AN EXAMPLE OF A MATERIAL BALANCE AS USED IN THE USSR

SUMMARY INTERREPUBLIC BALANCE OF (Commodity) FOR 1960

(thousand metric tons)

	1959 Total (This Year's Plan)	1960 Total (Next Year's Draft Plan)	Of Which, By Union Republics: RSFSR	Ukrainian SSR	Belorussian SSR	Other Republics	Imports	Other Receipts
Total Resources	1600	1850	930	325	150	295	100	50
Production	1000	1200	700	200	100	200	--	--
Imports	--	100	--	--	--	--	100	--
Other Receipts	150	50	--	--	--	--	--	50
Balance at Beginning of Year:								
At Suppliers	270	300	140	75	35	50	--	--
At Consumers	180	200	90	50	15	45	--	--
Total Distribution	1600	1850	930	325	150	295	100	50
For Production and Investment Programs of Union Republics	680	880	425	130	75	100	100	50
RSFSR	230	300	210	45	--	--	20	25
Ukrainian SSR	190	250	55	65	75	--	30	25
Kazakh SSR	60	75	40	--	--	35	--	--
Belorussian SSR	20	25	15	10	--	--	--	--
Uzbek SSR	25	30	25	--	--	5	--	--
Azerbaydzhan SSR	50	60	60	--	--	--	--	--
Lithuanian SSR	20	30	--	2	--	8	20	--
Latvian SSR	40	50	--	7	--	23	20	--
Tadzhik SSR	15	20	20	--	--	--	--	--
Estonian SSR	30	40	--	1	--	29	10	--
Deliveries for All-Union Needs	470	520	315	80	45	80	--	--
For Production and Investment Programs of Union Ministries and Departments	250	270	150	50	25	45	--	--
Market Stocks	45	50	15	10	10	15	--	--
Exports	30	40	40	--	--	--	--	--
State Reserves	30	35	35	--	--	--	--	--
Other Expenditures	20	25	25	--	--	--	--	--
Undistributed Reserves	95	100	50	20	10	20	--	--
Balance at End of Year:								
At Suppliers	250	200	90	45	20	45	--	--
At Consumers	200	250	100	70	10	70	--	--

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Statistical Administration, and this system is reportedly being adapted to the needs of the new methods.

New approaches are based on past and present planning practices involving working out "balances" for material-technical supply. These specify in physical terms the availabilities and allocations of particular commodities for the plan period. Such techniques are used to determine the internal consistency of plan drafts.

The problem of integrating these separate balances into a single system or plan has confronted Soviet planners for decades, but the recent availability to Soviet planners of advanced computers, coupled with the increased complexity of the expanding Soviet economy, have prompted development of improved techniques to cope with the problem. Since a Moscow conference of statisticians in mid-1957, Soviet economists have mounted a major effort, originating, borrowing, and adapting methods for achieving consistency in plans broader than for a single commodity. Leontief's input-output techniques have been given particularly close attention.

Input-Output Techniques

Potential Soviet application of input-output techniques in planning differ from the usual Western use of these methods, i.e., analysis of past relations among parts of the economy. The problem confronting Soviet planners is: Given the relations among industries (and desired changes in these relations), what are the possible combinations of production targets for various industries and activities which can best implement the economic policies and programs of the regime and enable it to attain its principal goals?

On the other hand, the usual problem confronting Western economists in their use of these techniques is: Given the production and sales statistics of a group of industries and activities for a certain period, what is the pattern of relationships that these statistics imply? The Soviet problem thus involves factors beyond those usually incorporated in Western work.

INPUT- OUTPUT ANALYSIS

INPUT-OUTPUT ANALYSIS is a method of studying the interdependencies among "industries" or differentiated activities of an economy; it is particularly useful for the study of large and complex modern economies marked by a high degree of industrial specialization. Transactions among industries are arrayed systematically on a "<u>transactions table</u>" which summarizes in simplest terms the flows of goods and services among industries within an economy for a given period, usually a year.

Such a table implies a set of "input-output ratios" detailing the amounts of various inputs necessary to produce a unit of output for each industry. These ratios may be arrayed into a "<u>technology table</u>" arranged like the transactions table. The technology table then reflects the "technology" or pattern of "structural relationships" which governs production in the economy for the period under consideration. If the transactions table has been expressed in value terms, the technology table can be used to show the amount paid by any industry to other individual industries to purchase the intermediate goods needed for its own production. It is possible, for example, to see how many pennies the auto industry spent for steel for every dollar's worth of autos it produced during the period.

The technology table is an especially powerful tool for planners. If the planners, say, wish to increase the output of autos by 50 percent in the coming plan period, the technology table gives them a means to check their plans for steel output with the planned increased auto output to forestall possible raw material shortages. (They might also check the "second order" effects of an increase in steel output on their plans for the output of coal.)

If portions of the technology table itself are altered --say, less steel per auto is to be used, either because of new design or greater efficiency in fabrication—the new input-output ratios can be used for planning.

Complete mathematical "solution" of the system of equations implied by these tables --a step adding considerable refinement to their use--calls for numerous computations, running into the millions if industries are differentiated in sufficient detail to yield useful planning data. Timely solution, of course, requires high-speed electronic computers.

INPUT-OUTPUT TABLES are first cousins of the familiar baseball "won-lost" table that shows at a glance how many games each team in a league has won and lost in its play with each of the other teams in the league.

	Wash'gton	Cleveland	New York	Detroit	Boston	Baltimore	Kan. City	Chicago	Won	Lost	Percentage	Games Behind
Wash	—	15	13	13	14	11	12	16	94	60	.610	—
Cleve	7	—	11	14	14	12	15	16	89	65	.578	5
N. Y..	9	11	—	8	9	10	17	15	79	75	.513	15
Det...	9	8	14	—	11	9	15	10	76	78	.494	18
Bost..	8	8	13	11	—	14	11	10	75	79	.487	19
Balt..	11	10	12	13	8	—	8	12	74	80	.481	20
K. C..	10	7	5	7	11	14	—	12	66	88	.429	28
Chic..	6	6	7	12	12	10	10	—	63	91	.409	31
Lost..	60	65	75	78	79	80	88	91	—	—		

THE TWO BASIC TABLES

At least the "transactions table" and the "technology table" must be worked out for even the simplest interindustry analysis. Although tables useful for planning purposes would need perhaps hundreds of "industries," brief, truncated tables of as few as three industries can be used for some purposes.

In the simple illustrative input-output tables below, interindustry relations are depicted for only three of the many industries of a hypothetical complex modern economy for a single year. Note that flows within an industry are ignored--an industry's purchases from itself are shown as zero. This particular hypothetical economy is assumed to carry on no foreign trade.

TRANSACTIONS TABLE
(billion dollars)

PRODUCING "INDUSTRIES" / PURCHASING "INDUSTRIES"	Coal Mining	Steelmaking	Auto Mfg.	Other	Households & Government	Output
Coal Mining	0	50	10	60	30	150
Steelmaking	5	0	70	130	0	205
Auto Mfg.	10	15	0	70	220	315
Other	35	85	125	955	640	1840
Primary Input	100	55	110	625	890	2510

The <u>Transactions Table</u> arrays the flows of goods and services between "industries" of an economy. In this case these flows are measured in dollars for some year. The "Households and Government" column represents final demand; the "Output" column gives total sales of the particular "industry." Consider the steelmaking industry: it sold $70 billion worth of steel to the auto-manufacturing industry; it sold no significant amount of steel to final consumers; its total sales were $205 billion, of which $130 billion were transactions with other industries not specified on this truncated table. "Primary input" is labor.

MATCHING TECHNOLOGY TABLE

PRODUCING "INDUSTRIES" / PURCHASING "INDUSTRIES"	Coal Mining	Steelmaking	Auto Mfg.
Coal Mining	.000	.244	.032
Steelmaking	.033	.000	.222
Auto Mfg.	.067	.073	.000

The <u>Technology Table</u> arrays the inputs per unit of output (in this case, $1) implied by the transactions table. To keep the table simple, only the three "industries" under study have been included. Once again consider the steelmaking industry: for every dollar's worth of steel it produced (and sold), the table shows that it spent over 24 cents on purchases from the coal-mining industry and over 7 cents on purchases from the auto manufacturing industry, in the first instance probably for coking coal and in the second perhaps for trucks.

PROBLEMS AND PITFALLS

<u>How broadly to define "industry."</u> Sectors of economic activity may be defined broadly or narrowly. If highly differentiated, say on a single product basis, with thousands of "industries," tables become massive and computation cumbersome On the other hand, if broad definitions are applied, such as "manufacturing industry," the resulting analysis has little relevance for operational planning. Present Soviet efforts may involve tables as large as 1200x1200, but are more likely to utilize tables of less than 200 industries (a 200x200 table).

<u>Problem of relative prices.</u> For many applications it is useful to have the transactions table expressed in a common denominator (as in the sample table to the left, which uses dollars). This means that physical flows of goods and services must be "priced." Distortions in relative prices may arise from several practices--for example, charging different purchasers different prices for the same item or service, or using "going" prices when these involve several different relative price patterns. Planning implementation would be complicated if the pattern of values used by the planners deviates widely from the scale of values of purchasers.

<u>The data problem.</u> In US applications of input-output analysis, the task of obtaining adequate data has generated long lags between the year studied and the completion of a transactions table for that year. Soviet input-output analysis, with the pervasive reporting and compilation efforts of the Central Statistical Administration, may be much more timely.

<u>Making the analysis "dynamic."</u> Any but the crudest and simplest planning applications require use of "dynamic" techniques, especially taking account of and planning for changes in the technology or structure of the economy. The methodological and statistical complications of this task are formidable. Accurate forecasting of the efficiency of operating new capital equipment not yet installed is only one aspect of this complex task. Soviet planners will continue to rely heavily on adjustments in the course of plan implementation to correct for miscalculations in the initial plan.

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The extensive computations involved in these techniques are manageable, however, with the use of advanced computers. The principal problems confronting Soviet workers in using these techniques probably involve the suitability for those purposes of the existing data and of the data-collecting techniques and also the problem of reducing measurements of the flow of goods and services to a common accounting unit. The existing structure of Soviet relative prices may be found inadequate for this purpose.

Soviet "Operations Research"

While striving to perfect over-all national planning by new mathematical techniques, the planners are not overlooking potentialities in these techniques for improving planning in areas of smaller scope. Mathematical approaches, similar to those associated in the West with "operations research," are being utilized increasingly by Soviet planners, economists, and engineers for the solution of detailed and complex production problems, especially those arising from the scheduling and programing of automatic-line production. Such applications, in turn, could aid the development of improved national planning.

The provision of digital computers for automatic control of production may well furnish facilities and experience suitable for adaptation to much wider planning applications than those initially conceived. (Prepared by ORR; concurred in by OSI) 25X1

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