy, LXVIII: 6 (December 1960), pp. 545-556.

⁸A. Ia. Boiarskii, "O matematicheskikh metodakh i trebovaniiah marksistskoi ekonomicheskoi nauki," Planovoe khoziaistvo, 1960, No. 1, pp. 92-96; A. Kats, "Ekonomicheskaiia teoriia i primenie matematici v ekonomike," Voprosy ekonomiki, 1960, No. 11, pp. 92-103; also Nemchinov's preface to Kantorovich's monograph, particularly pp. 7-11.

⁹Comment by A. I. Notkin in Obschie voprosy primeneniia matematiki v ekonomike i planirovanii, 1961, 1960 Conference, I, p. 193. See also the comments in this volume by P. S. Mstislavskii, Ia. A. Kronrod, A. G. Aganbegian, Kats and Boiarskii.

¹⁰Oskar Lange, Balans zatrat i vypuska produktsii, Moscow-Novosibirsk: Izdatel'stvo AN SSSR, 1958, reprinted in Nemchinov (ed.), Primenenie matematiki v ekonomicheskikh issledovaniiah, 1959, pp. 214-250.

¹¹V. Leont'ev i drugie, Issledovaniia struktury amerikanskoi ekonomiki, Moscow: Gosstatizdat, 1958, The translation was reviewed extensively in Vestnik statistiki, 1959, No. 6, Planovoe khoziaistvo, 1959, No. 8, and Voprosy ekonomiki, 1959, No. 6.

¹²T. Riabushkin, "Balansovye postroeniia v burzhuaznoi statistike," Vestnik statistiki, 1956, No. 6, pp. 50-59.

¹³S. G. Strumilin, "K skheme balansa narodnogo khoziaistva SSSR," in Akademiia nauk SSSR, Uchenye zapiski po statistike, Volume I, Moscow: Izdatel'stvo AN SSSR, 1955, pp. 223-239.

¹⁴The leading name in this as in the whole area of input-output thinking in the USSR is that of Academician Nemchinov. See his comments in Vsesoiuznoe soveshchanie statistikov, 4-8 iunia 1957 g., Moscow: Gosstatizdat, 1958, pp. 222-223, and his more extended treatment in "O sootnosheniakh rasshirennogo vosproizvodstva," Voprosy ekonomiki, 1958, No. 10, pp. 27-29.

¹⁵Cited in M. Z. Bor, Voprosy metodologii planovogo balansa narodnogo khoziaistva SSSR, Moscow: Izdatel'stvo AN SSSR, 1960, p. 30.

¹⁶"It is necessary to review the previous [Stalinist] opinion of the balance of 1923/24 and give it an objective valuation, taking into account that this balance proves the priority of Soviet economic science in the creation of the interbranch material balance." M. Kokorev and S. Lushin, "Trud po voprosam teorii i organizatsii planirovaniia," Planovoe khoziaistvo, 1962, No. 9, p. 93.

¹⁷Vsesoiuznoe soveshchanie statistikov, pp. 177-219.

¹⁸V. A. Sobol', Ocherki po voprosam balansa narodnogo khoziaistva, Moscow: Gosstatizdat, 1960, Chapters V-VII.

¹⁹Later attached to the Gosekonomsovet, the State Economic Council, which was responsible for long-range planning. At the end of 1962, in the organizational reshuffle following the November Plenum of the Party Central Committee, Gosekonomsovet was renamed Gosplan and the former Gosplan was reformed as the Council of the National Economy of the USSR (SNKh SSSR). Izvestiia, November 24, 1962, p. 2.

²⁰G. Grebtsov, "K voprosu o razrabotke svodnogo material'nogo balansa," Planovoe khoziaistvo, 1959, No. 6, pp. 57-58.

²¹For a glimpse of the broad range of problems studied and the variety of institutions engaged in research or implementation, see the 1960 Conference volumes. The proceedings of that conference have been summarized in Nauchnye doklady vysshei shkoly, Ekonomicheskie nauki, 1960, No. 3, pp. 140-151, Planovoe khoziaistvo, 1960, No. 5, pp. 88-90, Vestnik statistiki, 1960, No. 7, pp. 41-52, and Voprosy ekonomiki, 1960, No. 8, pp. 100-128.

²²V. D. Belkin, "O plane koordinatsii rabot po primeneniiu matematicheskikh metodov i elektronnykh vychislitel'nykh mashin v ekonomicheskikh raschetakh," 1960 Conference, I, pp. 129-149; Voprosy ekonomiki, 1960, No. 8, pp. 122-123, 126-128.

²³The general purpose and nature of the study were first set out in M. Eidel'man, "K voprosu o postroenii otchetnogo mezhotraslevogo balansa proizvodstva i raspredelenii produktsii v narodnom khoziaistve SSSR," Vestnik statistiki, 1960, No. 1, pp. 55-69. The methodology is discussed in greater detail in the author's "Opyt sostavleniia otchetnogo mezhotraslevogo balansa proizvodstva i raspredeleniia produktsii v narodnom khoziaistva SSSR," Vestnik statistiki, 1961, No. 7, pp. 8-31. This article also provides some of the actual data of the table. A third article by the same author, "Mezhotraslevoi balans obshchestvennogo produkta i ego ekonomicheskoe sodержanie," Voprosy ekonomiki, 1961, No. 10, pp. 61-74, is a summary report with considerable loss of detail of both data and methodology. The major source for the data of the table is TsSU, Narodnoe khoziaistvo SSSR v 1960 godu, Moscow: Gosstatizdat, 1961, pp. 103-144.

²⁴Belkin, op. cit., p. 132.

²⁵L. Berri, F. Klotsvog, S. Shatalin, "Opyt rasheta eksperimental'nogo planovogo mezhotraslevogo balansa na 1962 god," Planovoe khoziaistvo, 1962, No. 9, pp. 34-43. Hereafter this article will be referred to as "1962-plan balance."

²⁶The two tables were handled by different affiliates of the State Economic Council, the value table by the Economic Research Institute and the physical-unit table by the Computing Center of the Council.

²⁷"1962-plan balance," p. 41.

²⁸"Soveshchanie po voprosam primeneniia matematicheskikh metodov v ekonomike," Voprosy ekonomiki, 1962, No. 1, pp. 117-118.

²⁹M. Eidel'man, "K voprosu o postroenii . . ." op cit., p. 57; L. Ia. Berri and A. N. Efimov, "Metodologicheskie voprosy postroeniia mezhotraslevogo balansa," Mezhotraslevoi balans proizvodstva i raspredeleniia produktsii v narodnom khoziaistve, 1962, 1960 Conference, III, pp. 51-52.

³⁰The head of the Computing Center of the State Economic Council, Kovalev, complained that processing of information in the Central Statistical Administration frequently takes 8-11 months. "Soveshchanie po voprosam . . .," Voprosy ekonomiki, 1962, No. 1, p. 116.

³¹Report on the 1960 conference, Voprosy ekonomiki, 1960, No. 8, p. 126.

³²TsSU, Narodnoe khoziaistvo SSSR v 1961 godu, Moscow: Gosstatizdat, 1962, pp. 77-117.

³³1960 Conference, I, p. 134.

³⁴For example, Levine, "Input-Output Analysis and Soviet Planning," p. 132.

³⁵ Perhaps the most vociferous advocate of this approach is V. D. Belkin. See his introduction to A. G. Aganbegian et al., Primenenie matematiki i elektronnoi tekhniki v planirovanii, Moscow: Ekonomizdat, 1961, p. 6; also his comments in 1960 Conference, III, pp. 329-330. According to F. N. Klotsvog, this is indeed "the most widespread" view. Klotsvog, "K voprosu o planovom mezhotraslevom balanse," Ocherki po sovremennoi sovetskoj i zarubezhnoj ekonomike, I, p. 59.

³⁶ 1962-plan balance," p. 34.

³⁷ Ibid., pp. 41-42.

³⁸ For good measure they throw in the assertion that it was Soviet economists who first expressed the possibility of planning from final demand and national income. Ibid., p. 42.

³⁹ Read, uninterrupted growth for the simultaneous satisfaction of constantly rising needs, social and individual. See, for example, Ministerstro vysshego i srednego spetsial'nogo obrazovaniia SSSR, Politicheskaiia ekonomiaia sotsializma, Moscow: Sotsekgiz, 1960, p. 118-121.

⁴⁰ W. Duane Evans and Marvin Hoffenberg, "The Nature and Uses of Interindustry-Relations Data and Methods," Input-Output Analysis: An Appraisal, Studies in Income and Wealth, Volume 18, Princeton: Princeton University Press, 1955, p. 60.

⁴¹ Pravda, November 20, 1962. At the November 1962 Party Plenum, Khrushchev demanded that the power of the state cease to be measured in terms of the amount of steel produced.

⁴² Summary of a report by G. M. Geller of the Nutrition Institute of the Academy of Medical Sciences of the USSR in Voprosy ekonomiki, 1962, No. 4, p. 79.

⁴³ S. Partigul, "Statisticheskoe izuchenie sprosa naseleniia," Vestnik statistiki, 1961, No. 6, pp. 9-21; P. Maslov, "Primenimost' koeffitsientov elastichnosti v statistike i planirovanii tovarooborota," Vestnik statistiki, 1961, No. 10, pp. 33-46.

⁴⁴ P. Krylov, "Nekotorye voprosy metodologii perspektivnogo planirovaniia povysheniia urovnia zhizni naroda," Planovoe khoziaistvo, 1960, No. 8, pp. 51-63. P. F. Zhelezniak, "Analiticheskie metody izucheniiia zavisimosti potrebleniia ot dokhoda," Matematicheskaiia statistika, 1962, 1960 Conference, Volume VII p. 79, declares that growth of consumption depends on changes in per capita income and in needs and "at the base of human needs for most articles lies an objectively existing magnitude--the norm." Similarly, Aganbegian, outlining a dual research approach of statistical and normative studies,

asserts: "Only the unity of these two approaches, in our opinion, will give the more correct results," 1960 Conference, I, pp. 200-201.

⁴⁵Vestnik statistiki provided a capsule history of Soviet balances in three articles: I. Morozova, "Pervyi balans narodnogo khoziaistva SSSR," 1958, No. 4, pp. 34-48, on the 1923/24 balance; P. Moskvín, "K istorii balansa narodnogo khoziaistva SSSR za gody dovoennykh piatiletok," 1959, No. 4, pp. 24-31; and M. Eidel'man, "Iz istorii balansa narodnogo khoziaistva SSSR," 1958, No. 8, pp. 43-58, on postwar balances.

⁴⁶T. V. Riabushkin, "Voprosy istorii razvitiia balansovogo metoda v sovetskom soiuze," in Akademiia nauk SSSR, Uchenye zapiski po statistike, IV, Moscow: Izdatel'stvo AN SSSR, 1959, p. 48.

⁴⁷M. Bor, A. Notkin, "Metodologicheskie problemy balansa narodnogo khoziaistva," Voprosy ekonomiki, 1961, No. 5, pp. 36-37, 39.

⁴⁸Ibid., pp. 37-39.

⁴⁹V. Kats, "O planovom balanse narodnogo khoziaistva" Promyshlennno-ekonomicheskaiia gazeta, August 3, 1958, p. 2.

⁵⁰"1962-plan balance" p. 43.

⁵¹F. Kotov, P. Krylov, "Ob osnovnykh metodicheskikh polozheniakh k sostavleniiu narodnokhoziaistvennykh planov," Planovoe khoziaistvo, 1958, No. 9, p. 11.

⁵²Alfred Zauberman, "The Soviet Debate on the Law of Value and Price Formation," in G. Grossman (ed.), Value and Plan, Berkeley and Los Angeles: University of California Press, 1960, pp. 17-35.

⁵³For example, Nemchinov, "Matematiku i elektroniku--na sluzhbu planirovaniu," Planovoe khoziaistvo, 1961, No. 3, p. 36; remarks by Kovalev at conferences in November 1961, reported in Voprosy ekonomiki, 1962, No. 1, p. 116 and 1962, No. 4, p. 72.

⁵⁴Eidel'man, "Mezhotraslevoi balans . . .," op. cit., p. 65.

⁵⁵Nemchinov is very fond of the so-called "expanded reproduction potential" which is the difference, $(v_1 + m_1) - c_2$, using the Marxian two-sector model notation. See his "Teoreticheskie voprosy mezhotraslevogo i mezhregional'nogo balansa proizvodstva i raspredelenia produktsii," 1960 Conference, I, p. 27 and his "Matematiku i elektroniku . . .," Planovoe khoziaistvo, 1961, No. 3, p. 37. But "potential" is acutely sensitive to price policy, to the distribution of turnover taxes and profits between producers' and consumers' goods.

⁵⁶No account appears to be taken in any of the discussion on input-output of a characteristic of the Soviet economy that is not

neglected in discussion of other aspects of planning--namely, that relative prices do have some affect on production decisions via profitability incentives.

⁵⁷ 1960 Conference, I, pp. 217-219.

⁵⁸ There are a number of papers on the subject in Vols. II (Matematicheskii analiz rasshirenogo vosproizvodstva, 1962) and III of 1960 Conference; also summaries of reports delivered at the Coordinating Conference held on November 28-30 1961, in Voprosy ekonomiki, 1962, No. 4, pp. 66-85.

⁵⁹ Khrushchev's speech was reported in Pravda, November 20, 1962, comments by P. N. Demichev in the issue of November 21 and by Keldysh and Lavrent'ev (Academy of Sciences) in the issue of November 23.

⁶⁰ On the term "command economy" and its applicability to the USSR, see Gregory Grossman, "Industrial Prices in the USSR," American Economic Review, Papers and Proceedings, XLIX:2 (May 1959), p. 52.

⁶¹ See Nemchinov's "Matematiku i elektroniku . . .," Planovoe khoziaistvo, 1961, No. 3, pp. 31-32; comments by Kulev in 1960 Conference, I, pp. 153-544; comments by Gren'kov and Golanskii in Voprosy ekonomiki, 1962, No. 4, pp. 68, 70.

⁶² Nemchinov, "Matematiku i elektroniku . . .," p. 32.

⁶³ E. Liberman, "Plan, pribyl, premia," Pravda, September 9, 1962.

⁶⁴ See remarks by Liberman and M. Bor, Ekonomicheskaja gazeta, November 10, 1962, pp. 10-12.

⁶⁵ G. M. Sorokin, "Perspektivnoe planirovania narodnogo khoziaistva SSSR," Planovoe khoziaistvo, 1956, No. 1, p. 42.

⁶⁶ For an analysis of an underlying model as well as the origin and later history of the Plan, see Evsey D. Domar, "A Soviet Model of Growth" in his Essays in the Theory of Economic Growth, New York: Oxford University Press, 1957, pp. 223-261.

⁶⁷ Sorokin, op. cit., pp. 42-43.

⁶⁸ It is not known whether Sorokin was present at this conference. At any rate, the proceedings do not record any participation by him in either the prepared reports or the discussion.

⁶⁹ Zycie gospodarcze (Warsaw), June 3, 1962, cited in Monatsueberblick ueber die entwicklung in der Sowjet Union, June 1962, a mimeographed bulletin issued by the Eastern Department of the German Social-Democratic Party in Bonn.