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SOVIET POST ATTACK RECOVERY: AN INITIAL ASSESSMENT (U)

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SRI International
Strategic Studies Center
1611 North Kent Street
Arlington, Virginia 22209

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[redacted] This Technical Note examines the applicability of using an econometric model in the evaluation of the recovery potential of the Soviet Union following a nuclear war. The large-scale model of the Soviet Union, SOVMOD, served as an analytical tool for the project. Specific observations are made concerning the limitations of such a system in assessing intersectoral differences during recovery and improvements needed in an econometric model

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constructed for examining peacetime economic processes if features of recovery phenomena are to be properly treated.

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PREFACE

This Technical Note examines the applicability of using an econometric model in the evaluation of the recovery potential of the Soviet Union following a nuclear war. Specific observations are made concerning the limitations of such an analytical tool in assessing intersectoral differences during recovery and improvements needed in a econometric model constructed for examining peacetime economic processes if features of recovery phenomena are to be properly treated.

The analysis was conducted by Holland Hunter under the direction of M. Mark Earle, Jr. The report is in partial fulfillment of research under Contract No. DNA001-76-C-0227.

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I [redacted] SUMMARY [redacted]

[redacted] The problem of evaluating Soviet economic recovery potential following a nuclear exchange between the US and USSR has received increased attention during the past two years as a result of changes in US strategic nuclear doctrine.

[redacted] SRI's Strategic Studies Center was asked to examine the role econometrics might play in the assessment of Soviet recovery. Under a separate DoD contract, SRI had developed a large-scale econometric model of the Soviet Union. While not constructed to look at the phenomenon of recovery, this model, SOVMOD, was considered a useful analytical system for examining the role econometrics might play in improving our understanding of recovery processes. This report presents the results of the evaluation.

[redacted] Three initial observations should be made.

1. It is recognized that recovery is a political-military-economic phenomenon. Thus, from the outset, the SRI project team viewed econometrics as a technique to gain insights into recovery processes, rather than as a means of forecasting recovery. Through the proper use of an econometric model adapted for recovery analysis, however, insights regarding the factors which significantly affect outcomes and the relationships between industrial sectors and rates of recovery can be developed.

2. A total system model like SOVMOD measures each target sector's value in terms of the whole economy and includes feedbacks. It also traces each target system's value over time. There are important differences between this approach and those analyses that look at sectors in terms of engineering processes.

3. An embedded input-output module can generate data on the relative importance of each industry's flows. While major uncertainties exist regarding the impact of a nuclear attack on peacetime input-output coefficients, sensitivity analyses can establish boundaries for the coefficients that are useful in calculating reasonable alternative recovery paths.

[redacted] Selected scenarios were evaluated as a means for identifying what changes to SOVMOD should be made. The major attack assumptions are given in Table A.

[redacted]

[redacted]

[redacted] Table A

SCENARIOS [redacted]

[redacted] Table A-1

Impact on Fixed Capital (billion rubles, at 1970 prices) [redacted]

	Stock on Hand	Taken Out	% Cut
Total industry	333.9	85.1	25.5
Transport and Communications	145.5	30.0	20.6
Housing	229.3	10.0	4.4
Other	353.0	0	0
Total	1061.7	125.1	11.8
Invertories	213.5	55.6	26.0
Sum	1275.2	180.7	14.2

[redacted] Table A-2

BREAKDOWN OF CAPITAL LOSSES IN INDUSTRY

(Billion rubles at 1970 prices) [redacted]

	Fixed Capital Jan 1976	Assumed Loss	% Cut
Machine-building and metal working	73.5	24.0	32.7
Electroenergy	54.0	20.0	27.0
Ferrous metallurgy	32.3	13.0	40.2
Chemicals and petrochemicals	31.9	8.0	25.1
Petroleum products	28.3	10.0	35.3
Processed foods	27.0	0	0
Construction materials	20.9	4.0	19.1
Forest products	15.8	0	0
Soft goods	15.6	3.1	20.0
Coal products	15.2	3.0	19.7
Other industry	19.4	0	0
Total industry	333.9	85.1	25.5

[redacted] Table A-3

IMPACT ON POPULATION AND EMPLOYMENT

IN MILLIONS OF PEOPLE [redacted]

	Percent Loss	
	Assuming civil defense evacuation of cities	Assuming no civil defense evacuation of cities
Urban population	20	40
Rural population	10	10
Total	16	28
Nonagricultural employment	19	39
Agricultural employment	0	10
Total employment	16	31

[redacted]

Four recovery scenarios were evaluated. They are:

(1) civil defense involving evacuation of Soviet cities, together with continued trade with Western Europe but at a reduced level.

(2) civil defense as above but no trade with Western Europe;

(3) no civil defense but continued Western Europe trading, again at lower levels;

(4) neither civil defense nor trade with Western Europe.

Each set of equations were reviewed to ascertain what factors would need to be adjusted given that economic resources would be shifted away from civilian consumption and toward the rebuilding of capacity. The value of conducting recovery analyses using an econometric model is, in part, that these assumptions can be explicitly reviewed by other economic specialists and, if appropriate, amended.

Tables B and C give an overview of the results of the scenario analyses.

The major implications to be drawn from the scenario analyses are as follows:

1. There is a dramatic difference between the civil defense and no-civil defense cases.

2. Differences between industrial sector recoveries is evident and, even at this stage of analysis, useful in developing insights regarding trade-offs a Soviet planner might face.

3. Clearly, the assumptions used to adjust "Western Europe trade" as a means to estimate what the Soviet economy might gain from capturing relatively intact the Western Europe industrial base are one of the major areas to be addressed in the revision of SOVMOD. Yet, the initial runs

[redacted]

[redacted] Table B

TRENDS IN TOTAL GNP DURING RECOVERY, FOUR SCENARIOS
IN BILLIONS OF RUBLES AT 1970 PRICES [redacted]

	Year 1	Year 2	Year 3	Year 4	Year 5
Control solution	470	497	520	544	567
CD and WE trade	351	398	421	448	476
CD, no WE trade	351	395	413	436	458
No CD, WE trade	306	344	365	390	414
No CD, no WE trade	306	342	359	379	399

[redacted] Table C

FIRST-YEAR AND FIFTH-YEAR CONTRASTS BETWEEN SCENARIOS ONE AND
FOUR, FIVE SELECTED BRANCHES OF INDUSTRY [redacted]

	First Year		Fifth Year		Percent Increase	
	CD-WE	No CD-WE	CD-WE	No CD-WE	CD-WE	No CD-WE
	ANNUAL GROSS OUTPUT (billions of rubles)					
Electric power	97	87	129	113	33.0	30.0
Ferrous metallurgy	87	78	121	109	39.0	40.0
Petroleum products	120	117	166	153	38.0	31.0
Chemical products	129	117	151	122	17.0	4.0*
Machine building	119	113	185	170	55.0	50.0

* reflects role foreign capital plays in this sector

[redacted]

[redacted]

demonstrate that it is domestic capital and not the Western European industrial base that provides the principal means to reestablish industrial capacity.

4. The scenario recovery paths illustrate the value of contingency planning and recovery preparation -- yet, the preliminary scenarios reflect recovery with implausible speed because the existing model structure is not optimized for recovery evaluations. Changes to the model to improve its ability for evaluating recovery problems are identified in Chapter V.

[redacted]

[redacted]

II BASIC CHARACTERISTICS OF THIS APPROACH TO ECONOMIC ANALYSIS OF THE POSTATTACK RECOVERY PROCESS

The time focus of this research project is on the period from R-Day forward. R-Day is the day when economic recovery begins. It will have been preceded by a period of survival and reorganization, perhaps six to 18 months long, which in turn follows a nuclear exchange and war. The intricate details of the war and the survival period are not part of this study. They bequeath to the start-up point in this project a specific set of assumed values for surviving industrial capacity, population, etc., sufficient to permit a model of the economy to get under way. Our focus is on the years of recovery stretching five or 10 or more years into the future.

The results of this research on the postattack recovery process may well carry implications for the war-fighting and survival periods. The nature of the initial attack and of responses to it during the survival period will obviously influence the subsequent paths of recovery. In order to discover these relationships, this project focuses on the future recovery process and will then reason backward to the earlier pre-recovery events that can influence start-up conditions.

A decisive analytic advantage of this approach, different from that previously employed in major research efforts, is that it bypasses all the controversial and debatable issues of how a major nuclear exchange comes about and how it is responded to during the war-fighting and survival stages. Differences of view on these issues have in the past prevented analysts from ever reaching the analysis of a postattack recovery process. Experience with the current project has already convinced us that valuable insights are achievable through this new approach, as demonstrated in Sections IV and V of this report.

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Since we are analysing the way the Soviet economy might recover from a major conflict, we need a total system framework that will incorporate the quantitative structure of the whole economy and monitor the process by which its interacting activities are reconstituted. This requires a comprehensive statistical model with sufficient disaggregated detail so that all significant interactions are distinguished. It must also be a dynamic model which evolves over time as stocks and flows are enlarged. In this way, the interdependencies among the constitutent parts of a large economy can be systematically studied and their dynamic evolution over time can be traced.

Systematic analysis of this kind will permit identification of the critical flows that are vital to reconstituting Soviet industrial capacity. It will identify the dynamic bottlenecks in the recovery process, that is the key capacity limitations whose slow growth would hold back recovery of the rest of the economy. It will also permit estimation of significant milestones, that is the dates by which specified stages of recovery would be reached under well-defined assumptions. Thus, both intersectorally and intertemporally, the vulnerable critical points in the recovering economy will be identified, that is pinpointed within a consistent framework of general economic recovery.

[redacted]

[redacted]

III [redacted] A BRIEF DESCRIPTION OF SOVMOD II

A. Main Features of the Model

SOVMOD II is a medium sized annual model of the Soviet economy similar in design to models built for the U.S. economy but specifically modified to reflect the command institutions of the Soviet economy. In its second stage, the one employed for the research reported here, it consisted of 156 stochastic equations and 97 identities. These relations incorporated 252 endogenous and 142 exogenous variables. The model was composed of the following blocks of equations:

- POPULATION AND EMPLOYMENT
- CAPITAL INFORMATION
- WAGES, INCOME, AND PRICES
- INVESTMENT
- CONSUMPTION
- STATE BUDGET
- FOREIGN SECTOR
- AGGREGATES
- PRODUCTION (6 SECTORS: INDUSTRY DISAGGREGATED INTO 12 BRANCHES)
- MATERIAL INPUTS (LINKED TO THE INPUT-OUTPUT COMPONENT)

The equations of the model were fitted to annual data for the Soviet economy from the late 1950's into the early 1970's. The model thus incorporates the normal, stable behavior of the economy and its parameters are all statistically significant to a fully satisfactory degree. The evidence used has come from three sources: (1) Official Soviet statistical handbooks, (2) U.S. reconstructions of official Soviet data, and (3) Experts' judgments on individual points.

The model computes a set of consistent annual activity levels in each part of the economy as all the parts interact. It replicates years during the sample period very faithfully and tracks the actual expansion path of the economy very closely. It thus demonstrably incorporates the actual behavior of this command economy to a fully useable degree of accuracy.

[redacted]

Its foreign trade sector and a few others are somewhat erratic; an effort is being made to remedy these deficiencies in the next generation of the model--SOVMOD III.

B. Capabilities for Analysis and Projection

SOVMOD II exposes the normal, peacetime structural relationships in the Soviet economy, both those relating one sector to another and those relating one year to the next. These are the underlying, consistent parameters relating all parts of the total economy to each other. They display the shares, propensities and multipliers at work in the system. More importantly, the software associated with SOVMOD II permits the analyst to compute the economy-wide impact of specific events on the total system. A change in any part of the system can be introduced and its consequences traced. Introduction of the hypothetical change requires recomputation of solution values for all the variables in the system so that a new consistent set can be obtained. Comparison of the original control solution with the new set of activity levels and stocks discloses the full consequences of the hypothetical change as it spreads throughout the economy.

The model has been designed so that existing trends can be readily extended into the future to generate an expansion path for the whole economy that is consistently related to its present structure. The consequences of specific events can be traced as they move out into future years. Lagged consequences are systematically handled in the model. SOVMOD II is thus a research instrument that permits research intervention for carrying out hypothetical experiments of a sophisticated kind. One can compare the observed behavior of the Soviet economy with "what would have been" in the absence of some specific event. One can project forward the path that will be taken by the Soviet economy if specified trends continue. One can ask any number of hypothetical questions about the response of the economy to precisely-formulated assumed events and derive internally-consistent results. It is, in short, a powerful instrument for analysing the economic aspects of the recovery process.

[redacted]

C. Examples of Its Use to Date

SOVMOD II was used to measure the impact of bad harvests in the USSR in 1973 and 1975. The procedure involved inserting the normal levels of grain and other crop outputs (on a smooth, moving-average basis) and comparing the total system results with the actual performance of the economy. Discrepancies demonstrate vividly how the crop shortfalls spread to other sectors of the economy and influenced subsequent years. This work is recorded in the Soviet Econometric Model Working Paper, "The 1975 Soviet Grain Harvest, the Tenth Five Year Plan, and the US/USSR Grain Agreement," by Donald W. Green (December 1975).

SOVMOD II has been used to measure the impact of high-technology capital equipment imported into the USSR from the West. Production functions for several key industrial branches were respecified to distinguish between domestically-produced and imported capital equipment. These functions, together with capital gestation relations which link annual investment with subsequent capital capacity increments made it possible to compute hypothetical output levels for recent years in the absence of actual imports of high-technology Western equipment. Again, the contrast between actual output levels and those computed without these imports exposed vividly the specific impact of these imports and their indirect reverberations elsewhere in the economy.

SOVMOD II has also been used in a longer-run exercise to test the consequences of an altered rate of technological progress on Soviet output over the next 15 years. The result was to indicate "how much difference it would make" if during the 1980's existing trends were modified by a substantial improvement or a substantial slackening in the annual rate of technological progress. Similarly, we examined the influence of altered patterns of foreign trade on the evolution of Soviet output over the period from now until 1990. These exercises, while hypothetical, give a feel for the range of possibilities that might unfold in specified circumstances. This work was reported in the U.S. Congress Joint Economic Committee, Soviet Economy in a New Perspective (Washington, D.C.: GPO 1976) pp. 197-215.

[redacted]

[redacted]

In the same volume (JEC, pp. 301-331), the use of SOVMOD II to examine the feasibility of the Soviet Tenth Five-Year Plan is documented. The plan indicators are examined in the context of the total system model and their dynamic consistency is reviewed. Moreover, SOVMOD II makes it possible to explore implied developments in various sectors not explicitly discussed in the published plan document. The study also analyzes a number of scenarios that trace the impact on plan implementation of specific variations in weather, trade, and world economic conditions.

[redacted]

[redacted]

IV [redacted] RESULTS OF SELECTED TESTS USED IN SOVMOD II [redacted]

A. [redacted] Baseline Control Solution

Application of SOVMOD II to postattack recovery research has involved a substantial number of experiments built around a baseline control solution. This solution incorporates the current and expected behavior of the Soviet economy over the next few years. It embodies current Soviet resource allocation priorities and procedures. This means that it gives priority to investment and defense in expenditures by the State; aggregate civilian consumption has only a residual claim. The patterns of household spending on consumer goods reflect individual choices within a regime of marked scarcity. Allocation of labor by occupation and region also reflects largely individual choice. The control solution embodies existing trends and carries them forward, including the effects of recent developments like the bad crop year of 1975. The control solution is the same as the one used to test the feasibility of the 10th Five Year Plan; its details are set forth in the paper by Green et al. in Soviet Economy in a New Perspective.[1] Under peacetime conditions, the Soviet Gross National Product and its major components all continue to expand, reflecting four major forces at work: (1) Additions to the labor force, (2) continued growth of fixed capital stocks, (3) imports of high-technology capital plant and equipment, and (4) domestic technological progress.

Starting from this control solution, initial experiments involved simple across-the-board shocks, e.g., reducing all capital stocks by 50 percent. With no change in labor supplies, the model simply substituted labor for capital, so that output quickly regained pre-shock levels in a highly implausible way. It was obvious that more detailed and realistic experiments were necessary.

---

[1] D.W. Green et al, "An Evaluation of the Soviet Tenth Five Year Plan Using the SRI-WEFA Econometric Model of the Soviet Union," in Joint Economic Committee, Soviet Economy in a New Perspective, (Washington, D.C.: GPO 1976).

[redacted]

[redacted]

B. [redacted] Controlling Assumptions Concerning the Attack [redacted]

[redacted] Our tests applying SOVMOD II to postattack recovery analysis made use of a handful of simple assumptions supplied to us for illustrative purposes. The assumptions focused on the extent of fixed capital destroyed, the extent of population loss, and the assumed changes in foreign trade. In order to reflect the responses by Soviet authorities, we added a few simple assumptions concerning policy revisions in output and investment priorities. While this set of straightforward assumptions permitted a number of meaningful experiments, it should be stressed that a thorough simulation would require far more detailed and extensive specification of all relevant conditions. At this first stage of research, however, we have left all other features of the peacetime normal model unchanged.

[redacted] The absolute and percentage cuts suggested for application to the Soviet economy's fixed capital and inventories are set forth in Tables 1 and 2. The attack is assumed to take out almost 12 percent of the economy's fixed capital, i.e., 125 billion rubles out of a 1062 billion ruble total. The cut is slightly over 25 percent for industry, 21 percent for transportation and communications, and under five percent for housing. Inventories are assumed to be reduced by the same percentage affecting industry; the overall cut for fixed capital plant and equipment together with inventories is 14 percent of the economy's total.

[redacted] Within the industrial sector, the cuts range from 40 percent for iron and steel (ferrous metallurgy) to 19 percent for construction materials. The attack is focused on machine building and metal working, electric power, iron and steel, and petroleum products. These quick assumptions provide a basis for exercising the model and, of course, they could be easily modified to reflect specific considerations in subsequent experiments.

[redacted]

[redacted]

[redacted] Table 1

SPECIFICATIONS OF SELECTED ILLUSTRATIVE ATTACK SCENARIOS [redacted]

Impact on Fixed Capital (billion rubles, at 1970 prices)

	Stock on Hand	Taken Out	% Cut
Total industry	333.9	85.1	25.5
Transport and Commun.	145.5	30.0	20.6
Housing	229.3	10.0	4.4
Other	353.0	0	0
Total	1061.7	125.1	11.8
Inventories	213.5	55.6	26.0
Sum	1275.2	180.7	14.2

[redacted] Table 2

BREAKDOWN OF CAPITAL LOSSES IN INDUSTRY [redacted]

(Billion Rubles at 1970 Prices)

	Fixed Capital Jan 1976	Assumed Loss	% Cut
Machine-building and metal working	73.5	24.0	32.7
Electroenergy	54.0	20.0	37.0
Ferrous metallurgy	32.3	13.0	40.2
Chemicals and petrochemicals	31.9	8.0	25.1
Petroleum products	28.3	10.0	35.3
Processed foods	27.0	0	0
Construction materials	20.9	4.0	19.1
Forest products	15.8	0	0
Soft goods	15.6	3.1	20.0
Coal products	15.2	3.0	19.7
Other industry	19.4	0	0
Total Industry	333.5	85.1	25.5

[redacted]

[redacted]

[redacted] Two basic assumptions were provided us concerning the impact of the attack on population. In the absence of civil defense preparations leading to successful evacuation of cities, the urban population would fall by 40 percent. Alternatively, successful evacuation of cities would mean a reduction of 20 percent in an urban population. In each case, the rural population was to be taken as falling by 10 percent. The absolute dimensions of these cuts and related changes in the level of employment are set forth in Table 3. No effort was made to distinguish between regions or industries in imposing these population and labor force cuts.

C. [redacted] Controlling Assumptions Concerning Soviet Responses [redacted]

(U) We assumed that the first stage of postattack recovery would be carried out under conditions of enhanced command under which the authorities managing recovery would impose substantially different priorities on the surviving economy and population. The peacetime claims of consumption would be sharply restricted so that resources could be focused on reconstitution of destroyed capital. We assumed that the authorities would maintain per capita food consumption at control solution levels, but impose drastic restriction on the availability of durable consumer goods, soft goods, and services. We assumed also that in shifting resources towards investment, especially high priority would be given to reconstituting electric power and machine building within industry, along with transportation; investment is redirected away from housing and the service sector. The altered structure of end uses resulting from these and other assumed shifts is set forth in Table 5 under the next section below.

[redacted] Another basic assumption was provided us concerning Soviet foreign trade, again in two versions. One version assumes that Soviet trade with Western Europe, like Soviet trade with the United States, Canada, and Japan, falls to zero throughout the recovery period. Alternatively, we assumed that Soviet control of Western Europe permits the USSR to maintain

[redacted]

[redacted]

[redacted] Table 3

ASSUMED IMPACT ON POPULATION AND EMPLOYMENT,
IN MILLIONS OF PEOPLE [redacted]

	Control Solution Totals (1976)	Deaths	Percent Cut
Assuming civil defense: evacuation of cities			
Urban population	158.4	31.7	20%
Rural population	99.7	10.0	10%
Total	258.1	41.7	16%
Nonagricultural employment	93.6	17.5	19%
Agricultural employment	36.7	3.5	9%
Total employment	130.3	21.0	16%
Assuming no civil defense: evacuation of cities			
Urban population	158.4	63.4	40%
Rural population	99.7	10.0	10%
Total	258.1	73.4	28%
Nonagricultural employment	93.6	36.5	39%
Agricultural employment	36.7	3.5	10%
Total employment	130.3	40.0	31%

[redacted]

[redacted]

its imports from Western Europe at 80 percent of the 1976 control-solution level, while reducing its exports to Western Europe to 20 percent of the 1976 control-solution level. We further assumed that these imports and exports would increase five percent annually during the recovery period. Table 4 shows the present direction of Soviet exports and imports, indicating the significance of this part of Soviet trade.

[redacted] We assumed that, during the recovery period, the urban and rural populations would grow at the same rate as in the control solution and that the division between agricultural and nonagricultural employment would remain fixed in the 1976 adjusted proportions. This allows for reallocation among nonagricultural sectors and branches but maintains agricultural production at levels consistent with the reduced labor force.

D. [redacted] Implicit Assumptions [redacted]

[redacted] Apart from the indicated changes in SOVMOD, these tests keep all activity levels and parametric relationships in their peacetime mode. This means, in particular:

- no changes in the agricultural sector except for a 10 percent rural population loss
- no changes in Soviet exports or imports except for those specified in trade with the "developed West"
- all peacetime lags in fixed capital gestation and other behavior responses continue to shape the time-pattern of recovery, except that the unfinished capital in progress at the time of attack has been reduced proportionately wherever fixed capital was destroyed.

Some of these implicitly-assumed continuities are unrealistic. Subsequent analyses will establish the reasonableness of implicit assumptions such as these by sucessively relaxing them to ascertain the impact on the outcomes computed by this set of experiments.

[redacted]

[redacted]

Table 4

SOVIET IMPORTS AND EXPORTS BY MAJOR REGION,
1976 PROJECTIONS IN MILLIONS OF DOLLARS

	Imports From	Exports To
CMEA countries (Eastern Europe)	16,363 (48.4%)	14,433 (46.6%)
Western Europe	8,970 (26.6%)	7,128 (23.0%)
U.S., Japan, and other "developed West"	3,664 (10.8%)	2,011 (6.5%)
Developing countries	2,936 (8.7%)	2,296 (7.4%)
Other socialist countries	1,775 (5.2%)	2,930 (9.4%)
Unspecified	100 (0.3%)	2,200 (7.1%)
Total	33,808 (100.0%)	30,998 (100.0%)

[redacted]

[redacted]

E. [redacted] Four Illustrative Scenarios

Putting these variations in order, we have four basic scenarios:

(1) civil defense which evacuates Soviet cities, together with continued trade with Western Europe;

(2) civil defense as before but not trade with Western Europe;

(3) no civil defense but continued Western European trading; and

(4) neither civil defense nor trade with Western Europe.

In each case we examined the extent of economic recovery over a five-year period, looking at the level of GNP, its composition, and the rate of recovery of major dimensions of the economy. SOVMOD computes a great variety of associated detail. In further research, it would be important to analyze many internal developments, sector by sector and year by year, but in this initial research stage we confine our report to major features of the four scenarios.

Variation of defense expenditures during the recovery period was also examined as a significant influence on trends. In the mid-1976 version of SOVMOD II, budgeted defense outlays are not closely linked with individual industrial branch output levels and we found that the impact of varying the level and growth rate of defense expenditures was negligible. This should not be taken, however, as an accurate description of the situation to be expected under postattack recovery. It represents a deficiency in SOVMOD that is now being corrected.

[redacted]

[redacted]

F. [redacted] Redirection of Resources Under Enhanced Command [redacted]

[redacted] As noted above, we assumed that the recovery period would begin with a substantial redirection of economic resources away from civilian consumption and toward investment in the rebuilding of capacity. The resulting changes are most drastic when cities are not evacuated and when trade with Western Europe ceases. The shifts are less severe if civil defense and continued trade with Western Europe are assumed. Two of the four scenarios are illustrated in Table 5, whose upper panel shows end use changes assuming civil defense and continued Western European trade; their absence shows the consequences displayed in the lower panel.

[redacted] The share of consumption in total GNP drops from 60 percent in the control solution down to 50 percent (43 percent without civil defense and West European trade), while investment rises from 32 percent to 40 percent of GNP (44 percent without civil defense and West European trade). Under our assumptions there is a very drastic cut in the availability of consumer durables, which fall to one-third or less of the control solution levels. Food for consumption is maintained by our assumptions at unchanged per capita levels; the absolute amount falls only in proportion to population losses. SOVMOD computes resulting availabilities accordingly, and the levels for the first two recovery years are shown in Table 5.

[redacted] The adjustments inserted in the SOVMOD structure that led to this outcome are set forth in Table 6. Solution values for civilian consumption computed as a residual claim are set lower than they would be otherwise by 5 billion rubles for durables and 5 billion for nondurables in each of the first five recovery years. Investment outlays in each of the first two years are reduced by 5 billion rubles in housing and 3 billion in the services sector, while being increased by 2.5 billion for transport and communications, and 12.5 billion rubles for industry. Note that the prior claim of investment on resources shows a net increase of 5 billion rubles each year. Within industry the increases are focused by assumption on machine building and electroenergy, with increased attention

[redacted]

[redacted]

[redacted] Table 5

END-USE CHANGES IN LEVEL AND STRUCTURE OF OUTPUT, CONTROL SOLUTION VERSUS YEARS ONE AND TWO OF PAR, IN BILLIONS OF RUBLES AT 1970 PRICES [redacted]

SCENARIO ONE--CD AND WE TRADE

OUTPUT CATEGORY	1976 IN CONTROL SOLUTION	YEAR ONE	YEAR TWO
FOOD	132.5	111.1	114.8
SOFT GOODS	66.6	35.3	41.5
DURABLES	21.0	7.8	7.1
SERVICES	61.7	19.4	37.5
TOTAL CONSUMPTION	281.8 (60%)	173.6 (50%)	200.9 (51%)
INVESTMENT	149.2 (32%)	141.4 (40%)	158.9 (40%)
OTHER USES	39.1 (8%)	36.4 (10%)	37.7 (9%)
TOTAL GNP	470.1 (100%)	351.4 (100%)	397.5 (100%)

SCENARIO FOUR--NO CD AND NO WE TRADE

OUTPUT CATEGORY	1976 IN CONTROL SOLUTION	YEAR ONE	YEAR TWO
FOOD	132.5	94.9	97.8
SOFT GOODS	66.6	25.2	30.5
DURABLES	21.0	4.7	3.8
SERVICES	61.7	6.4	19.5
TOTAL CONSUMPTION	281.8 (60%)	131.2 (43%)	151.6 (44%)
INVESTMENT	149.2 (32%)	134.9 (44%)	149.4 (44%)
OTHER USES	39.1 (8%)	40.3 (13%)	41.5 (12%)
TOTAL GNP	470.1 (100%)	306.4 (100%)	342.5 (100%)

[redacted]

[redacted]

[redacted] Table 6

ADJUSTMENTS TO CONSUMPTION AND INVESTMENT IN
THE CONTROL SOLUTION, BY YEAR, IN BILLIONS OF 1970 RUBLES [redacted]

	Year 1	Year 2	Year 3	Year 4	Year 5
Consumption of durable goods	-5.0	-5.0	-5.0	-5.0	-5.0
Consumption of nondurables	-5.0	-5.0	-5.0	-5.0	-5.0
Investment outlays:					
Housing	-5.0	-5.0			
Services sector	-5.0	-5.0			
Transport and communications	+2.5	+2.5			
Industry	+12.5	+12.5			
Within industry:					
Machine building	+5.0	+5.0			
Electroenergy	+2.5	+2.5			
Ferrous metallurgy	+1.5	+1.5			
Petroleum products	+1.5	+1.5			
Chemical products	+1.0	+1.0			
Construction materials	+1.0	+1.0			

[redacted]

[redacted]

also to ferrous metallurgy, petroleum products, chemical products, and construction materials. After the first two years these new directions of investment continue to shape the recovery pattern as SOVMOD computes consistent sectoral recovery trends.

G. [redacted] Impacts on Consumption and Investment [redacted]

[redacted] Table 7 and its accompanying chart show how the level of aggregate consumption develops over the first 5 years of recovery under our four scenarios. The control solution shows consumption rises from 282 billion rubles to 329 billion rubles or by 17 percent over five years. By comparison, the assumed attack in the absence of civil defense and trade with Western Europe would bring aggregate consumption in the first recovery year down to 46 percent of the control solution level, i.e., it would be cut by more than half. If there was no civil defense but trade with Western Europe continued, the cut would be to 49 percent of the control solution level. Under these assumptions it would take something like 15 to 20 years for civilian consumption to regain the control solution level (10 to 15 years if Western European trade continued).

[redacted] If population losses are held down through prior evacuation of cities, the fall in consumption is to 59 percent of control solution levels (62 percent if trade with Western Europe is maintained). Recovery proceeds at about the same rate thereafter; the level of consumption would regain control solution levels in 10 to 12 years in this case (8 to 10 years if Western Europe trade is available). While these blows to consumption are severe, they involve our assumption that a subsistence diet is assured throughout; it is the availability of consumer durables that is drastically curtailed in all these scenarios.

[redacted] It is apparent that population losses are more serious than the loss of trade with Western Europe. The two lowest curves reflect the absence of civil defense evacuation of cities; the two upper curves show the extent to which losses are checked through adequate civil defense. For each

[redacted]

[redacted]

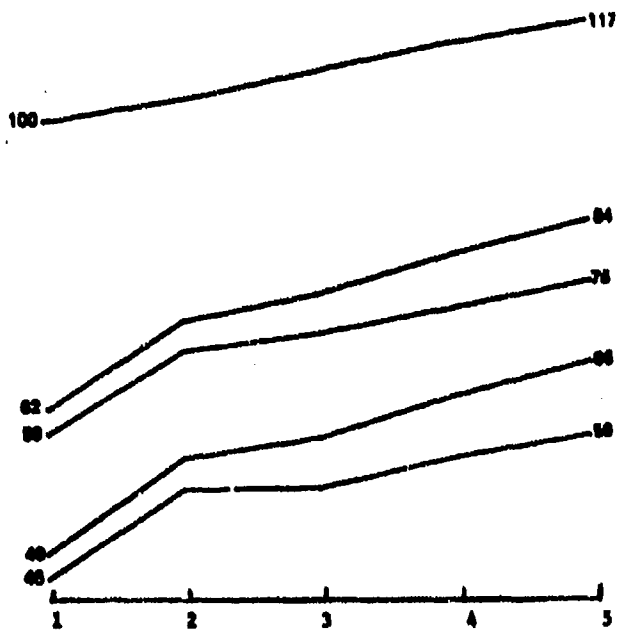
[redacted] Table 7

IMPACTS ON AGGREGATE CONSUMPTION IN FOUR SCENARIOS,
YEARS ONE THROUGH FIVE, IN BILLIONS OF RUBLES AT 1970 PRICES (U)

	Year 1	Year 2	Year 3	Year 4	Year 5
Control solution	282	290	304	318	329
CD and WE trade	174	201	210	224	236
CD, no WE trade	167	192	197	205	213
No CD, WE trade	137	160	165	176	186
No CD, no WE trade	131	152	152	159	165

Chart I

AGGREGATE CONSUMPTION



[redacted]

[redacted]

of the pairs, the upper curve results from the availability of trade with Western Europe, while the lower curve reflects the situation without this trade. The underlying absolute data are in Table 7. The reference numbers on the ratio-scale chart are indexes with the control solution 1976 level as a base of 100.

[redacted] If the allocational priorities of the peacetime control solution had continued to prevail, the attack would have caused a substantial reduction in the level of investment as well as consumption. We made a test run of the impact without any allocational shift in order to expose the dimension of the investment cuts involved. However, the adjustments set forth above in Table 6 have the effect of countermanding this reduction in investment to such an extent that the actual level of investment outlays for the reconstruction of heavy industry and transportation actually regains the control solution level after the first year and thereafter rises increasingly above what would otherwise have prevailed. This in turn adds to the depth of the cuts in household consumption, and it is the combined impact of reduced total output and redirected resources that appears in our consumption estimates. It is, however, the rebuilding of basic industrial capacity that eventually provides a foundation for the restoration of consumer standards of living.

[redacted] The combined impact of these changes in both consumption and investment makes the fall in total GNP less drastic than the fall in consumption alone, and makes the rate of recovery more rapid. Table 8 and its accompanying chart show the trends for each of our four scenarios. When population losses are modest and Western European trade is available, the GNP regains the control solution level in five years. In the absence of civil defense and Western European trade, the recovery period extends to seven or eight years. The absence of civil defense brings aggregate GNP down initially to 65 percent of the control solution level, while evacuation of cities cuts the loss by 10 percentage points. The presence or absence of West European trade makes no initial difference but does affect the rate of growth modestly, adding three or four percentage points to the level of

[redacted]

[redacted]

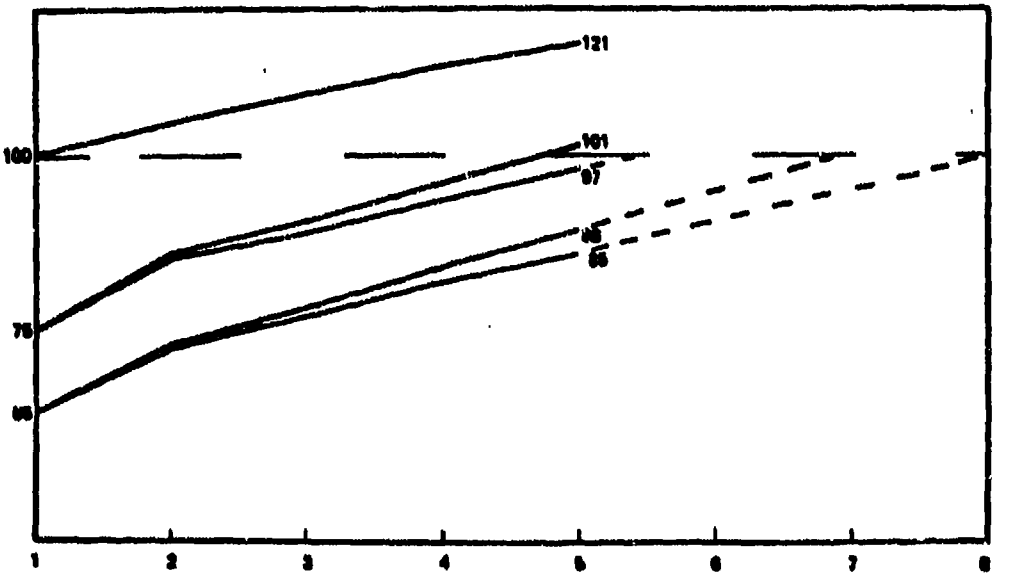
[redacted] Table 8

TRENDS IN TOTAL GNP DURING RECOVERY, FOUR SCENARIOS,
IN BILLIONS OF RUBLES AT 1970 PRICES [redacted]

	Year 1	Year 2	Year 3	Year 4	Year 5
Control solution	470	497	520	544	567
CD and WE trade	351	398	421	448	476
CD, no WE trade	351	395	413	436	458
No CD, WE trade	306	344	365	390	414
No CD, no WE trade	306	342	359	379	399

Chart II

TOTAL GNP



[redacted]

[redacted]

GNP in the fifth year. In its overall impact on total GNP, therefore, these results suggest that the availability of resources from Western Europe will not make a major contribution to Soviet postattack economic recovery.

[redacted]

[redacted]

V [redacted] DETAILED RECOVERY PHENOMENA WITHIN THE INDUSTRIAL SECTOR [redacted]

A. [redacted] Factors Influencing Recovery in Five Major Branches [redacted]

(U) The power of SOVMOD to trace out the interacting phenomena of a detailed response to a hypothetical attack can be illustrated by following some of the important sectors of Soviet industry as they are reconstituted. In this section, therefore, we select five of the twelve industrial sectors and examine the constrasting ways in which they respond to two of the four scenarios.

[redacted] Several factors are at work in determining these detailed responses. The first is the industrial focus of the assumed attack. As noted above, the assumed attack takes out 40 percent of the capital stock of ferrous metallurgy, 37 percent of electric power fixed capital, 35 percent of petroleum refining capacity, 33 percent of the fixed capital capacity of machine building and metal working, and 25 percent of the capacity of the chemical and petrochemical products branch. The absolute amount of capital destroyed varies from 24 billion rubles for machine building down to 8 billion rubles for chemical products. These losses impact on the production capabilities of each branch and also define the dimensions of the rebuilding task.

[redacted] A second factor influencing each branch's response is the nature of its production function. As can be seen in Table 9, these branches differ sharply in the proportions of labor and capital they use. They also differ in the extent to which they draw on imported capital, and in the overall responsiveness of output to changes in variable inputs. The relevant coefficients for Cobb-Douglas[1] production functions fitted to the logs of absolute values are set forth in Table 9A. While the story here is complex, it is sufficient to note that changes in labor input have a small

---

1 [redacted] Two-factor production functions homogeneous of degree one.

[redacted]

[redacted]

Table 9A

SOVMOD II INDUSTRIAL BRANCH PRODUCTION FUNCTIONS (SIMPLIFIED): COEFFICIENT VALUES FOR RIGHT-HAND ELEMENTS

	Constant	Labor	Domestic Capital	Imported Capital
Electric power	-.17	.40	.62	--
Ferrous metallurgy	.31	.37	.53	--
Petroleum products	3.00	.07	.43	.23
Chemical products	1.15	.34	.23	.49
Machine building	1.06	.17	.51	.16

[redacted] Table 9B

Capital formation equations for selected branches of industry, SOVMOD II, summer 1976:

Electric power: $\Delta K = 1.39I - 1.33(I_{-1}+I_{-2}) + 1.52(I_{-3}+I_{-4})$

Ferrous metals: $\Delta K = .42(I + I_{-1} + I_{-2})$

Petroleum products: $\Delta K = .23(I + I_{-1} + I_{-2})$

Chemical products: $\Delta K = .52(I_{-1}+ I_{-2})$

Machine buildings: $\Delta K = .57(I + I_{-1})$

[redacted]

[redacted]

effect on output changes of petroleum products, that chemical products production is substantially influenced by imported capital, and that capital is a greater influence than labor for all five of these branches. The branches differ also in the speed with which their fixed capital can be rebuilt. Construction of electric power facilities takes up to five years in this model, as indicated in Table 9B. Ferrous metals and petroleum products require up to three years, while the delays for chemical products and machine building are less prolonged. In recent Soviet experience, as illustrated by the capital gestation function estimated for the chemical products branch, the best results come from exluding current-year investment and focusing on investment in the preceding two years; for machine building on the other hand, the powerful terms are current-year and preceding-year investment. Finally, restoration of the five branches varies because of assumed investment priorities which assign special importance to electric power and petroleum products. The combined influence of all these factors produces markedly different sequences of reduction and reconstitution, as spelled out in the following brief discussion.

B. [redacted] Initial Impacts on Capital, Labor and Output [redacted]

[redacted] Table 10 shows how the five selected branches of industry react in the first year of the recovery period, compared to the levels of activity they would have shown in the control solution. Output levels for all five industries are, of course, lower than in the control solution, but to different extents. The ouput reductions are compared in Table 10 with the cuts in fixed capital and labor force that take place under the assumptions of Scenario One and Scenario Four. According to our assumption, the cuts in fixed capital are the same whether there is civil defense protection or not, while the reductions in labor force as assumed to be 40 percent without civil defense and 20 percent with civil defense. These labor cuts apply uniformly to each of the five branches (slight deviations in the data reflect minute model adjustments

[redacted]

[redacted]

Table 10

CAPITAL, LABOR, AND OUTPUT LEVELS, FIRST YEAR VERSUS CONTROL SOLUTION, TWO VARIANTS, IN BILLIONS OF RUBLES AT 1970 PRICES AND IN PERCENTAGE OF REDUCTION [redacted]

	Control Solution	Assuming CD-WE	% Fall	Assuming No CD-WE	% Fall
	FIXED CAPITAL AT BEGINNING OF YEAR				
Electric power	54.0	34.0	37	34.0	37
Ferrous metallurgy	32.2	19.2	40	19.2	40
Petroleum products	28.3	18.3	35	18.3	35
Chemical products	31.9	23.9	25	23.9	25
Machine building	73.5	49.5	33	49.5	33
	AVERAGE ANNUAL LABOR FORCE (000 workers)				
Electric power	697	566	19	424	39
Ferrous metallurgy	1,366	1,108	19	828	39
Petroleum products	287	233	19	173	40
Chemical products	1,775	1,442	19	1,080	39
Machine building	13,930	11,316	19	8,477	39
	ANNUAL GROSS OUTPUT				
Electric power	141.0	97.3	31	86.6	39
Ferrous metallurgy	123.7	86.9	30	78.1	37
Petroleum products	150.4	119.6	20	117.3	22
Chemical products	149.0	128.9	13	116.8	22
Machine building	152.2	118.9	22	113.2	26

[redacted]

[redacted]

and rounding errors). The interbranch differences in capital cuts reflect the specified assumptions about the hypothetical attack.

[redacted] For all five branches the reductions in output are more drastic when lack of civil defense evacuation leads to 40 percent reductions in the labor force. For electric power and ferrous metallurgy, the output cuts are proportionate to the cuts in capital and labor. In the other three branches, output cuts are less than proportionate to the reduction in capital and labor inputs, though the marked contrast for the chemicals branch disappears in Scenario Four.

[redacted] The electric power industry and iron and steel industry are the two whose output falls more sharply, since they were the hardest hit and their production functions are sensitive to changes in capital input. By contrast, the chemical products industry, unusual in its insensitivity to capital and labor inputs and also least badly hit in the attack, shows only a 13 percent output reduction under the assumptions of Scenario One. The machine building and metal working branch, like the petroleum products branch, show an output reduction of about one-fifth in response to capital cuts of one-third and labor reductions of one-fifth under Scenario One.

C. [redacted] <u>Recovery Trends over the First Five Years</u> [redacted]

[redacted] The process of economic recovery occurs quite differently in these five selective branches of industry, as can be seen from the data in Table 11. Capital capacity is reconstituted at different rates, reflecting both the differences in attack impact, and, more importantly, the differences in assumed priorities for investment together with technical differences in the speed of capital construction (length of capital gestation periods). The sharpest increase in annual investment is in the machine building and metal working (MMW) industry, where annual investment outlays in the fifth year are 3.5 times as large as in the first year.

[redacted]

[redacted]

Table 11

RECOVERY TRENDS IN LABOR FORCE, INVESTMENT AND CAPITAL STOCKS, AND GROSS OUTPUT, FIVE SELECTED BRANCHES OF INDUSTRY, FIRST FIVE YEARS OF PAR, SCENARIO ONE [redacted]

	Control Solution	First	Second	Third	Fourth	Fifth	Five-Year % Increase
	LABOR INPUT (thousands of workers)						
Electric power	697	566	557	569	580	586	3.5
Ferrous metallurgy	1,366	1,108	1,107	1,115	1,122	1,132	2.2
Petroleum products	287	233	240	247	252	257	10.3
Chemical products	1,775	1,442	1,439	1,490	1,510	1,532	6.2
Machine building	13,930	11,316	11,592	11,917	12,221	12,566	11.0
	ANNUAL INVESTMENT (billion rubles)						
Electric power	4.3	4.3	6.9	9.4	10.3	11.4	165.0
Ferrous metallurgy	3.1	3.1	5.1	7.4	7.6	7.7	14[illegible].0
Petroleum products	6.7	6.7	8.7	10.8	12.1	13.7	10[illegible]
Chemical products	4.4	4.4	5.8	7.2	8.0	8.8	10[illegible]
Machine building	9.3	9.3	14.8	23.3	29.0	32.6	251.0
	FIXED CAPITAL STOCK (billion rubles)						
Electric power	34.0	34.0	37.5	44.1	50.7	52.1	53.0
Ferrous metallurgy	32.2	19.2	21.3	24.1	28.4	35.5	85.0
Petroleum products	28.3	18.3	20.5	23.6	27.7	33.9	85.0
Chemical products	31.9	23.9	26.6	29.2	32.5	38.6	62.0
Machine building	73.5	49.5	55.3	64.0	82.7	108.8	120.0
	ANNUAL GROSS OUTPUT (billion rubles)						
Electric power	141	97	103	115	126	129	33.0
Ferrous metallurgy	124	87	92	98	108	121	39.0
Petroleum products	150	120	128	138	150	166	38.0
Chemical products	149	129	134	139	144	151	17.0
Machine building	152	119	127	138	159	185	55.0

[redacted]

[redacted]

Expansion in MBMW investment outlays starts immediately and continues throughout the five-year period. By contrast, fixed capital investment outlays in the chemicals branch and the petroleum industry merely double over the first five years. The absolute increments are much smaller and rise far less rapidly than in MBMW. Investment in electric power and ferrous metallurgy expands substantially; the fifth year level is 2.65 times the first year level for electric power and 2.48 times as large for ferrous metallurgy.

By contrast with these sharp increases in investment, the recovery rates of expansion in the labor force are extremely modest. In machine building and petroleum, the fifth-year level of labor input is about 10 percent larger than the first year, while for electric power and ferrous metallurgy the five-year increase is only between two and four percent; chemicals records a six percent increase. Labor is in short supply, even under the assumptions of Scenario One where civil defense holds the urban population loss down to 20 percent, and the model doles out labor increments sparingly.

As a result of the marked increases in annual investment outlays, the fixed capital stocks of these five branches all expand substantially. The sharpest increase is shown by machine building and metal working, where the fifth-year capital stock is 2.4 times as large as the first year's stock, reaching a level 48 percent above that of the control solution. In electric power, the capital stock rises 53 percent, but doesn't quite regain the control solution level for 1976. Capital in the other three branches rises between 60 and 85 percent, exceeding control solution levels by 10-20 percent.

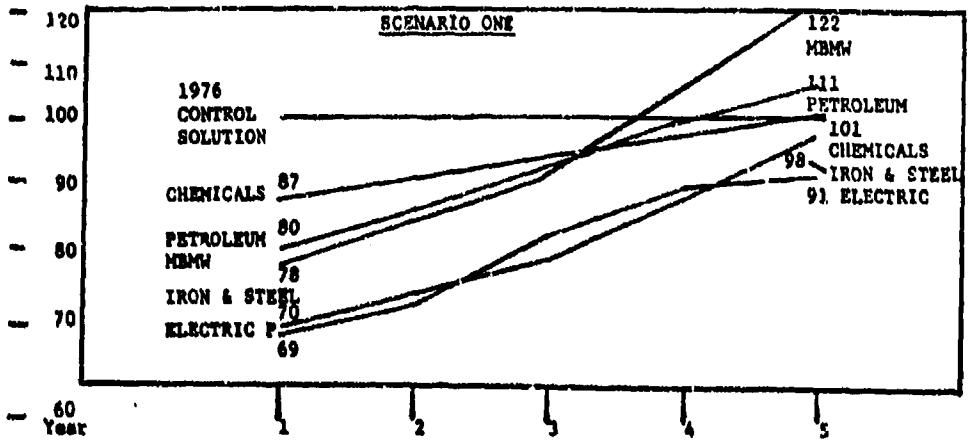
The combined results of these changes in labor and capital input is to permit a substantial degree of recovery in output levels, differing noticeably from one branch to another. Panel one of Chart III shows the trends. Output for machine building and metal working rises 55 percent in the first five years, reaching a level 22 percent above the control

[redacted]

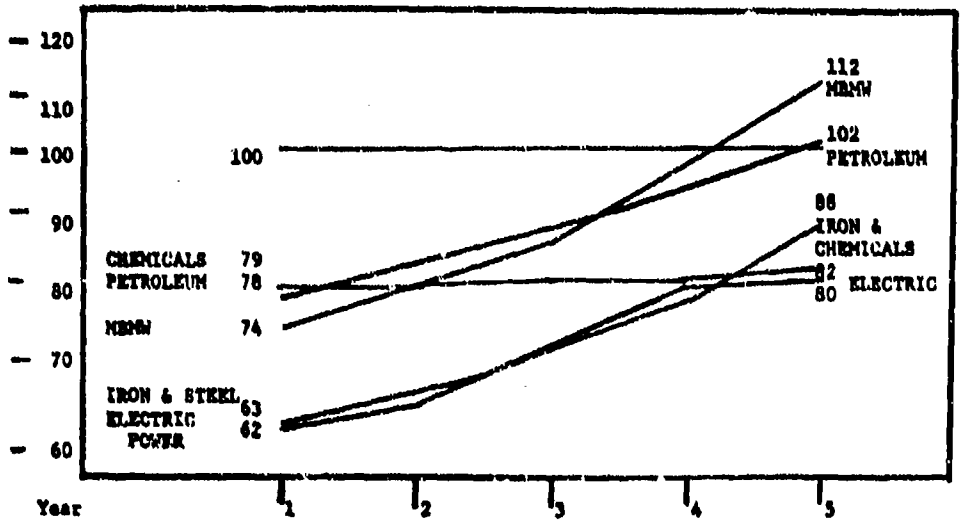
[redacted]

[redacted] Chart III

OUPTUT INDEXES FOR SELECTED INDUSTRIES,
FIRST FIVE YEARS OF THE RECOVERY PERIOD,
1976 CONTROL SOLUTION OUTPUT = 100 (U)



SCENARIO FOUR



[redacted]

[redacted]

solution. The output of electric power, however, through rising 33 percent, is still nine percent short of the base year control solution level. Iron and steel output rises 39 percent over this five-year period, almost reaching the control solution level, and the petroleum industry raises its output 38 percent, exceeding the control solution level by 11 percent. The output of chemical products and petrochemicals only rises 17 percent, but since its initial decline was so modest, the fifth-year level returns to the control solution level.

This analysis of branch recovery has referred so far to Scenario One in which civil defense protects the labor force and trade with Western Europe proceeds without major reduction. How much difference does it make if we examine recovery rates in Scenario Four, in which there is no civil defense and trade with Western Europe comes to a halt? Summary results for these five selected branches of industry are displayed in Table 12. Results differ substantially from one branch to another. Electric power and ferrous metallurgy show practically no growth in labor input, comparing the fifth year with the first year of recovery. Petroleum products and machine building, on the other hand, show labor input increases of 11-12 percent, equal to those they showed under Scenario One. For chemical products, the labor input increase is six percent as it was in Scenario One. By our assumptions, the volume of annual investment and the resulting changes in fixed capital stocks are the same in Scenario Four as they are in Scenario One. This is, of course unrealistic, but is was not feasible to carry out more refined adjustments in these initial experiments.

Though the recovery of output levels in Scenario Four is lower than in Scenario One for these five industrial branches, the contrast is only marked for the chemicals and petrochemicals industry. Here output in the fifth year is only four percent above that of the first year, as contrasted with a 17 percent growth under Scenario One. Output remains almost 20 percent below the preattack level, as shown in the lower panel of Chart III. Scenario Four also involves a falling off in the volume of imported capital for the chemicals branch, and though domestic capital formation replaces imported capital in volume, the lower productivity of domestic capital evidently puts a non-negligible drag on recovery.

[redacted]

[redacted]

[redacted] Table 12

FIRST-YEAR AND FIFTH-YEAR CONTRASTS BETWEEN SCENARIOS ONE AND FOUR, FIVE SELECTED BRANCHES OF INDUSTRY [redacted]

	First Year		Fifth Year		Percent Increase	
	CD-WE	No CD-WE	CD-WE	No CD-WE	CD-WE	No CD-WE
LABOR INPUT (thousands of workers)						
Electric power	566	424	586	428	3.5	0.9
Ferrous metallurgy	1,108	828	1,132	835	2.2	0.8
Petroleum products	233	173	257	193	10.3	11.6
Chemical products	1,442	1,080	1,532	1,141	6.2	5.6
Machine building	11,316	8,477	12,566	9,420	11.0	11.1
FIXED CAPITAL STOCK (billions of rubles)						
Electric power	34.0	34.0	52.1	52.1	53.0	53.0
Ferrous metallurgy	19.2	19.2	35.5	35.5	85.0	85.0
Petroleum products	18.3	18.3	33.9	33.9	85.0	85.0
Chemical products	23.9	23.9	38.6	38.6	62.0	62.0
Machine building	49.5	49.5	108.8	108.8	120.0	120.0
ANNUAL GROSS OUTPUT (billions of rubles)						
Electric power	97	87	129	113	33.0	30.0
Ferrous metallurgy	87	78	121	109	39.0	40.0
Petroleum products	120	117	166	153	38.0	31.0
Chemical products	129	117	151	122	17.0	4.0
Machine building	119	113	185	170	55.0	50.0

[redacted]

[redacted]

VI [redacted] MAJOR LIMITATIONS OF SOVMOD II FOR RECOVERY ANALYSIS

A. Inadequate Specification of Defense Sector Relations with Industry and Transportation

SOVMOD II handles defense claims primarily as a budgetary influence, keeping resources away from investment and consumption. Requirements are not, however, made specific as to industrial branch or output category, nor are the labor force implications carefully modeled. Now that new numbers are coming available it will be feasible to build a more detailed defense component into SOVMOD so that these links between defense claims and the surrounding economy are specified with more precision. This will have greater critical importance in the recovery period than in normal peacetime conditions since greater commitment to defense during recovery would lower investment and prolong recovery of industry and consumption. It will also have greater strategic significance since competing program priorities during recovery will determine the basic shape of the recovery.

B. Lack of Attention to Material Flow Constraints and Capital Specificity

Production functions in SOVMOD II make output a function of labor and capital inputs but do not take account of intermediate purchases from other producers. As a result, structural limitations on current output are under-represented in the model and the economy's ability to change its pattern of production is overestimated. This deficiency has now been repaired with the insertion of an input-output module in SOVMOD III. A related shortcoming concerns the initial lack of detail on end uses; here too the next generation of SOVMOD permits specification of priorities with greater precision.

[redacted]

[redacted]

SOVMOD II directs generalized investment resources into the building of new capital stocks (as it should), but also permits existing capital to shift from one activity to another in a very unrealistic way. Under postwar conditions, where sharp changes in the composition of output must be expected, a more tightly constrained set of capital relations is necessary. In a successor model this can easily be arranged.

C. Inadequate Treatment of Foreign Trade and Its Domestic Linkages

Exports and imports are related to the world economy through normal peacetime relative-price influences in SOVMOD II. Only in a few sectors are Soviet equipment imports closely linked to domestic capital formation and branch outputs. This broad approach is currently being supplanted by a much more detailed specification of the foreign trade sector so that SOVMOD III will be far more capable of incorporating marked changes in the composition of foreign trade and tracing their impact on the domestic Soviet economy.

D. Inability to Model the Phases of Recovery

All the experiments reported above derived from a model that contained a great many influences carried over from the years preceding the assumed attack; there was no thorough way to cut these lagged responses out of the model. Many endogenous variables continued to be determined by activity levels from one to four years earlier (that is, in the preattack period). Investment continued to be influenced by earlier tax revenues, and workers responded to earlier relative wage differences.

This inability of SOVMOD II to handle a sharp break with normal peacetime continuities calls for the design of a modified model that is specifically built to start off the recovery period with a fresh set of parameters, unhooked from the past. Moreover this first stage of recovery will involve features of "enhanced command" that substantially alter the

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priorities and allocation mechanisms of the model. During the process of recovery the "enhanced command" phase will give way to a "transition phase" on the way to eventual appearance of a new "peacetime normal" phase. At present, SOVMOD II cannot handle these transitions, but a modified model can be built specifically to do so.

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