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## CURRENT SUPPORT BRIEF

KANTOROVICH, LINEAR PROGRAMMING AND MARX;  
A LOOK AT A CONTROVERSIAL NEW BOOK

OFFICE OF RESEARCH AND REPORTS

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KANTOROVICH, LINEAR PROGRAMMING, AND MARX;  
A LOOK AT A CONTROVERSIAL NEW BOOK

A new book by L. V. Kantorovich, who is now gaining international acceptance as the father of linear programming on the basis of an article published in 1939, is a major pioneering theoretical work which attempts to extend the methodology and implications of linear programming from specific applications at the sub-aggregate level into the economy-wide problems of national planning, investment criteria, and price formation. 1/ It is a book which will become a focus of controversy in his own country and arouse unusual interest among Western specialists. Some Western readers may mistakenly praise Kantorovich for adopting the basic premises of Western economic theory; Soviet criticism will proclaim that he has fallen into bourgeois heresy. Neither viewpoint would be quite accurate nor totally wrong.

The book consists of three chapters of descriptive text followed by two detailed mathematical appendixes. The first chapter is an exposition of basic principles of linear programming with applications in areas of production planning for the enterprise (or group of enterprises) and in transport problems. The basic problem is that of finding the least expensive combination of inputs and processes among those which are available for realization of the output goal. The problem of minimizing transport costs is mathematically similar. There is little Soviet criticism of this chapter.

The second chapter goes more deeply into the theory of economizing and attempts to generalize the theoretical implications of scarcity which is the result of limits of available resources (including capital, land, and labor skills, as well as natural resources) and the demands put upon these resources by both the planned output targets and the requisite outputs of intermediate goods. As a part of the mathematical solution of the problem of maximizing production (or minimizing inputs) with limited resources and limited process alternatives, numerical values are assigned to these limiting factors. Kantorovich terms these "objectively grounded valuations" and, in effect, they are the prices--shadow prices--which are mathematically appropriate to the available supply of resources, given the demands upon them. In their nature, shadow prices are created by scarcity. When the effort is made, as by Kantorovich, to demonstrate that use of "objectively grounded valuations" would be desirable in planning there is conflict with the classical Marxist labor theory of value, as well as with the existing structure of official prices.

Chapter Three extends the analysis into the difficult problem of determining the most productive allocations of capital investment resources. Since capital investment alternatives are customarily evaluated, even in the Soviet Union, in terms of capital outlay, operating costs, output, and service life, the methods of costing these variables markedly affects investment decisions. As might be expected, Kantorovich casts his vote for "objectively grounded valuations" including the equivalents of interest rates in determining costs.

Though Western economists may hail Kantorovich for recognizing a greater role for opportunity costs (that is, a consideration of the value of the input in its most productive use, recognizing that use of a scarce resource precludes its use for other output) as affecting the valuation of commodities and for making necessary corrections to the labor theory of value, they must be very careful to retain perspective.

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First, he does not formally reject the labor theory of value and he insists, although unconvincingly, that his theories are in conformity to it. Secondly, he certainly does not espouse a market economy and his system is not dependent upon market forces to establish demand. He accepts central determination of final output. Given that, he would make more allocative decisions below the top decision levels according to objective decision criteria. This of course affects the mix and volume of intermediate output.

Since he accepts the fact that final targets must come from the planners, he is primarily concerned with a system establishing the most efficient composition of intermediate allocation. Unlike most Soviet economists, however, he does not confine himself to a discussion of the problem of minimizing inputs into a given output program but also observes the correspondence of the problem of maximizing final outputs, given available inputs and processes. A basic thesis of the book is that although great economic growth has been realized, even greater growth could have been achieved with better decision criteria and better utilization of resources. Though he does not deny the necessary role of non-economic considerations in the formulation of economic objectives, he does think that greater efficiency would permit their more rapid attainment.

Soviet criticism of the book proceeds on several grounds. A footnote exception was taken to Kantorovich's views by the editors of Voprosy Ekonomiki (#1, 1960, p. 122) who will run a series of criticisms this year (1960). Academician Nemchinov's introduction to the book itself contains sharp criticism. Professor Boyarskiy wrote in Plannovoye khozyaystvo #1, 1960, a bitter review praising Kantorovich's mathematics and condemning his economics. "Could not such brilliant mathematics and Marxism be combined?" he asks in effect, apparently hoping to achieve this synthesis himself.

A cause of criticism which is rarely expressed but often lies between the lines is the desire of a vested interest to protect its power. Since command over resources is power in a real sense, intermediate planners possessing varying degrees of authority may be understandably reluctant to surrender it to a planning system which would provide impersonal measures of the quality of their decisions. Much of the criticism of Kantorovich comes from intermediate officials and may be strongly influenced by considerations of vested interest although this criticism is couched in terms of questioning his Marxist purity. As noted below, many of the attacks upon this theoretical basis are weak or ambivalent.

A second line of criticism, which Kantorovich has anticipated, concerns questions of practicality. The calculation of his objective criteria corresponding to shadow prices and of interest rates appropriate to investment problems would require more data than are now at hand and the extensive use of computers. Recognizing this, he has taken pains to outline transitional steps for improving the planning system, which to some extent involve making use of successive approximations. He clearly believes that the expense of such improvements would be recovered through more productive use of primary and intermediate commodities. He does not premise this improvement upon the reform of wholesale prices, which are strongly affected by non-economic and institutional factors, but would calculate new planning prices reflecting scarcity values and which would be used only for major decisions.

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In the Soviet reviews, Kantorovich has been attacked upon a score of grounds which have no great validity or which are criticisms inconsistent with practices already officially approved. He has been accused of the heresy of marginal productivity theory, although his marginalism is not explicit but is inherent in linear programming i.e., marginal rates of substitution determine opportunity costs and shadow prices.\* An attack on this ground would tend to undercut the use of the linear programming technique itself, which is in official favor.

He has been attacked for suggesting the inclusion of differential rents\*\* (on land, equipment, and labor skills) in planning prices, although this attack also ignores the fact that many colleagues for various reasons have considered the inclusion of one or all of these in allocation problems. He will certainly be labelled as non-Marxist, or anti-Marxist, although a growing body of Soviet literature states that classical Marxist analysis, which after all was not of a socialist economy, has been superseded by the growing body of knowledge stemming from the operational experience of the Soviet economy.

It is very significant that to this time no articles have appeared attacking linear programming itself. A keynote of the attack on Kantorovich, as given in Academician Nemchinov's introduction to the book itself, is that techniques which have demonstrable value at the sub-aggregate level are not necessarily appropriate for national planning, for various reasons which he then discusses, but not conclusively. It is the regime's obvious desire to preserve the integrity of linear programming as a useful planning tool, coupled with Kantorovich's growing international reputation, which gives him needed protection against attacks which would have consigned any other economist to oblivion. A Leningrad colleague, Novozhilov, went into near oblivion after being attacked for developing "bourgeois" mathematical models along the lines of a general equilibrium system. Professor Boyarskiy in Moscow is advocating a less heretical view favoring sub-aggregate application of linear programming, and his more orthodox views are noted with approval by the Soviet economic journals.

On purely theoretical grounds, Kantorovich has developed analytical tools which will be a great challenge to young Soviet economists in coming years. His models can be dynamic, with changing scarcity values and changing interest rates, and could lead to increased understanding of Soviet growth prospects. An inter-industry flow study for a selected group of commodities being prepared this year by the Central Statistical Administration is similar to one of his specific suggestions.

\* A marginal rate of substitution is loosely described as the amount of one product foregone to get an additional unit of another product, or of the same product by another process. It is related to the productivity of inputs.

\*\* In the Soviet context, differential rent questions are most easily seen in the case of land. Thus, where a kolkhoz is prosperous because of rich and productive land, the question arises whether the revenue accruing from the land should be seen as income to the kolkhoz, or whether there should be a charge related to the productivity of the land paid to the state as owner of the land. The latter measure would tend to equalize kolkhoz revenues to a greater extent. Kantorovich would argue that the same kind of question arises from the use of equipment which is highly productive and underpriced. As may be seen, there are important questions of income distribution which arise unless, as Kantorovich suggests, a distinction is made between payment prices and planning prices.

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In conclusion, this book is exceptionally significant because of the contribution it can make to Soviet economic theory and to planning practice in so far as it is accepted. If Kantorovich's concepts and methodologies were fully implemented there would have to be some shift in the locus of economic power--an unlikely development. The Soviet vested interests, be they party officials, managers, or planners, are not likely to relinquish control over the multitudinous economic decisions made at intermediate layers of the Soviet economy. Yet to the extent that their success, in terms of realization of economic objectives of interest to them, or in terms of their own personal performance criteria, depends upon increased efficiency, many of Kantorovich's concepts and techniques can be viewed as useful tools. In the years to come it is likely that increased use will be made of more efficient analytical tools in support of economic decision-making.

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Analyst :



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Source :

1. Kantorovich, L. V., Ekonomicheskiy raschet nailuchshego ispol'zovaniya resursov, (Economic Calculation of the Optimum Utilization of Resources), Moscow, 1959. U.

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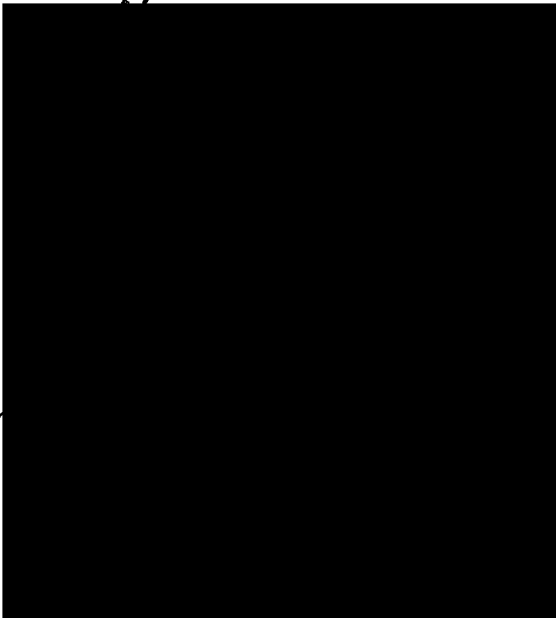
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