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FINAL REPORT

IMPACTS OF CRISIS RELOCATION ON U.S. ECONOMIC AND INDUSTRIAL ACTIVITY

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Defense Civil Preparedness Agency
Washington, D.C. 20301

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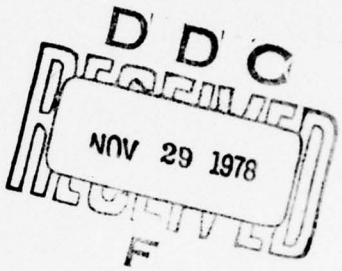
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(6) IMPACTS OF CRISIS RELOCATION ON U.S. ECONOMIC AND INDUSTRIAL ACTIVITY

by

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(12) 212 p.



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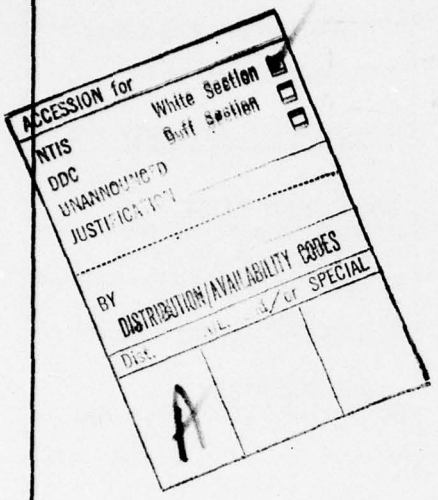
This study is the second phase of a DCPA project on determining the potential economic and industrial impacts of crisis relocation. As a result of the first-phase study, a number of problems were further examined: the advantages and disadvantages of the payment mechanisms to be used during the relocation period; estimates of levels of activity in essential-industry categories; overall

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economic impact during and after crisis; and applications of study findings to a local test area (Colorado Springs, Colorado).



DETACHABLE SUMMARY

IMPACTS OF CRISIS RELOCATION ON U.S. ECONOMIC AND INDUSTRIAL ACTIVITY

Contract No. DCPA01-76-C-0331 Work Unit 2313E

Background and Objectives

The potential economic impact of crisis relocation (CR) is one of the major considerations surrounding the development of the CR option. An initial study* was conducted in 1977 for the Defense Civil Preparedness Agency to define the economic and industrial problems of a crisis relocation that ended with a peaceful resolution of the crisis. Major problems were identified for various elements of the economic system (i.e., the individual, business, financial institutions, and local/state governments). Possible consequences of such problems and measures for their control were examined in terms of the phases of the crisis situation (i.e., pre-CR Crisis, CR-Initiation, CR-Maintenance, and CR-Reconstitution Phases). Essential industry types were identified and methods for industry planning were outlined. A macroeconomic model was also developed to measure the impact of the CR crisis on the early post-crisis period.

As a result of the initial study, a number of problems were selected for further examination in the follow-on effort herein reported. It was clearly desirable to examine in more detail the advantages and disadvantages of the payment mechanisms that might be used during the CR-Maintenance Phase since these would have a direct impact on the organization of operations in host areas. The essential-industry planning problem required more complete development, particularly with respect to the quantitative methods of estimating the levels of activity of essential industry categories. The overall economic impact during and after crisis also required additional study to test sensitivity to specific CR control measures and to assess overall economic feasibility. To assure utility of the findings, initial efforts were made to apply study findings to a local test area.

---

*Richard K. Laurino, et al., Economic and Industrial Aspects of Crisis Relocation: An Overview, Center for Planning and Research, Inc., Palo Alto, California, May 1977.

Financial Systems

The basic financial problem to be faced in crisis relocation is how to provide the minimum essential financial services without allowing unacceptable depletion of the assets of the financial community. Such a depletion would prevent the proper functioning of financial establishments during crisis relocation and impede the recovery of the economy in the post-crisis period. Federal regulations and draft guidance allow the Federal Reserve Board and individual banks to exercise control over withdrawals and transfers of credit, and also allow banks to take such other actions relating to their services as might be required during a period of emergency. The exact nature and timing of such actions, however, require additional study and planning.

The basic economic objectives to be addressed by the banking system would be:

1. To assure that everyone receives essential goods and services
2. To keep the distortions of the host area economy to a minimum
3. To minimize the economic start-up problems associated with the post-CR period.

Basic to carrying out these objectives would be the decision on the payment mechanisms to be used during the crisis relocation period. Federal agencies are currently reviewing this problem to determine methods for keeping the economy functioning to the degree possible during the CR-maintenance period. However, before reliance can be placed on normal mechanisms, an examination is required of the possible problems induced by the CR situation.

Three general approaches can be considered for use in crisis relocation: (1) direct cash payments, (2) deferred payments, and (3) free goods and services. Direct payments would include the use of currency in making purchases, the use of bank checks (i.e., cashier's checks, etc.), or the use of personal checks. Deferred payment schemes would include the use of credit cards (standard or "universal") or the use of some invoice scheme. Free services are generally taken to mean the provision by a government agency of essential goods and services to those needing such assistance.

A general pattern of advantages and disadvantages is associated with each approach (see Table S-1). Direct payment schemes (with the exception of personal checks) would generally be the most widely accepted by merchants

Table S-1

CHARACTERISTICS OF PAYMENT MECHANISMS

Payment Mechanism	Description	Major Advantages	Major Disadvantages	Requirements
Direct Cash Payment o Currency o Bank generated checks	Depositors receive limited check and currency over the counter at banks in host areas	Merchant acceptability Financial control Minimum accountability	Depletion of liquid assets OTC capacity overload Security problems Non-depositors not helped	Simplified OTC procedures and accounting Modified Federal Reserve procedures Revised courier activities Relocation of risk area banks
o Personal checks	Personal check given for purchases Possible limits on maximum check values	Easily implemented at retail level Reduced physical security problems	Limited financial control Depletion of assets Low merchant acceptance Increased fraud Benefit only to demand deposit holders	Deferral of check clearing Federal Reserve guarantees Simplified updating of accounts
Deferred Payment o Regular credit cards	Cards used in retail purchases Possible limits on amounts and outlets	Easily implemented (retail) Reduced physical security Reduced depletion of assets	Not currently used by grocery stores Excessive charges Major increases in credit outstanding Limited acceptability Increased fraud Limited to credit card holders	Preparation for use at government centers Preparation of measures to control use
o Universal credit cards	Cards provided to all for credit purchases Backed by Federal government	Wider population coverage Reduced depletion of assets Reduced physical security	Costly implementation Control of use required Post-CR repayment losses Privacy problems High fraud rate	Development of data base Pre-printing of cards and forms Regional storage and maintenance Distribution of cards in crisis

Table S-1 (concluded)

Payment Mechanism	Description	Major Advantages	Major Disadvantages	Requirements
Invoice System	Individual purchase using standard invoices at authorized outlets	Reduced depletion of assets Entire population covered Lower physical security requirements	Controls to limit transactions Applicable only at government authorized outlets Post-CR payment delays Implementation costs	Development of data system and forms Training of staff Processing of forms in post-CR period
Free Government Services	Government provides essentials at authorized locations	Reduced depletion of assets Covers entire population Lower security problems Low accounting requirements	Large increase in government costs Slow post-CR payment Control of use required Possible credibility loss for other payment modes Reduced host area economic activity Fraud in center operations	Exchange mechanism (wholesale) Control of demand Accounting system Training of center staff Allocation control

and would maintain the merchant's liquidity for maintaining business activity. Such schemes, however, would put a considerable strain on the financial and operational capabilities of the banking system. Depletion of individual assets would also occur which could delay the recovery during the post-CR period.

Deferred payment schemes have the advantage of preventing the rapid depletion of bank and individual assets during CR-maintenance, but would be less acceptable to individual merchants and might require limitation of exchanges to government operated or government authorized outlets. Normal systems of validation of charges might not function effectively. The universal credit card, preplanned and stockpiled by the Federal government, would be costly to implement and maintain.

Invoice systems might be a more practicable system for deferred payment. An invoice system (machine coded) could be devised to record exchanges made by individuals. Because of implementation and control problems, however, such a system would probably have to be restricted to use at government controlled or authorized outlets and for essential services only.

The free goods and services approach would eliminate the need for records of individual transactions and would reduce or eliminate the depletion of individual assets, but a corresponding increase in government expenditures would result. Other payment mechanisms would be needed to prevent a slowdown in host area economic activity and prevent host area residents from becoming dependent upon the free service system.

A review of the advantages and disadvantages of the various payment mechanisms has led to the conclusion that a mix of payment mechanisms would probably be the best choice. Deferred or free services mechanisms appear to be the best for evacuees and essential goods and services. Other established mechanisms (cash, etc.) could be used for all other purchases subject to controls to limit bank withdrawals. No obvious requirement was found for completely new payment mechanisms such as the universal credit card. The chosen mechanisms might have to continue into the early post-CR period, which tends to support the choice of the established mechanisms.

Essential Industry Planning

Some industry (i.e., essential industry) would be required to continue production during crisis relocation to meet minimal demands of the population and to achieve other national objectives without unduly depleting available

inventories. Lists of essential industries nationwide and by States have been prepared, but the level of production in each category has not been established. In the first report in this series, it was suggested that most essential industry could produce well below the normal level to meet the CR demands. In this event, government would have some flexibility in allocating production goals to individual facilities and could use this flexibility to maximize production in non-risk areas, thereby reducing the number of key workers in risk areas and preparing for recovery in event of attack.

In the present study, this possibility was examined for the food industry consisting of 32 food production categories. Based on per capita food consumption levels specified in USDA Defense Food publications, total demand for production in each category was determined using an input-output model. Total demands were compared with the food production capacity existing in metropolitan and non-metropolitan areas, and minimal risk area production figures were determined. With standard levels of food production, the number of key workers in risk areas were reduced to 33% of the peacetime levels. With substitutions to the diet, key workers could be reduced to 26%. With emergency expansion of production in non-risk areas, and substitutions to the diet, food industry workers in risk areas could be reduced to 6% of peacetime levels. To achieve these reductions, however, it would be necessary to have perfect distribution of products and services over the United States. Other calculations were made at the State level (i.e., Colorado) to obtain results of more use to local and regional planners. Results for the State of Colorado showed production levels and key workers in risk areas reduced to the range of 20 to 38% of peacetime levels--a less dramatic but still significant result.

The results demonstrated that a significant potential could exist for reducing production and key workers in risk areas. Actual achievement of such reductions would require detailed implementation at local and regional levels. To assess these planning problems, the study team visited the local test area (Colorado Springs). With the assistance of local and State planners, the study team was able to visit selected essential facilities to obtain information and assess the overall feasibility of the proposed planning methods. This information, together with the ongoing efforts of the local and State planners, suggests that the available data and the level of cooperation of private enterprise should be sufficient to complete State

and local industry plans. However, the need for additional specific Federal guidance to focus planning efforts is apparent. The feasibility and characteristics of detailed facility plans for CR production remain to be determined.

Estimation of Economic Impact

The crisis and resulting crisis relocation would have significant impact on all elements of the economy. In the previous study in this series, the nature of these impacts was described with respect to elements of the economy (individual, business, financial, and local/State government) over the various phases of the crisis (pre-CR Crisis, CR-Initiation, CR-Maintenance, CR-Reconstitution). A summary of these effects is given in Table S-2. In the most general sense, losses to the individual would be primarily in terms of income loss over the crisis period. Business, especially in the risk areas, would be shut down with consequent loss of revenue, and financial institutions. would be faced with depletion of assets and increased pressure to provide services during and after the CR movement. During the CR-Maintenance Phase, local and State governments would lose a relatively small amount of revenue but would incur very high expenditures for population subsistence and other emergency operations.

Estimates of costs during the CR-Maintenance Phase are speculative because knowledge of the CR process is still evolving. Such estimates provide some guidance as to costs of alternative measures and the general feasibility of CR relative to other defense operations during the same period. Some of the costs to the private sector could be high by historical standards, but appear to be well within the capabilities of the economy to withstand (see Table S-3). Salaries lost by risk area employees during the CR-Maintenance Phase could be about $1.3 billion per day (base year 1975), although at least part of this loss would be covered by employer payments, unemployment benefits, vacation pay, risk area work benefits, and possibly overtime hours after peaceful resolution of the crisis. Business in risk areas could suffer up to $2 billion per day in lost manufacturing value added (MVA). About $0.35 billion per day of business loss would be in fixed costs (not counting salaries that might be paid by some organizations). Also in this case, losses might be reduced by higher rates of sales in the aftermath and possible higher prices, as in the case of utilities.

Table S-2

SUMMARY OF EFFECTS OF CRISIS RELOCATION

Operational Phase	The Individual	Business	Financial Institutions	Local & State Government
Pre-CR Crisis	Selective unemployment Changed consumption Reduced savings Reduced access to savings and investments	Production shutdowns Inventory liquidation Deferral of payments and expenditures Reduced access to assets Reduced access to credit	Increased withdrawals Reduced savings Reduced receivables Reduced interbank funds Management controls	Reduced tax receipts Increased costs Delayed inter-government payments Increased cash flow
CR-Initiation	Stoppage of income Emergency costs Cash shortage Lower acceptability of checks and credit cards	General shutdown Freeze on assets and payments Security problems Distribution stoppage	Shutdown of risk area bank services High service demands in host areas Security problems Shutdown of exchanges	Curtailed service income Greatly increased emergency costs Restricted access to liquid assets
CR-Maintenance	Loss of employment income CR-Maintenance expense Cash shortage Restricted access to liquid assets Overdue obligations Security of assets	Shutdown of most risk area business Support of essential industry Expansion of host area industry Stoppage of accounts receivable Distribution problems	Control of withdrawal Credit restrictions Increased net borrowed reserves Curtailed interbank borrowing Reduced profits Reduced debt payments	Reduced regular income Increased emergency costs Controlled access to funds Accelerated payment Dependence on inter-government revenue
CR-Reconstitution	Slow re-employment Lower income Reduced liquid assets Overdue obligations Changed consumption patterns Reduced savings	Slow buildup of production Slow buildup of demand Depleted inventories Inadequate working credit Production inefficiencies Loss of asset values Reduced financial stability Reduced access to credit	Check clearing backlog High level of float Maintenance of bank liquidity Excessive credit demands Records updating Low savings rate Phase out of controls	Reduced revenue Inter-government claimes Increased welfare costs Payment of accrued obligations Depleted liquid assets Reduced asset values Reduced tax base

Table S-3

SELECTED DIRECT COSTS ASSOCIATED WITH CR-MAINTENANCE PHASE

Cost Factor	Direct Cost (1975) $Billion/day	Direct Cost (1975) $Billion in 2 Weeks
Salaries (non-government)	$1.3	$18
Risk area business (MVA)*	2.0†	28†
Risk area business (fixed costs)§	0.35	5
Financial sector (added costs)Δ	0.02	0.3
State and local operations added cost‡	0.3	4
Subsistence of evacuees	0.5	7
Other evacuation costs: commuting	0.03	0.4
relocation and return	N.A.	2
Shelter upgrading and recovery (for evacuees)	N.A.	6-18
Local government revenue loss	0.05	0.7
TOTAL	$2.5	$43-55

*Less government, financial, and agriculture.

†Not included in total; salaries and fixed costs are added to the total as separate factors.

‡Own personnel only; 12-hour day plus minimum operating logistics.

§Not including salaries.

ΔAdded check clearing costs plus interest loss due to 15% depletion of demand deposits.

Financial sector losses are difficult to determine since they will depend to a large extent on the policies adopted regarding controls on cash withdrawals and types of payment mechanisms to be used. Fixed costs and costs of check processing, however, are small costs compared to total costs of peacetime operations and costs associated with possible depletion of demand deposits. With appropriate and well-timed controls over deposits, the costs to banks should be manageable and generally much less than many other CR cost factors.

Local, State, and Federal governments would incur large costs associated with emergency operations and relatively minor losses in terms of lost revenue in risk areas. Emergency operations costs, while large, should be viewed as deferred defense expenditures. In these terms, such costs appear to be substantially less than any comparable strategic defense system. Costs should also be viewed in terms of costs being incurred in the same period by the military operations that gave rise to the CR operations. Principal costs would be associated with subsistence of evacuees and the provision of shelter protection for the evacuee population and other local emergency operations (e.g., public safety, public health, etc.). Subsistence costs would probably be on the order of $0.5 billion per day assuming that all evacuees were provided with free services. Emergency operations of local governments might add an additional $0.3 billion per day in labor costs. The costs of shelter would depend upon the type of shelter provided, payment policies with respect to labor, and the amount and payment policy for cleanup of shelter subsequent to CR operations. With a mix of shelter upgrading types, the costs could range from $6 to $18 billion.

Initial losses to the private sector during the CR-Maintenance Phase (1975) could be on the order of $25 billion dollars. For the government, costs could range from $20 to $30 billion for evacuee subsistence, emergency operations and shelter construction. Payments of some form to individuals would be desirable in any event to provide individuals with funds needed to meet obligations in the early post-CR period.

Economic costs and problems could also be significant in the post-CR period. With a slow start-up of industry, the private sector could suffer post-CR losses equal or greater than the losses sustained during the CR-Maintenance Phase. The study of possible government policies for this post-CR period warrants continuing attention.

In this study, an improved economic model (TEMCRIS II) was devised to study post-CR economic behavior.* Initial test runs on the model tend to indicate that the basic U.S. economic system is stable under the type of economic shocks imposed by CR operations. Economic disruption appears to be eliminated in about 1 to 2 years after the end of CR. The severity of such effects and their duration could be significantly reduced by appropriate government policies such as increased government expenditures and transfer payments during and immediately after the CR-Maintenance Phase.

Recommended Planning and Research Efforts

The results of the study tasks have indicated the character and general feasibility of economic and industrial activities during crisis relocation. Proper performance of such activities would require a more complete understanding of the problems and the implementation of appropriate control measures. To this end, the following planning and research efforts are recommended:

- o Guidelines for Industrial Operations During CR. This effort would require examination of key economic problems facing industry in maintaining operations during crisis relocation. The two principal categories included would be: (1) operational or logistic problems, and (2) financial management problems. Information would be gathered to establish feasible operational conditions for essential industry including logistic support requirements. Financial requirements such as cash flow, payroll, credit, etc. for continued operation during CR would be examined.
- o Guidelines for Financial Institutions During CR. In this effort, the operational problems of banks functioning in CR situations would be examined in detail to provide needed guidelines for implementing emergency payment mechanisms and other required emergency services. Requirements of CR (such as payment mechanisms) would be reviewed with selected financial institutions, and the problems and planning requirements for implementation would be identified. Findings would be tested by application to conditions faced by specific financial institutions.
- o Examination of Requirements for Rapid Post-CR Recovery. Study efforts have indicated that the losses in the post-CR period could be equal to or greater than losses during the CR-Maintenance Phase, so that

*See also, "TEMCRIS LP I/O Model," Frank Trinkl, et al., prepared by Center for Planning and Research, Inc. for Federal Preparedness Agency, August 1978.

a means of rapid start-up of the economy in the post-CR period would be essential. This effort would establish in detail the economic elements at the end of the CR-Maintenance Phase for several alternative scenarios, and would use these as a basis for estimating impact on industrial recovery. Possible alternative government policies that would stimulate recovery would be devised and the impact of these policies on the economic elements and the economy as a whole would be estimated.

- o Guidelines for Local and Regional Industrial Support Activities. Recent evidence indicates that development of industrial plans at the local and regional levels appears feasible, but that additional guidance is required to focus these efforts on essential requirements. These suggested guidelines would include the detailed specification of planning requirements for essential industry facilities and would include development of the additional local and regional planning requirements to support the essential industry including logistic and financial support, safety, and utilities. Requirements for coordination between industrial production and distribution would be considered for risk and host areas and local and regional jurisdictions.
- o National Level Industrial Planning Guidance. Study efforts suggest that national level guidance would be helpful in developing efficient local and regional industrial plans. To test this premise, recently developed planning factors for food production should be applied at the local and regional level, and the feasibility and utility of these factors should be evaluated. Planning factors for selected other essential industry categories would also be developed.
- o Economic Impact of Federal Policies. Prior studies in this series have developed models and data bases for estimating the economic impact of CR and associated policies in the post-CR period. Initial runs on arbitrary policies have indicated that appropriate policies would be helpful in reducing the national economic impact of CR. In this study, a range of feasible policies would be devised and used to develop initial conditions as models for inputs. Econometric models would be improved and tested with new inputs. Results would be evaluated in terms of relative utility to the control of economic impact.

- CR Related Economic/Industrial Measures Assisting Postattack Survival and Recovery. It has been recognized that CR crisis could end in an attack rather than a peaceful resolution of the crisis. Consequently, added economic/industrial measures would be indicated to prepare for this outcome. This study would examine measures compatible with the CR operations to increase attack preparedness in the industrial sector and the economy as a whole. Consideration would be given to the role that CR preparations would play in an overall industrial recovery strategy. Tradeoffs between CR operations and CR preparations would be identified and examined.

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I. INTRODUCTION

A. Background

The option for nationwide crisis relocation (CR), currently under study by the Defense Civil Preparedness Agency for possible use in a deep international crisis, could involve the movement of as many as 135 million people from 400 risk areas (urban areas)[1]. The scale and complexity of such an operation, requiring relocation for periods of one to several weeks, would result in an economic impact that would be a significant determinant of the feasibility and characteristics of the relocation option. Recognizing this fact, DCPA has undertaken studies to identify and estimate economic effects and to design measures for the control of these effects.

The initial results of an economic impact study were reported early last year[2]. The study defined in some detail the character and magnitude of problems that might arise for the economic system and its basic elements (i.e., the individual, business, financial institutions, and local/state governments).

The basis for the study was the assumption that the crisis would end in a peaceful resolution. A second outcome, a nuclear attack on the United States was considered in the formulation of control measures but was not investigated in detail. The study indicated that the economic problems could very well begin prior to crisis relocation (pre-CR Crisis Phase) and continue through the time spent in the relocation sites (CR-Initiation and CR-Maintenance Phases). In the event of peaceful resolution, economic impact could persist long after return of the population to the risk areas (the CR-Reconstitution Phase).

The magnitude of the possible economic dislocation from CR was indicated to be large, but not unduly large compared to the costs of actual or potential military actions giving rise to the deep crisis. Furthermore, a number of opportunities were identified for controlling the costs during the crisis and reducing losses in the post-crisis period.

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1. "Planning Assumptions for Crisis Relocation Planning," FPA/DCPA Draft Guidance, Sept. 29, 1977.

2. Richard K. Laurino et al., "Economic and Industrial Aspects of Crisis Relocation: An Overview," Final Report for DCPA, Center for Planning and Research, Inc., May 1977.

The basic concept in controlling effects would be to keep the economic system functioning to the extent practicable during CR, and to restore full functioning as rapidly as possible thereafter. This concept implies maintenance of the monetary system, and the functioning of industry essential to population maintenance and other specified national objectives. To this end, initial study efforts identified problems facing the banking system under crisis conditions; outlined approaches for identifying essential industry and minimizing the numbers of key workers in risk areas; and developed prototype models for estimating national economic impact after the crisis.

The results given in this current report cover extensions to the initial findings, including: a more detailed examination of the banking system emergency operations; development of models and preliminary results relating to required essential-industry production levels; additional development of econometric models for estimating post-CR impact; and estimates of costs associated with CR maintenance.

B. Objectives

The general objective was to: "Analyze the impact of planning for, carrying out, maintaining, and revoking the crisis relocation of population on all echelons of the U.S. economic system."

Specific objectives included but were not limited to, the following:

- o Estimate the economic costs of relocation on the nation as a whole (GNP, etc.) and suggest procedures for reducing deleterious effects.
- o Estimate effects on bank, fiscal, and monetary system (credit, debt, wage, compensation, etc.), and suggest procedures for reducing deleterious effects.
- o Develop means to predict and assess local impact of relocation on economic systems including consumer demands for use by planners and apply to the Colorado study area.

II. BASIC ASSUMPTIONS UNDERLYING CRISIS RELOCATION PLANNING

A number of basic assumptions underlie current CR research and planning efforts. These assumptions, while often dealing with questions of authority or operations, do nonetheless impinge upon the economic aspects of the planning problem. Official guidance and studies have over the past years established the traditional roles of government in responding to major national and regional emergencies. While these traditional roles are still relevant, it was recognized that additional planning guidance would be required because of the character of the crisis relocation problem. During the past year, joint efforts by several Federal agencies (DCPA, FPA, and others) have been underway to develop such guidance[1*], which can be categorized in terms of: crisis conditions, authority for planned actions, operational assumptions, and economic/industrial assumptions. The guidance, which is still tentative, could have a significant influence on CR economic planning.

A. Crisis Conditions

The crisis relocation option, if fully implemented over the nation, could involve as many as 135 million people in as many as 400 urban (risk) areas. Most of these people would be moved within about three days to surrounding (host) areas characterized by much lower population densities and correspondingly lower population support resources. The areas evacuated would include all of the larger industrial and commercial centers, containing a large fraction (over two-thirds) of the industries and workers. A high level of cooperation from the population would be expected when they were requested to relocate; however, some people would not be willing to leave the risk areas, creating added management and support problems.

The need to implement CR plans might occur either after a prolonged period of international crisis, or within 24 to 48 hours following some international incident. The longer period would permit added CR implementation, but because of the possibility of short warning, a minimum CR capability would have to be established prior to the crisis[1]. Depending on crisis conditions, some portion of the U.S. risk population, estimated between 10 and 20 percent, could be expected to leave the risk areas prior to nationally directed CR. This

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*References are listed at the end of Section II.

and other possible actions could cause economic problems prior to the invoking of the CR option (e.g., runs on banks, panic buying, absenteeism, etc.).[2]

The duration of the relocation (CR-Maintenance Phase) would probably be in the range of one to two weeks, but the possibility of a longer relocation period cannot be excluded[1]. As a consequence, support systems (e.g., logistic, economic, etc.) should be designed to provide support beyond two weeks without catastrophic failure.

The relocation period might be terminated either by a peaceful resolution of the crisis, or by a nuclear attack on the United States[1]. Consequently, planning must be balanced so that the system can continue to function in either eventuality. This type of planning suggests that use should be made of risk area capabilities during the CR-Maintenance Phase, while at the same time increasing host area capabilities to function independently of damaged risk areas in the event of an attack.

B. Authority

Any implementation of the CR option would be at the direction of the President. If not previously declared, a national emergency would be declared by the President, giving him the authority to take all actions necessary to implement CR plans. Review of the likely scenarios also suggests that many deleterious economic actions could begin prior to the declaration of a national emergency or initiation of crisis relocation. Consequently, to avoid unnecessary problems, CR plans would need provisions to begin implementation of selected economic measures at an early time in the crisis prior to CR initiation.

The Governor of each State would be responsible for the Statewide implementation of the CR plans following the Presidential decision. Local governments would continue to exercise control within their jurisdictions with the assistance of other jurisdictions in compliance with intergovernmental compacts and agreements. Federal resources and capabilities would be used to support State and local authorities[1]. However, Federal authorities could be expected to continue to exercise traditional authority over nationwide systems such as the financial systems[3]. (See also Appendix A.)

Return of the relocated population to their homes following crisis resolution would occur at the direction of the States' Governors, or at the request of the President. The planning and execution of such a return would have a significant impact on the duration of the economic impact in the post-crisis period.

C. Operational Assumptions

The basic operational concept would be to create as few new procedures, plans, and organizations as needed to carry out the crisis relocation option. Organizations and procedures prescribed in existing State postattack plans might be employed, but only to the extent that they are applicable to CR. All plans for providing essential services and resources (e.g., food, fuel, transportation) during the CR-Maintenance Phase would attempt to use existing distribution and other systems to the maximum extent possible rather than creating new standby systems[1,4]. This approach would place emphasis on continued use of risk area resources. However, because of the possibility of attack, a requirement would still exist to improve and expand existing production, inventory, and other capabilities in host areas to the extent that this can be done without disrupting minimal required activity of the normal systems[2]. The requirements for such balanced planning place a premium on understanding in more detail the type and level of industrial activity in risk and host areas.

The normal restrictions on operations imposed by Federal and State regulatory bodies would be replaced or suspended as required during the relocation period. These actions would include restrictions on hours driven by truck drivers, environmental standards, and other regulations that might affect the operational capabilities of essential systems (e.g., banking, etc.). Several standby regulations currently exist permitting maintenance of essential banking operations, to provide economic units with access to funds, credit, and services essential to continued operations[3, 5-8].

CR plans would also provide for control of the return movement of evacuees to risk areas, including phased return and other measures as necessary for orderly reoccupation and resumption of pre-crisis activities[1]. In particular, rapid resumption of industrial activity would be a significant factor determining the overall economic impact of the use of the CR option.

Because of the conflict-related nature of the crisis, CR planning should be based only on the availability of civilian resources and should not assume the availability of assistance from active or reserve components of the military forces. This assumption, together with the predicted scale of operations, suggests a major increase in the size of local emergency forces, with consequent major increases in costs of operations to be paid through local and State government agencies. Federal agencies will be responsible for developing or revising their respective plans to continue essential, uninterruptible

functions in risk areas during crisis relocation periods[1]. Thus, the traditional roles of government agencies in a CR emergency are to be maintained to the degree possible.

D. Economic/Industrial Assumptions

When the President directs implementation of crisis relocation, normal business activities would become secondary to preparing for defense of the nation and the relocation of the population. Many businesses and the economic system as a whole would suffer losses from shutdown of operations in risk areas, disrupted patterns of demand, changed production mixes for essential industry, changed business policies, and disruptions in labor and supply activities[2]. Host areas could also expect very large increases in demand to be placed on functioning industry and services.

During the CR-Maintenance Phase, efforts would be made to maintain the pre-crisis economy to the maximum extent possible with a minimum of extraordinary controls[1]. The short-term nature of the CR-Maintenance Phase (one to several weeks) would not permit implementation of a complex, nationwide system of economic controls. Unless such a system were already in effect, any system of resource management or economic stabilization placed into effect at the time of crisis relocation would consist of measures that were easily understood and could be implemented quickly[1]. In this regard, the occupancy of host areas by both host-area residents and evacuees from risk areas could create control problems, because of differences in economic systems used by the two groups (e.g., monetary transactions by host-area residents, and free goods and services to evacuees). Consequently, a reconciliation of the systems would be desirable, including a variety of expedient control measures to permit equity of treatment during the CR-Maintenance Phase[2].

Another basic assumption calls for the continuation of the use of the monetary system. While limited monetary transactions would be allowed, no one would be denied the necessities of life through the inability to pay[1]. This assumption reflects the continuation of the traditional role of government in emergency to provide both direct and indirect assistance during and after an emergency to the individual in need.

Another major impact on the economic/industrial system would result from the assumed stoppage of regular mails. Most individuals and businesses would not receive mail during the CR-Maintenance Phase, causing a delay in receipt

of income. The disruption of inter-regional mail would also prevent full functioning of the check-clearing process and other nationwide financial services. Essential regional financial services could be maintained using courier services and emergency banking procedures in host areas, and minimal functioning of banks and service centers in selected risk areas. Another planning assumption made is that unreasonable loss to business and individuals would be avoided by a Federal declaration of a financial transaction moratorium that would permit temporary delay in meeting some financial obligations (e.g., mortgage payments, interest payments, etc.) without incurring penalties.

Crisis relocation would result in substantial additional expense to State and local governments. Under these circumstances, it has been assumed that the Federal government would provide financial assistance to the State and local governments to offset some of the costs of these additional services. Also, Federal funds would be made available for all required Federal activities in assisting State and local governments to implement the crisis relocation plans.

Should the crisis be peacefully resolved, evacuees would be assisted in returning to their homes in the risk areas. At that time, actions would be taken by State and Federal governments to alleviate the impact of relocation[1]. This assumption would presumably include action to alleviate the economic impact, which could be significant. Many individuals and businesses would return without appreciable liquid assets. To prevent the resulting economic hardship and to assure a rapid economic recovery of the entire system, prompt financial aid from government would appear to be essential.

Essential services and activities would be continued in risk areas during crisis relocation. Needed workers (key workers) would commute daily from host areas to risk areas for this purpose. Essential industries would include: local government administration, emergency services, public utilities, production and processing of essential goods and services, transportation, essential financial operations, etc.[1]. Essential production need not include all facilities producing the necessary goods and services. The specific facilities and levels of activity could be reduced to reflect the reduced demand levels authorized for the CR period. Authorized demands could be obtained by increased production in host areas and decreased production in risk areas. Specification of essential production and demand will require additional studies at the national and regional levels.

References for Section II

1. "Planning Assumptions for Crisis Relocation Planning," FPA/DCPA Draft Guidance, Sept. 29, 1977.
2. Richard K. Laurino et al., "Economic and Industrial Aspects of Crisis Relocation: An Overview," Final Report for DCPA, Center for Planning and Research, Palo Alto, CA, May 1977.
3. "Money, Credit and Banking," OEP, Executive Office of the President, June 1965.
4. CPG-2-8A to E, "Guide for Crisis Relocation Contingency Planning," Parts I to V, DCPA, January 1976.
5. "Preparedness Programs for Emergency Operations in Banking," FG-F-3.25, Board of Governors of the Federal Reserve Systems in cooperation with Dept. of Defense, U.S. Government Printing Office, Washington, D.C., 1970.
6. "Economic Stabilization," Chapter 13, The National Plan for Emergency Planning, OEP, Executive Office of the President, December 1964.
7. "Preparedness Guidelines for Emergency Savings and Loan Operations," Federal Home Loan Bank Board, Washington, D.C., 1965 (Revised).
8. "Re-evaluation of Postattack Financial Policies," Board of Governors of the Federal Reserve System, Washington, D.C., August 30, 1974.
9. "Outline of CR Impact Factors on the Banking System," D.I. White, Federal Reserve Bank of Kansas City, July 26, 1977.

III. COMMERCIAL BANKING SYSTEM

A. Current Guidance Related to National Emergencies

Maintenance of the monetary system during crisis and crisis relocation would require the continued functioning of the banking system. Banks must be able to provide the minimal needs for cash and credit to individuals and essential business, while at the same time assisting with implementation of monetary controls and protecting the banking system's financial structure.

Various issued and proposed regulations of the Federal government deal with the operations of the banking system during national emergencies and subsequent to attack. This guidance is not specifically designed for CR situations but does reflect the traditional roles and control measures. New policies for the CR situation will, however, probably be required.

Under existing regulations, the Secretary of Treasury is responsible for emergency control of the banking system, and has authorized the Federal Reserve System to exercise emergency banking functions such as receipts and disbursements of currency, clearing of checks, and provision of liquidity for Federal Reserve banks, commercial banks, trust companies, private banks, savings banks, and mutual savings banks. The Federal Home Loan Board has similar responsibilities for Federal Home Loan banks, savings and loan associations, building and loan associations, cooperative banks, and homestead associations. The Director of the National Credit Union Administration is responsible for the emergency measures taken by all credit unions.[1*]

Suggested measures for attack preparedness and recovery are set forth in various official booklets and agency documents[2,3]. Many of the measures are appropriate to the CR situation. According to the guidance, defense planning should give consideration to:

- Organization and administration of the bank's emergency program
- Personnel protection
- Continuity of management and alternate headquarters
- Physical property
- Duplicate records.

Under the guidance, all banking institutions would remain open to the extent possible. In the CR situation, this statement might be interpreted to mean that all non-risk area banks would remain open with such minimal support

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* References are listed at the end of Section III.

from risk area banks, service centers, or personnel as might be required. Banks would be given the authority to temporarily curtail, limit, suspend, or delegate any and all operations and functions[4]. Existing regulations would allow banks to restrict cash withdrawals and credit transfers where such transactions were believed to be unauthorized or unnecessary. Allowed transactions could include needs for war effort, essential living, taxes, payroll, etc. The recent guidance [5] suggests that some obligations such as taxes and mortgage payments might be deferred under the provisions of a moratorium declared for the period of the crisis.

The guidance recognizes the possible need for the establishment of temporary substitute quarters for the continuance of banking operations. In the CR situation, this approach might allow establishment of host area quarters for risk area banks to service their customers.

The existing regulations also provide for possible modification of legal restrictions during emergency to allow banks to make loans to, borrow from, and discount assets with other banking institutions without regard to the restrictions of Federal or State law[4]. While such a measure might not be required for the CR situation, some easing of legal constraints/procedures might be required together with Federal guarantees to individual banks against losses from use of the emergency transaction procedures.

Federal Reserve banks have been assigned a central role in national emergencies[3]. In addition to the measures previously mentioned, the Federal Reserve banks would:

- o Provide for emergency distribution of currency.
- o Collect checks and other cash and non-cash items including those drawn on inoperable banks.
- o Make credit available to both member and non-member banks for essential economic activities, and to non-bank customers for essential purposes when such credit is not available on reasonable terms.
- o Buy and sell U.S. Government securities for their own account.
- o Raise and lower reserve requirements for member banks as necessary, and extend these requirements to non-member banks where conditions warrant.
- o Perform fiscal agency functions as authorized by Secretary of the Treasury.

The application of these and other emergency measures in the CR situation would probably be different from the attack situation. Actions taken would be tempered in the CR situation by the desire to limit impact on post-CR economic recovery.

B. Current Checking and Credit Card Systems

1. General Considerations

It has been estimated that over 90 percent of the dollar volume of transactions are accomplished by checking accounts[6]. Thus, any extensive use of the monetary system during CR would appear to require at least the limited use of checking and possibly credit card systems. To understand the problems with these systems in emergency, it is desirable to characterize their operations under normal conditions, and then to examine how these normal operations might be disrupted by the operational requirements of the CR option.

A check is basically a bill of exchange written by a payor, ordering a commercial bank in which he maintains a checking account to pay on demand a certain sum of money to the order of the payee[6]. To assure that this process functions quickly and efficiently, checks from the bank at which the check is deposited are sent through a check clearing process (usually involving one or more Federal Reserve Banks and/or commercial clearing houses) and on to the payor's bank. The check is usually "paid" by means of an adjustment of accounts among the involved banks, issuance of credit or currency to the payee, and the entering of a debit to the account of the payor. Often the payor's bank is not in the same locality as the payee's bank so that several banks as well as the transportation system can be involved in the clearing process.

The check clearing system is primarily a high volume system for collecting low-dollar value items[7]. In 1970 approximately 23 billion checks[6] were processed, rising to an estimated 26 billion by 1973[8]. In 1970, over 72 percent of these checks were made out for less than $100[7].

The checking system has been described by Hock[9] as a system with peripheral, median, and core activities.

The periphery includes:

- o The transaction defined as that which occurs in the marketplace when value is exchanged between individuals and/or organizations.
- o The entry defined as the methods by which the value (or item) requiring bank services enters the banking system.

The median includes:

- o The primary handling defined as the manipulation of the value in the banking organization at which the value enters.
- o The primary exchange defined as that which occurs when the value passes between primary banking organizations (e.g. the payee's and the payor's banks).

The core includes:

- o The secondary handling defined as the manipulation of value by organizations such as the Federal Reserve which act between the primary banking organizations.
- o The secondary exchange defined as that which occurs when value passes between secondary organizations (i.e., between two clearing houses or Federal Reserve Banks, etc.).

Figure 1 illustrates this process in its simplest form. In the peripheral transaction, the check is passed from payor to payee as a direct encounter, or is mailed in. Since during the CR-Maintenance Phase, it is assumed that most private mail delivery would be stopped, one of the principal means of completing such transactions would not be available. For the individual or business, the direct encounter would generally have to be used (e.g., personal delivery of payroll checks to employees, private courier services, direct payment for purchases in a retail store, etc.).

The entry of the check into the banking system most often occurs when the payee deposits the check into his own bank either by the bank's over-the-counter (OTC) service or by mail -- 82% of transactions are by OTC and 18% are by mail[10]. Payee's checks might also enter the banking system by mail directly from the payor, a frequently used option by large companies for payroll checks, dividends, etc. Here again, because of the stoppage of mails it would be necessary for the payor to make a direct encounter with the payee's bank. In this regard, it is worth noting that only about 2 to 3 percent of a bank's customers usually make use of OTC services in a day[11].

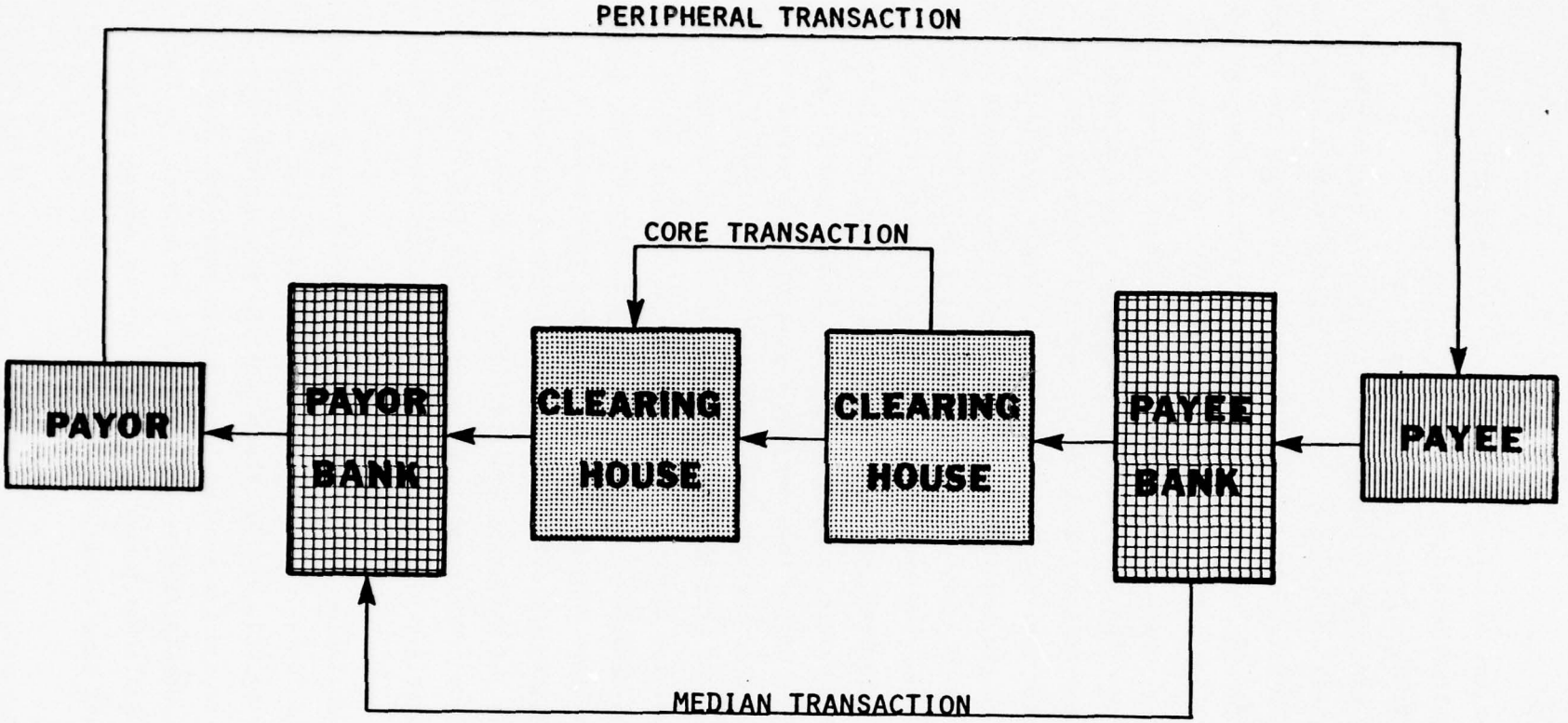


FIGURE 1 CHECKING SYSTEM PROCESS

CORE
MEDIAN
PERIPHERAL

Consequently, the use of this method of entry in emergency, when a large fraction of the depositors would be present at the same time, might easily exceed the normal OTC capacity of the average bank.

The primary handling of the item at the payee's bank begins with the receipt of the check or checks by the bank, together with a deposit slip. Depending upon the size, activity, and policy of the bank, the teller or other bank employee may or may not check the individual items and totals at this initial stage. This process usually takes 2 to 3 minutes[12]. The day's collection of checks and deposit slips from each teller's transactions is subjected to proofing and encoding. The total amount of each item is stamped next to the existing MICR* code, and all the items for each teller are added to assure that totals balance (i.e., totals on deposit slips equal totals on checks and bookkeeping tickets). The balanced or "proofed" work of each teller is reviewed and any necessary reconciliations are made. In an emergency, proofing could be done anywhere with the commercial type adding machine. However "encoding" is most often done with large encoder/sorters which are fixed installations in the bank offices.

The total work of the bank for the day is then processed via large, sophisticated computer sorter/readers which are also fixed installations. For smaller banks and branches, this step is usually accomplished at some larger bank or service center usually located in an urban (risk) area. The machine reads the MICR code and sorts checks and items by the thousands per minute. The auxiliary equipment units (magnetic tape units, high speed printers) record all MICR information passing through the system so that both tape records and hard copy are available. At the end of the batch, the printout is used to compare debit and credit totals (deposit slips and cash paid out) with credit totals (checks or cash received) and differences are reconciled.

Checks are sorted as required into: (1) deposit slips and other internal items, (2) checks "on us", (3) several separate sorts for transit items (checks on other banks), and (4) items that the machine cannot read[13]. For transit checks, totals for each destination are determined and a "cash letter" for each destination is prepared which represents the claim of the payee's bank on all other banks as a result of the deposit of the transit checks. The day's tape containing records of deposits is later merged with

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*Magnetic Ink Character Recognition.

the existing master tape or ledger recording the status of accounts from the preceding day, and a complete statement (hard copy) of all accounts is prepared for business on the next day. Such statements are forwarded from the processing center to smaller banks and branches by private courier service.

Transit checks and cash letters may be exchanged directly between banks (i.e., median activity), but usually pass through the core activity and are processed by a Federal Reserve Bank or commercial clearing house (i.e., core activity). Transmission of the checks is usually by private courier (air or ground). Most checks are written within 150 miles of the payor's bank (payroll checks of large corporations are a notable exception). Payor and payee banks in the same locality or region can clear checks through a single core activity center, although even in this instance, other agent banks (i.e., correspondent banks) can be involved. Where the banks are in different regions, more than one such center would generally be involved. In this instance, transmission of checks could be by mail or private courier. The continued function of such courier services during CR, at least on a regional basis, would be essential to continued functioning of the checking system. Without such services, local banks would be unable to receive credit and cash from financial centers for the checks deposited and would be unable to maintain services to their customers.

At the Federal Reserve bank or clearing house, totals on check bundles from the payee's bank are proofed against the total on the cash letter. Subsequently, the bundles are again run through sorter/readers, and checks are collected for each participating bank, together with totals to be deducted from the participating bank's accounts. Alternatively, individual banks may receive their checks directly from the Federal Reserve or clearing house while billing for the checks could be made against accounts of a correspondent bank.

Checks delivered from the clearing house to the payor's bank or bank headquarters are again processed through sorter/readers which sort checks and record information on magnetic tape. The tape is later processed through the accounting system where the new debit information is merged with the general ledger tape of the bank. Each morning the branches or unit banks

receive the updated accounts of each depositor. At these banks the checks are microfilmed and canceled, and the checks are filed to each account and returned by mail with statements to depositors at appropriate intervals.

These services result in substantial costs to the banks. Cashing and processing of a personal check over the counter are estimated to cost an average of about $0.30[7,14]. This cost includes teller time plus processing and general allocated overhead costs. Fees charged for this service to the depositor generally represent considerably less than one-half of the actual cost[13]. The banks make up the difference by interest earned on money in deposit. Changes in the services mix that might result from a crisis and the change in the opportunities to earn interest could increase the cost of delivering service and create losses to the banks. Recent work suggests that emergency OTC schemes for gas rationing might cost more than twice the normal costs per transaction[14].

Banks maintain comprehensive security procedures to prevent unauthorized or fraudulent transactions. These procedures include procedures used by tellers to identify customers in OTC transactions, validation of account balance, etc. Many banks maintain "alert" systems to provide other member banks with rapid information relating to bad checks received by the bank. In times of crisis, modified operational procedures could create opportunities for passing of unauthorized or fraudulent checks. Part of the planning for emergency would have to include review of procedures, and preparation to keep such occurrences to a manageable level (many banks will not accept checks for cashing from non-depositors).

Summary:

- o Check clearing requires the physical transfer of checks throughout the banking system.
- o Check clearing requires the use of large sophisticated computerized machines that are installed in major risk areas.
- o Many of the banking services such as accounting are provided to small banks (such as host area banks) by other larger banks and service centers located in the host areas.
- o Transfer of checks among banks in the same region is made generally by private courier (air or ground).

- o Cash is usually provided by the Federal Reserve or correspondent banks, and is also delivered mainly by courier. A limited amount is also delivered by mail.
- o Local and regional check services could be provided under controlled conditions but at significantly increased per item costs.
- o Completion of the check clearing process probably could not be accomplished during CR because of the shutdown of financial installations in risk areas.

2. Banking in Colorado and Colorado Springs Area

Colorado commercial banks are organized on the unit banking system rather than branch banking as in some other states. Many of the banks in Colorado are part of holding companies: 51.2 percent of the deposits are in banks controlled by Colorado's seven multi-bank holding companies; and 72.7 percent of the deposits are in banks controlled by Colorado's 61 single and multi-bank holding companies[15]. Under this system, the larger bank or banks in the group often provide services such as check processing for the other smaller members. Customers of the smaller banks in non-risk areas tend to be drawn from local business and residents although some of the larger companies from the major cities (such as utilities, dairies, etc.) often open secondary accounts in outlying areas where they do business. Customers of the larger city banks tend to be drawn from every source -- local city, outlying counties, out-of-state, and foreign areas. Larger banks in Colorado Springs and other major cities also act as correspondents to smaller independent banks in surrounding areas, providing check processing, currency, loans, and other services. Commercial service centers are also located in Colorado Springs and other cities to provide accounting services for smaller independent banks in host and risk areas.

The size and service capacities of host area banks in Colorado are much smaller than those of risk area banks. One measure of this disparity is the comparative distribution of total assets and total demand deposits between metropolitan and non-metropolitan area banks. Table 1 presents comparative information for all commercial banks in Colorado. Metropolitan area banks have 74 percent of total assets and 78 percent of demand deposits. The predominance of Denver as the financial center of Colorado is illustrated

by the fact that total assets and total demand deposits in Denver are 63 percent and 65 percent of the State totals, respectively. Colorado Springs is a much smaller financial center than Denver with assets and demand deposits only about one-tenth those of Denver[16].

Table 1

COMMERCIAL BANKS IN COLORADO -- ASSETS AND DEMAND DEPOSITS

Factor	State	Colorado Springs	Denver	Total Metropolitan Area	Total Metropolitan Area % of State
Total assets (billions)	$ 8.77	$0.62	$5.56	$6.46	74%
Total demand deposits (billions)	3.43	0.24	2.23	2.57	78%
Number of banks	277	21	94	124	45%

	Average Demand Deposits (billions)	Average Total Deposits (billions)
124 Metropolitan area banks	$0.021	$0.052
153 Non-Metropolitan area banks	0.0056	0.015

Source: Bank Operating Statistics, Colorado FDIC, 1975.

The disparity in individual cases can be even more striking. For example, the Park State Bank (in Woodland Park, Colorado) with assets of $6 million processes about 1000-3000 checks per day[17] while the First National Bank of Colorado Springs with assets of $167 million processes between 40,000 and 70,000 checks per day[18]. These disparities in capacities together with the possible increase in the demand for OTC services during crisis point to a significant problem of providing services in host areas subsequent to a crisis relocation.

Table 2 shows relative capacity (measured in terms of deposits) of host counties around Colorado Springs with respect to the risk area county (El Paso) containing Colorado Springs. The totals indicate that total deposits (time deposits) of host counties are less than one-fourth of the total deposits of the risk area.

Table 2

COMPARISON OF DEPOSITS IN COLORADO SPRINGS RISK AREA

WITH ASSOCIATED HOST AREAS

	Total Deposits ($ million) (Less Time Deposits)
Total for State of Colorado	$2340.1
Host Counties	
o Teller	2.1
o Fremont	16.1
o Chaffee	6.6
o Gunnison	6.5
o Saquache	3.7
o Rio Grande	7.0
o Mineral	Neg
o Archuleta	1.6
o Conejos	3.5
Total for Host Counties	$ 47.1
Risk Area (El Paso County)	
Ratio deposits Risk to Host	4.25

Source: Bank Operating Statistics, Colorado, FDIC, 1975.
Neg - negligible.

The possibilities for expansion of service in host area banks is limited by the availability of tellers, vault cash, accounting support, and security problems. Small banks in host areas around Colorado Springs probably could increase use of part-time tellers normally working for their banks. The Canon City and Park State banks indicated that they had "two or three people" that they could call in an emergency[17,19]. The Federal Reserve comments suggest that tellers from the risk area might be able to work in host area banks.* Bank supervisors and officers have also been known to act as tellers in an emergency. With such augmentation of the work force and overtime work, it is estimated that OTC service might be doubled. It is questionable, however, whether such an expansion would meet the needs of the banks' depositors let alone the possible check cashing demands of evacuees from risk areas.

Maintenance of sufficient vault cash to meet check cashing demands in times of emergency would also be a problem. On the average, banks maintain about 9 percent of demand deposits in vault cash. Smaller banks such as those in the Colorado Springs host areas are limited on amounts of cash on hand by the terms of their insurance policies[19]. These increased OTC demands on the host area banks for currency would place additional requirements for financial services nominally located in risk areas--in particular, requirements for increased amounts and frequencies of cash transfers primarily from Federal Reserve banks and possibly correspondent banks. Also, courier services normally headquartered in risk areas would have substantial shifts in the level and distribution of service demands, requiring major changes in delivery routes and work schedules.

The need for timely updates of deposit account balances would also create demands on risk area financial services. For example, the First National Bank of Canon City and the Park State Bank of Woodland Park (host areas) make use of the services of Kaman Sciences in Colorado Springs for daily accounting, including updating of balances on demand deposit accounts. Records of the day's transactions are forwarded by the banks to Kaman Sciences each day by private courier. Updated records in hard-copy format are returned by private courier the following morning. Interruption of courier services or shutdown of service centers would prevent account updating since neither bank has procedures for manual updating of accounts.

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*See Appendix A for comments of Federal Reserve Bank of Kansas City.

Increased security problems would be associated with transit checks (i.e., either those accepted by bank customers and deposited, or personal checks received from non-depositors over the counter). The areas around Colorado Springs receive many tourists, and as a result, banks receive a high level of invalid and fraudulent transit checks. Small banks in these areas will generally not accept checks from non-depositors. Check cashing services can be arranged by means of a letter of credit or a bank preferred customer card[17,19]. Letters of credit can be forged so that in emergency such instruments might have to carry additional means of verification such as photographs or fingerprints[20]. Other security approaches in current use might be inadequate in emergency. Member banks in and around Colorado Springs have implemented a "check alert system" that warns all member banks about current bad check events experienced by each member bank[20]. Because of the dependence of the system on telephone communication, and the possible unavailability of staff and records of some banks, this system as currently configured probably would not function well during a CR situation.

The check clearing process for banks in Colorado is similar in its essentials to the process described earlier. Colorado banks may forward transit checks directly to a clearing house of the Federal Reserve bank in Denver. They may also deal directly with each other or through correspondent banks to transfer checks and settle accounts[21]. The principal route, however, for banks in and around Colorado Springs is for checks to be processed through the Federal Reserve or commercial clearing house in Denver. The distribution of transit checks for collection in Denver is: local clearing house or bank 31%; other (non-local) commercial bank 13.2%; Federal Reserve banks 53.7%; other 2.0%[23]. Transit checks are transported by private courier to Denver, often by private aircraft. The use of private aircraft in this area of the country during a CR emergency is likely to be quite restricted.

The check processing activity in Colorado is highly automated as in other parts of the United States. The Denver branch of the Federal Reserve Bank of Kansas City processes checks and other items for many member and non-member banks in Colorado[21]. The latest generation of high speed sorter/readers is used (IBM 3890). This equipment has the capacity to process 125,000 items per hour. Utilization of the equipment is normally high (i.e., 1.3 million items per day) but some expansion in processing

could be achieved if required (e.g., 2.1 million items is the highest level recorded in one day at the Denver Federal Reserve)[22]. The sorter/readers and associated peripheral equipment and office space occupy an entire floor at the Federal Reserve and could not be moved quickly to a non-risk area. Other clearing houses in Denver use sorter/readers of equal or lesser capacity (i.e., in the range of 70,000 to 125,000 items/hour)[21].

The Federal Reserve bank in Denver is currently processing items for 20 hours per day. Items from the Denver area ("city items") are processed five days a week; items from other areas ("country items") are processed six days per week[21]. For short periods of ten days to two weeks following an emergency such as CR, the system could probably boost production to near a maximum of 3 million items per day. However, the system would probably experience a greater downtime for service (now two hours per day). Also, the error rate on checks would go up considerably, creating an "adjustment" problem for a period of months thereafter[22]. Nevertheless, it would appear that an accumulation of items during CR could be worked off relatively rapidly after start-up of the system in the CR-Reconstitution Phase.

C. Characteristics of Credit Card Systems

The credit card system is a process for recording of information on purchases (generally retail), for monthly billing, and for payments. The purchaser receives credit during the collection period, while interest and service charges are generally absorbed by the retailer out of the purchase price. About 16 percent of retail purchases are made using some form of credit card[7]. Usage rate is quite variable, depending on type of purchase, with over 50 percent of car and truck rentals paid by credit card and virtually none for purchases in grocery stores[7]. In 1973, there were about 5 billion credit card transactions in the United States[7]. The proportion of the population using non-gasoline credit cards is high but by no means universal: two-thirds of median income families use credit cards but only one-third of poverty level families[24]. Categories of individuals who carry credit cards are shown in Table 3.

Table 3

CATEGORIES OF INDIVIDUALS WHO CARRY CREDIT CARDS*

	Carry	Don't Carry	Not Sure
1970 Total Public	54%	46%	0%
1972 Total Public	50	49	1
Male	48	52	†
Female	52	47	1
18 to 20	20	79	1
21 to 34	57	42	1
35 to 54	60	39	1
55 and over	42	58	†
Income Under $6,000	23	77	†
$6,000 to $9,999	50	49	1
$10,000 to $14,000	70	31	†
$15,000 and over	74	25	1
White	55	44	1
Non-White	25	74	1
Savings Bank Customers	54	45	1
Savings and Loan Customers	63	36	1
FSB Customers	63	36	1
1970 Total Leaders	87	13	0
1972 Total Leaders	82%	18%	0%

*From the 1972 Louis Harris Survey in addition to overall figures on a sampling of leaders.

†Less than 0.5%

Source: ABA Bank Card Letter, October 1972.

Types of cards have been categorized as follows[7]:

- o Bank Cards
- o National Independents
- o National Private
- o Local Private

The bank card is issued by providers that are part of the general payment system. The two major bank cards are BankAmericard and Master Charge. Cards are issued by individual local banks operating under a franchise type of arrangement with a national bank card organization. For both systems, key banks (generally in risk areas) and regional associations perform the functions of clearing sales tickets and managing regional credit verification information systems. Of the 14,000 banks in the United States, about 13,000 offer some form of credit card plan. About 1000 of the banks are principal banks involved in financing the operations. The total amount outstanding on bank credit cards (1976) was about $10 billion[25] including loans made on credit card accounts. The average purchase was $22 in 1974[7]. About 40 million bank credit card accounts are in force with about 25 million being considered active accounts (i.e., some purchases during the preceding month)[7].

National Independent cards serve the same function as bank cards, but the service organizations are not part of the national payment system. Examples include American Express, Diners, and Carte Blanche. National Private cards are oriented to specific products, services, or organizations. Included in this category are petroleum companies, airline travel cards, national retail store chains, hotel chains, etc. Local Private cards are issued by local retail merchants for credit purchases with the issuing firm[7].

The credit card purchase clearing process is similar in most respects to the check clearing process. Any card holder may transact credit purchases with merchants affiliated with any member bank.

The retailers may be required to obtain "on-line" verification and authorization of the purchase. Centrally located computers (in risk areas), which are contacted by the retailer via telephone lines, provide information on the card and amount of purchase. Generally there will be some minimum amount above which the retailer must obtain verification (e.g., $50). The computer system will check the cardholder's records and determine whether the card is valid, whether the total amount outstanding is within authorized limits, and

other pertinent data (e.g., number of purchases on same day). Validated transactions are then completed with the completion of the sales draft form. The capacity of these on-line validation systems is sufficient for normal use. However, the systems can be overloaded on occasion (e.g., holidays) when larger than usual numbers of transactions are undertaken[11]. Use of the validation system during crisis would therefore be infeasible because of the limited capacity of the computer system as well as the limits on the capacity of communications systems.

Generally at the end of the day, the sales drafts are deposited by the retailer at a nearby member bank. At this time, the retailer's account is credited with the total of the sales drafts less a discount. The member banks process all such sales drafts at par value and present the batches of drafts at a regional clearing house, or credit card association service center for payment. At the clearing house or service center, the sales drafts are sorted and totalled for each card holder's bank, and the batches are presented to the card holder's bank for payment. The card holder's bank sorts and processes the drafts and mails drafts and statements to each card holder at appropriate intervals[6].

Processing costs for credit card sales tickets are considerably higher than for checks. A recent study[26] indicated the total cost of an "on-us" sales draft through the Atlanta system to be 54.6 cents. This cost was divided into two main parts: (1) the direct merchant account, processing, and billing component equal to 15.3 cents; and (2) the cost of 37.2 cents per sales draft for authorization and fraud and credit losses*. Individual authorizations were very expensive--68 cents each. However, on the average, only a small fraction of the sales drafts were subject to authorization. The cost of clearing such a draft through an interchange system would add considerably to the total cost per item.

D. Economic Exchange in All Crisis Relocation Phases

1. Alternatives to the Existing Payment Mechanism

The previous section has reviewed the existing system of processing payments, noting the comparative cost of check and credit card transactions. This section discusses the merits of altering that system to cope most effectively with the specific problems of crisis relocation and reconstitution. These problems are briefly listed; they in turn suggest several

*Other costs not identified

criteria by which to evaluate any alternatives to the existing payment system. These alternatives are then examined with reference to the suggested criteria.

The problems introduced into the payment system by crisis relocation stem basically from the interruption of the normal processing flow of check and credit card transactions and the breakdown of security in both the formal and informal credit markets. The processing interruption comprises problems ranging from the dramatically increased withdrawal from demand deposits to the large backlog of unprocessed check and credit card transactions occurring during CR. The breakdown of security comprises problems ranging from the decreased availability of informal credit markets (e.g., check cashing at the local grocery) to the increased security necessary if most transactions switch from check and credit cards to cash.

To determine the most desirable alternative to cope with these problems requires a multi-faceted evaluation. The evaluation criteria must contrast the strengths and weaknesses of each alternative to the present payment system. A brief review of these criteria precedes the discussion of the alternatives themselves.

In order to implement a change in the payment mechanism prior to crisis relocation, the banking and credit industry at the time of relocation must have sufficient capacity to permit the required exchange or transactions. For instance, if depositors were allowed or encouraged to exchange their demand deposits for cash, the number of tellers would have to be sufficient to cope with this increased demand on OTC transactions. Similarly in the CR-Reconstitution Phase, the proposed system should have the capacity to process the backlog of transactions efficiently and quickly.

The integrity of the credit market relies on accurate accounting. Consequently, an important evaluative dimension is the ability to record the transactions accurately and to update accounts swiftly. Credit market integrity also relies on the uniform acceptance of the payment medium; a substantial lack of acceptance or the requirement of considerable collateral identification slows the process of exchange and may even make many transactions impossible. Of course, security against theft, embezzlement, or fraud are also important elements of credit market integrity. A balance between security and acceptance is necessary: the more widely, easily, and quickly a given payment medium is exchanged, the more likely the chance for fraud or theft.

The evaluation should extend beyond the financial market to the impact of the payment mechanism alternative on the distribution of goods and services in the relocation period. Some mechanisms such as invoices are particularly well-suited to integrate with the expected distribution system. Furthermore, the evaluation should also extend in time beyond the relocation to the reconstitution period. This criterion is very critical: if the time given for payment is short, the bank must honor the depositor's check quickly, with greater strain on the bank. A sudden deluge of checks early in the CR-Reconstitution Phase would cause serious problems for many banks. They might be forced to liquidate their government securities at heavily discounted prices.

Finally, the payment alternatives should be equitable both across economic classes and across the different types of institutions--retail merchants, credit card companies, banks, etc.

2. General Approaches

The principal objectives guiding the implementation of payment mechanisms are:

1. Assure that everyone receives essential goods and services.
2. Keep the distortions of host area economy to a minimum.
3. Minimize the economic start-up problems associated with the post-CR period.

Three general approaches can be considered for use in all crisis relocation phases. They are: (1) direct cash payments, (2) deferred payments, and (3) free goods and services. Direct payments would include the use of currency in making purchases, the use of bank checks (i.e., cashier's checks, etc.), or the use of personal checks. Deferred payment schemes would include the use of credit cards (standard or "universal") or the use of some invoice scheme. Free services are generally taken to mean the provision by a government agency of essential goods and services to those desiring such assistance.

A general pattern of advantages, disadvantages, and implementation requirements is associated with each approach (see Table 4). Direct payments schemes (with the exception of personal checks) would generally

Table 4

GENERAL APPROACHES FOR ECONOMIC EXCHANGE IN ALL CR PHASES

Payment Mechanism	Description	Major Advantages	Major Disadvantages	Implementation Requirements
Direct cash payment o Currency o Bank generated checks	Depositors receive limited check and currency OTC at banks in host areas	Merchant acceptability Financial control Minimum accountability	Depletion of liquid assets OTC capacity overload Security problems No benefit to non-depositors	Simplified OTC procedures and accounting Modified Federal Reserve support procedures Revised courier activities Risk Area bank move to host area
o Personal checks	Personal checks given for purchases Possible limits on maximum check values	Easily implemented at retail level Reduced physical security problems	Limited financial control Depletion of assets Low merchant acceptance, especially of evacuee checks Increased fraud limited to DD holders	Planned deferral and check clearing Cash supply by Federal Reserve Simplified updating of merchant accounts
Deferred Payment o Regular credit cards	Cards used in retail purchases Possible limits on amounts and authorized merchants	Easily implemented for some retail purchases Reduced physical security Reduced depletion of assets	Not currently used by grocery stores Excessive charges Major increases in credit outstanding Limited acceptability Increased fraud Limited to credit card holders	Preparation for use at government centers Preparation of measures to control use
o Universal credit card	Cards provided to all for credit purchases Backed by Fed. Govt.	Serves all on master list Reduced depletion of assets Reduced physical security	Implementation problems Requires use control Post-CR repayment Privacy problems High fraud rate	Pre-printing of cards and forms Regional storage Maintenance of cards Distribution of cards in crisis Development of data base

Table 4 - (concluded)

Payment Mechanism	Description	Major Advantages	Major Disadvantages	Implementation Requirements
Invoice system	Individual purchase using standard invoices at authorized outlets	Reduced depletion of assets Covers entire population Covers physical security requirements	Extensive controls required to limit transactions Applicable only at government subsidized outlets Post-CR payment delays Implementation problems	Development of data system and forms Training of staff Processing of forms in post-CR period
Free government services	Government essential at authorized locations	Reduced depletion of assets Provides for entire population Fewer security problems Low accounting requirements	Large increase in government costs Slow post-CR payment Requires external control to limit use Possible credibility loss for normal payment merchant Fraudulent use of invoices Reduction in host areas economic activity	Development of invoice system Control of demand Accounting system

be the most widely accepted by merchants and would maintain the merchant's liquidity for conducting business activity. Such schemes, however, put a considerable strain on the banking system. They are associated with a rapid depletion of bank assets, creating problems of liquidity and bank viability, which would require greatly increased support from the Federal Reserve. Also, bank operating procedures would be overtaxed in meeting the demand for services and would require major expedient measures such as limiting services and amounts withdrawn, relocation of bank activities to host areas, and other measures. Depletion of individual assets would also occur which could delay the recovery during the post-CR period.

Deferred payment schemes have the advantage of preventing the rapid depletion of bank and individual assets during the CR-Maintenance Phase. However, such schemes would be less acceptable to individual merchants and might require limitation of exchanges to government operated or government authorized outlets. Normal systems of validation of charges might not function effectively so that possibilities of fraud and excess credit charges would be difficult to control. Regular credit cards might not be usable for some essential goods unless extensive preplanning were accomplished and implemented (i.e., grocery stores do not usually belong to a credit card system). Standard credit cards would be useful only for those people who were normally part of the system, while others would not be helped by this means of exchange. The universal credit card, which has been suggested to be government issued to everyone during crisis, has serious implementation problems. An extended period of time would be required to develop a reasonably complete data base, produce the required cards, store them in regional locations, maintain the cards and data current, and distribute such cards during emergency.

Invoice systems might be a more practicable system for deferred payment. An invoice system (machine coded) could be devised to record exchanges made by individuals. The invoice could be accompanied by some form of identification card or punch card for recorded specific events of receipt of goods and services. Because of implementation and control problems, such a system would probably have to be restricted to use at government controlled or authorized outlets and for essential services only.

Free services provide a simpler approach to many of the problems. There would be no need to make records of individual transactions although aggregate service provided would have to be recorded for ultimate reimbursement of the group or agency. Also, some method would be required to limit individual use of the system to assure efficient and fair distribution of goods and services. Such a system would reduce or eliminate the depletion of individual assets, but a corresponding increase in government expenditures would result. Timely payment by the government for such services in the post-CR period would be necessary, to permit a rapid transition to the CR-Reconstitution Phase. Without the presence of some other payment mechanisms, host area economic activity could be hampered by government delay, while most host area residents might become dependent upon the free service system, further increasing its costs. Universal use of the system might also tend to break down the credibility of the standard payment mechanism during and after CR.

3. Detailed Criteria for Evaluating Alternatives

A number of detailed criteria have been established for evaluating the various payment mechanism alternatives. Note that in the alternatives (Cases I to VII) presented below, "Transaction Recording and Processing" refers to the difficulty of accurately recording and processing the transaction, and "Acceptability of Transaction" refers to the degree of acceptance by given agents of the particular type of transaction.

Case I: Use of Cash Obtained Directly from Banks

o Description

Depositors would obtain cash from their own banks in the host area (or in the risk and host areas during the pre-CR Crisis Phase) by OTC procedures. Risk area banks might be relocated by use of trailers, etc. in the host area. The cash would be used to pay merchants at the time of transaction. Limits on withdrawals would be advisable.

o Capacity of Banks

- For check cashing, the capacity of host area banks would be inadequate to service both customers and risk area depositors. With adequate warning, risk area banks would probably schedule orderly withdrawals for their own depositors.
- For check cashing, risk area banks would need to be moved to the host area if depositors did not make withdrawals before relocation.
- For check clearing, standardized and simplified OTC and check processing procedures would be needed to meet increased demands.

- Number of checks cashed during relocation would be lower than normal and therefore check clearing backlog could be conveniently processed in the post-CR period.

o Transaction Recording and Processing

- Disruption of account updating services would prevent normal monitoring of individual account balances. Manual procedures do not generally exist in banks. The mechanism would be feasible for a bank's own customers, assuming that standardized and simplified OTC and accounting procedures were used.

o Acceptability of Transaction

- For merchants, cash payment would be the preferred medium of exchange.
- For banks, inadequate cash reserves would require considerable increased borrowing at the Federal Reserve.
- For banks, the impaired OTC processing would possibly require a Federal guarantee against losses.
- For individuals, the check cashing might entail long service times.
- Currency would encourage host area residents to offer services to risk area evacuees.

o Security

- Disruption of normal validation procedures would create opportunities for increased fraudulent transactions.
- Disruption of normal bad check security arrangements would create increased lag time in identifying bad checks.
- Great increase in cash distribution to host areas would create physical security problems.

o Stability

- Unless the Federal Reserve allowed substantial increased borrowing, most banks would have insufficient funds to honor depositor withdrawals.
- Because of cash shortages, banks might attempt to recall short-term loans which would destabilize business.
- If individuals continued to prefer cash transactions during post-CR, the money supply would be reduced with a consequent reduction in economic activity.
- Depletion of individual and business liquid assets during CR would create severe cash-flow problems in the post-CR period.

o Equity

- The system directly serves only bank depositors.
- Unless strict limits were placed on withdrawals, wealthier customers would have an advantage in making purchases.

o Integration with Distribution of Goods and Services

- Without controls, the combined demand by the evacuee and host area populations could drive up prices and reduce stock of available goods.
- Excessive competition might occur between host area population and evacuees for host area goods and services.
- Cash transactions would not require recording of prices and might allow merchants to exceed posted prices.

o Financial Control over Credit

- Control over the amount of money paid out to depositors by banks would be questionable.

o Implementation Requirements

- Bank preplanning would be required, including emergency control procedures for cash dispensing in either risk or host areas.
- Management of banks' assets would be difficult, possibly requiring measures such as a moratorium on collection of short term loans to businesses and individuals.
- Revised procedures, schedules, etc. for Federal Reserve, courier services, etc. would have to be provided.
- The Federal Reserve would need modified procedures for supporting banks' need for funds.

Case II: Bank Guaranteed Checks (Cashier's Checks, Certified Checks, etc.)

o *Description*

Depositors would be provided with bank guaranteed checks, covering minimum subsistence needs and within deposit account balance. The checks would be used for direct purchase at host area retail stores, government service centers, etc. Amounts and rate of cashing would be controlled by banks (e.g., fixed amount, post dating, etc.). Risk area banks might need to move to host area to accommodate depositors.

o Capacity of Banks

- OTC service times to obtain bank authorized checks would be greater than under the cash alternative (Case I). As a result of increased service times, bank operating capacity might be exceeded.
- Handling capacity for merchants' deposits of checks and for provision of account credit would be increased.
- Fewer individual checks would be cashed and processed than in normal period, so that the processing backlog would be manageable in the post-CR period.

o Transaction Recording and Processing

- As in Case I, manual account updating would be needed.
- Interruption of check clearing process would delay debiting and crediting of "transit" checks which would create problems in updating merchants' accounts.

- Amounts drawn against merchants' accounts could be limited, although merchants might also be given guaranteed checks. An expedient regional check clearing process could simplify the accounting problems.

o Acceptability of Transaction

- Merchants might regard guaranteed checks as less negotiable than the currency in Case I.
- Merchants would need to keep additional currency on hand to cash these checks.
- Depositors would need to wait in line longer than in the cash alternative of Case I.
- This system would be unacceptable to non-depositors if it were the only payment mechanism in use.

o Security

- Fraudulent cashing of checks would likely increase because of identification problems, counterfeiting, disruption of security networks, etc.
- Delays would occur in identification of fraudulent "transit" checks and of counterfeited bank authorized checks.

o Stability

- Bank and individual assets would be depleted less rapidly than in Case I because accounts would not be debited until check returned to bank.

o Equity

- Non-depositors would not receive guaranteed checks.
- Host area residents might have some advantage with local merchants.

o Integration with Distribution of Goods and Services

- Integration would be essentially the same as for cash, except for difficulty in making change on retail purchases.
- There would be merchant problems in making essential payments (payroll, etc.). Full payment might have to be deferred and workers as well as evacuees might have to be limited to a regulated amount of bank authorized checks.

o Financial Control of Credit

- Control would be possible over the amount paid out by banks to depositors.

o Implementation Requirements

- New OTC procedures would have to be devised.
- Modified Federal Reserve Support procedures would be needed.
- Risk area banks would have to move to host areas.

Case III: Personal Checks Used Directly for Purchases

o Description

This would be the normal system of check use except for possible limits on the maximum dollar amount of any given check. Also, use might be limited to controlled centers and outlets.

o Capacity of Banks

- There would be a lower demand for OTC services than in Cases I and II.
- Volume of check processing and account updating would be higher than in Cases I or II and would create a substantial processing backlog for the post-CR phase.

o Transaction Recording and Processing

- The banking system might be unable to clear checks until the post-CR period, and depositors' accounts would therefore not be updated.

o Acceptability of Transaction

- Because they do not normally accept checks from outside area banks, host area merchants would find personal checks less acceptable than guaranteed checks or cash.
- Depositors would have difficulty cashing checks.
- This system would be unacceptable to non-depositors if this were the only payment mechanism used.

o Security

- There would probably be a much larger potential for fraudulent transactions than in Cases I or II because security networks and check validation procedures would be disrupted.
- Because personal checks are less negotiable, there would be greater security in their storage than in Cases I or II.

o Stability

- Delay in check clearing would give banks additional time to cover the checks.

o Equity

- Only demand deposit holders would be directly served by this payment mechanism.
- Checks of host area residents (regular customers) would likely be more acceptable to local merchants than checks of evacuees.

o Integration with Distribution of Goods and Services

- Less control could be exercised over check amounts than in Cases I and II, and larger excess demand could be created in host areas, taxing the distribution system.
- The necessity of limiting fraud could increase service times.

- o Financial Control Over Credit
  - Control over credit would be less centralized than in Cases I and II and would depend on the merchants' willingness to accept personal checks.
- o Implementation Requirements
  - This system would be easily implemented since it is merely a continuation (under minimal constraints) of the current checking system.
  - Expedient check clearing and accounting systems might be required.

Case IV: Existing Credit Cards

- o Description

  Private credit cards would be used to make purchases from retail merchants or government authorized outlets.
- o Capacity of System
  - Systems for validating purchases would be inadequate to handle increased number of transactions.
  - This mechanism would be feasible if purchases were limited to below validation threshold and item processing were deferred until post-CR period.
- o Transaction Recording and Processing
  - No method exists for determining whether total charges of an individual exceed the authorized limit.
  - Items could be processed and billing could be undertaken subsequent to the crisis period although there would be a substantial backlog.
- o Acceptability of Transaction
  - For merchants, acceptability would be the same as for Case II if the credit card system were to guarantee purchases under the authorization level, but there would be questionable acceptance by credit card organizations because of difficulty in controlling use.
  - This system would be unacceptable to non-card holders.
- o Security
  - There would be greater numbers of individuals exceeding credit limits.
  - Fraudulent use of credit cards would increase with loss of authorization system.
- o Stability
  - Credit card purchases would defer payments for an even greater period than in Cases I, II or III.
  - The total amount of credit extended might exceed the ability of card holders to repay within the time demanded in the post-CR period.

- o Equity
  - This system serves only credit card holders.
  - Use of only this system would exclude purchase of certain goods (e.g., groceries).
- o Integration with Distribution of Goods and Services
  - Purchases could not be directly regulated through a credit card system, resulting in increased demand and maldistribution of essential goods.
  - Recording of prices in transaction might act as a deterrent to unlawful price increases.
  - Only stores accepting credit cards would receive payment.
- o Financial Control of Credit
  - Total charges could exceed the previously authorized credit levels for individuals or for the system as a whole.
  - Control would be feasible if used with a rationing system, or at a specified government service center or other government authorized outlet.
- o Implementation Requirements
  - For real effectiveness, credit cards would require extension of use to some categories of essential goods (e.g., grocery stores).
  - Preplanning would be required for use in government authorized outlets.

Case V: Universal Credit Card

- o Description

  A credit card would be issued to everyone during the crisis for use in making purchases (alternatively, the card would be used at government authorized outlets, or at all private merchants). The Federal government would pay the cost of processing the transaction record but the processing itself would probably be contracted out. Purchases of essential goods below the authorized level would probably be guaranteed by the government.

- o Capacity of System
  - Without notice of intended issuance, credit card manufacturing capacity would be inadequate to make needed cards (100,000,000) during the crisis. Long lead time would be necessary to make and store cards throughout the country.
  - The processing backlog would be considerable because the card holder identifying information would probably not be stored in advance by the processing card agency.
- o Transaction Recording and Processing
  - Final accounting might be delayed by large volume of transactions.
  - A high level of error might be expected in billing individual purchases.

- o Acceptability of Transaction
  - Merchants would probably prefer cash or guaranteed checks and possibly even regular credit cards because they might think payment would be more rapid.
  - Acceptability to merchants would depend upon prompt crediting of purchases to their accounts, and upon availability of account balances.
  - Individuals would prefer the card because it would defer payment longer than in Cases I to IV.
- o Security
  - If the card were easily transferred or duplicated, there would be a potential for fraudulent use in transactions by individuals trying to escape payment in the post-CR period.
  - The system would reduce physical security problems in storage since cash use is not involved.
- o Stability
  - This system would defer payments more than those in Cases I to IV and thereby would slow depletion of demand deposits.
  - Consumer debt could be significantly increased but pressure for early payment might be less.
  - Slow payment of merchants by government would impede post-CR recovery.
- o Equity
  - The card would not serve those not on the Federal government's master list.
  - If the card resulted in increased net credit being granted, it would increase the CR period demand for goods.
  - Advantages would be given to those who used currency to augment card acceptability (especially if there was reduced confidence in government repayment).
- o Integration with Distribution of Goods and Services
  - Possible excess demand could interfere with distribution.
  - Within purchase limits specified, the card would be usable at all installations providing goods and services.
  - The card would integrate well with government distribution center activity.
- o Financial Control of Credit
  - This system would probably increase the total quantity of credit outstanding unless the number of purchases and purchase points were carefully controlled (e.g., addition of rationing, or transactions through a selected few authorized outlets).

o Implementation Requirements

- There would be a problem of assembling the data to produce the cards. (Current data bases such as IRS are incomplete.).
- This card would require implementation and distribution to regional centers in peacetime prior to crisis.
- There would be organizational and financial requirements in maintaining the system prior to crisis (i.e., updating cards, etc.).
- There would be a problem of distributing such cards during crisis to proper individuals.
- In order to respect privacy, the system would require prior authorization of individuals.

Case VI: Invoice System

o Description

A standardized invoice form would be provided at authorized outlets as the basis for purchase of essential goods and services. Invoices would be processed later and the purchaser would be billed by the government. The Federal government would pay the cost of processing the transaction record but the processing itself would probably be contracted out. The Federal government would guarantee payment to merchants as is done currently by card agencies. Charges below the authorized level would be guaranteed by the Government. Thus, the invoice system would be similar to a card system and would have the advantage of being issued on-site to all users.

o Capacity of System

- The time and cost of post-CR processing of invoices and mailing of bills might be considerable unless a pre-crisis system were established. Processing capacity could be reduced by accumulating charges on one invoice during CR at a designated outlet for each individual.

o Transaction Recording and Processing

- Large volume could delay completion of accounting.
- Accounting controls would be necessary to ensure that invoices submitted were valid charges.

o Acceptability of Transaction

- Merchants would probably have no preference between invoices and the universal card (Case V) but would prefer Cases I to IV because of faster perceived payment.
- Relative to all parts except Case I (currency), this system might encourage participation for payment by private citizens in CR activities (i.e., offers of housing, etc.) if they were issued invoices to use.
- Individuals would prefer invoices because it would defer payment longer than in Cases I to IV.

- o Security
  - Individuals providing false information might make later collection difficult.
  - Security storage problems would be minimal because the invoice would not be negotiable and individuals and organizations would need only limited banking activities.
  - Fraudulent claims for payment by merchants after CR might be widespread unless subject to some control.
- o Stability
  - Deferred payment would slow the depletion of personal assets.
  - Control of purchases would reduce the extension of credit and consequent depletion of banks assets.
- o Equity
  - This system would be available to all persons, but only for essentials.
  - Unauthorized use of cash or credit could lead to inequities.
- o Integration with Distribution of Goods and Services
  - Purchases could be limited to authorized distribution points.
  - Controls would be needed to prevent unauthorized distribution.
- o Financial Control of Credit
  - If the invoice system could restrict purchases at non-authorized distribution centers, control over credit would be relatively tight.
  - Slow post-CR payment and delays in government billing could cause slow economic recovery.
- o Implementation Requirements
  - Forms for invoices in machine readable form must be designed before CR (they might be incorporated with the relocatee registration form).
  - Training on filling out forms at relocatee registration centers or elsewhere must be undertaken in pre-CR period.
  - Processing of invoices after CR could be accomplished by commercial service centers, Treasury Department, or others over a period of time.
  - Procedures for limiting individual and family purchases would be required.

Case VII: Free Government Services

- o Description

  Essential goods and services would be provided by government to evacuees and host area residents free of charge. Control would be exercised on amounts of goods and services delivered to any individual.

- o Capacity of System
  - Capacity would be limited by the size and experience of available staff.
  - Post-CR processing could be accomplished by regular commercial service centers.
  - Banks' involvement would be minimal.
- o Transaction Recording and Processing
  - No accounting would be needed on transactions involving individuals.
  - Records of total services provided and invoices made to suppliers would be maintained.
- o Acceptability of Transaction
  - If services were delivered equitably and without excessive queues, individuals would accept the system.
  - Participation of private merchants would be restricted.
  - Invoices to wholesalers would be acceptable, provided that invoices were guaranteed by government and that wholesalers' current cash flow needs were met.
  - Host area workers might need incentives to render the system acceptable.
- o Security
  - Physical security would have to be provided to government procurement offices and authorized outlets.
  - Required transactions and their occurrences at the wholesale level would tend to reduce opportunities for fraud.
- o Stability
  - Excess demand for essential goods could be minimized.
  - The system would cause no immediate use of financial assets.
  - A very large increase in government expenditures would have to be absorbed later through taxation or inflation.
  - Slowness in government payment of invoices in post-CR period could slow rate of recovery.
  - Normal payment mechanisms might lose credibility if everyone would tend to avoid payment for goods and services during and after end of CR. However, if free services were given only in a controlled setting, the credibility loss would likely not be large.
- o Equity
  - If identification cards were provided and checked when receiving goods or services, the system should be equitable with respect to essential services.
  - Excess demand from those with cash or acceptable credit for non-essential goods would create some inequities.
- o Integration with Distribution of Goods and Services
  - Since individual transactions would not be recorded, saving of time could expedite delivery of goods and services.
  - Distribution system would require records of aggregate services for reimbursal.

- o Financial Control of Credit
  - Since there would be few retail transactions for essentials, control would be relatively good.
  - Wholesale transactions would be controlled by government vouchers.
  - Suppliers would require at least minimal access to cash for essential payments.
- o Implementation Requirements
  - The system would require organizing and planning in pre-CR period to deliver all essential goods and services through relatively few government authorized outlets.
  - Procedures and forms for identification and processing of individuals would have to be designed and printed before the crisis.
  - Logistics of supply delivery would require modification.

4. Summary Conclusions on Payment Mechanisms
   - o Significant dislocations to the host area economy will undoubtedly occur (evacuees causing problems, limits on purchasing power of host area population, etc.), but economic measures including payment mechanisms should seek to minimize such dislocations.
   - o Host area business and essential risk area business must have minimal access to cash regardless of the payment mechanism established. Host area business would probably not experience a radically increased demand if controls of payments were maintained.
   - o A mix of payment mechanisms would appear to be the best possibility. Deferred or non-payment mechanisms appear to be best for evacuees and essential goods and services. Other established mechanisms (cash, etc.) could be used for all other purchases to the extent that the commercial system will allow. However, controls would be required on bank withdrawals.
   - o Crisis relocation has no obvious requirement for completely new payment mechanisms such as the universal credit card.
   - o Pre-planned effort for the suggested payment mechanisms will be required but the level of effort appears feasible.
   - o A strategy of delay in processing accumulated transaction items until after CR appears feasible.
   - o Chosen mechanisms might have to continue into the early post-CR period and should be studied from this point of view (e.g., the mechanisms could be used to keep people in the host area until

risk areas were made ready for return. Also, payments on leaving could provide individuals with money to resume economic activity in the risk areas).

- o With respect to monetary costs in the pre-CR crisis period, the universal credit card appears to require the greatest expenditures for planning, data base development, manufacture, storage, and updating. The monetary costs of transactions in the CR and post-CR periods are small relative to total costs, and other characteristics (i.e., integration into distribution system) would determine the selection of a given payment mechanism.

E. Identifying Guidelines for Government Policies Regarding Banking Institutions

As part of the initial study effort, the problems facing financial institutions were examined, and several policy guidelines were suggested, depending on the phase of crisis relocation. These were:

Pre-CR Crisis Phase

- o Undertake increased open-market purchasing of U.S. Government securities to improve the reserve position of the banking system.
- o Undertake public information efforts to enhance orderly operations such as reduced withdrawals, speculation, etc.
- o Adjust the ratio of reserve requirements to match the rate of deposit withdrawals.
- o Allow selective availability of funds at the Federal Reserve discount window, possibly at a variable discount rate. In this way, encouragement could be given to those host area banks best prepared to meet the emergency.
- o Consider restrictions on large savings deposits withdrawals, including extension of waiting times prior to honoring withdrawals.
- o Curtail loans for non-essential purposes and curtail credit card cash-advance loans.
- o Restrict activities of financial markets -- e.g., by curtailing the operating hours of securities, commodities, and options markets.
- o Eliminate margin transactions in the securities and commodities markets, curtail options market, and possibly lengthen the time before proceeds of sales are forwarded to sellers.
- o Control the flight of capital to other nations.

CR-Initiation Phase

In addition to the policies already discussed, guidelines include:

- o Promote plans for maintenance of bank check clearing operations in risk areas and transfer of other functions to host areas.
- o Promulgate the principles underlying loss sharing to be followed upon resolution of the crisis.
- o Implement measures similar to Emergency Bank Regulation No. 1.
- o Consider implementation of foreign exchange controls to control capital withdrawals by foreigners.

CR-Maintenance Phase

Suggested policy in addition to those discussed under the pre-CR Crisis Phase and the CR-Initiation Phase are:

- o Develop plans for minimal functioning of banks in risk areas, and for relationships with banks in non-risk areas.
- o Develop a plan and procedures for assuring an adequate supply of cash for banks in host areas.
- o Continue review of plans for operation of commercial banks and the Federal Reserve Banks in a relocated mode.
- o Implement selective price and profits controls in host areas.

CR-Reconstitution Phase

During this phase, policies must be directed toward:

(1) Preservation of the solvency of financial institutions.

(2) Equalization of losses attributable to the crisis relocation.

(3) Selection of appropriate monetary/fiscal policies contributing to an orderly expansion of the economy.

(4) Assistance to banks in making prompt loans to industry.

While little effort was expended during the current study in further analyzing preferred policy guidelines for banking institutions, the search for, and assessments of, policy guidelines remains a paramount task. Each of the payment mechanisms previously discussed has a different impact on banking system liquidity and reserve position. Moreover, each has a different impact on the ability of banks to preserve their earning assets, especially loans. Preservation of earning assets in turn depends on the ability to make new loans and recall outstanding loans in an orderly manner. Thus, policies regarding the orderly management of reserve positions would become increasingly important.

During the next stage of the study, renewed effort should be expended on evaluating government policy choices regarding banking institutions in relation to the various phases of the crisis situation. Specific policies, depending on the various payment mechanisms, should be articulated and assessed.

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IV. ESSENTIAL INDUSTRY PLANNING

A. Basic Concepts and Approach

Industry would face a range of problems before, during, and after crisis relocation. Among the problems could be major demand changes, absenteeism, disruption of financial services, government controls, supply constraints, and others. The range of such problems was discussed at some length in the Phase I report of this series,[1] and the section on this subject is reproduced as Appendix D to this report. The present report restricts attention to the examination of the planning for essential industry production during the CR-Maintenance Phase.

It has been recognized[2] that some industry (i.e., essential industry) would be required to continue production during the CR-Maintenance Phase to meet the minimal demands of population subsistence and other national objectives (i.e., war mobilization, postattack recovery, etc.). It would also be desirable to meet these production objectives with the minimum risk to workers in essential industry (i.e., key workers). The Phase I study suggested that production for population subsistence would require less than normal production activity levels of all facilities producing essential goods or services. With the possibility of slack production capacity, planning could be undertaken to maximize production in non-risk areas and use risk area production only to fill remaining needs. The outline of such a planning procedure was presented in the Phase I report.[1] The procedure would make use of government planning at all levels (national, regional, and local). National level planning would be needed to set demand and inventory policy and develop first approximations to national production objectives of each essential good or service. Regional and local planning would provide allocations among areas and facilities to achieve the production objectives, and assist essential facilities in preparing a specific plan of operations.

The basic sequence of planning steps is illustrated in Figure 2. The initial step at the national level would be to establish general objectives and to use these objectives, together with knowledge of needs of various economic units, to derive specific final demands of the nation for various goods and services at an appropriate level of detail.*

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*Description of demands at the 4 or 5 digit level of the U.S. Standard Industrial Classification is recommended.

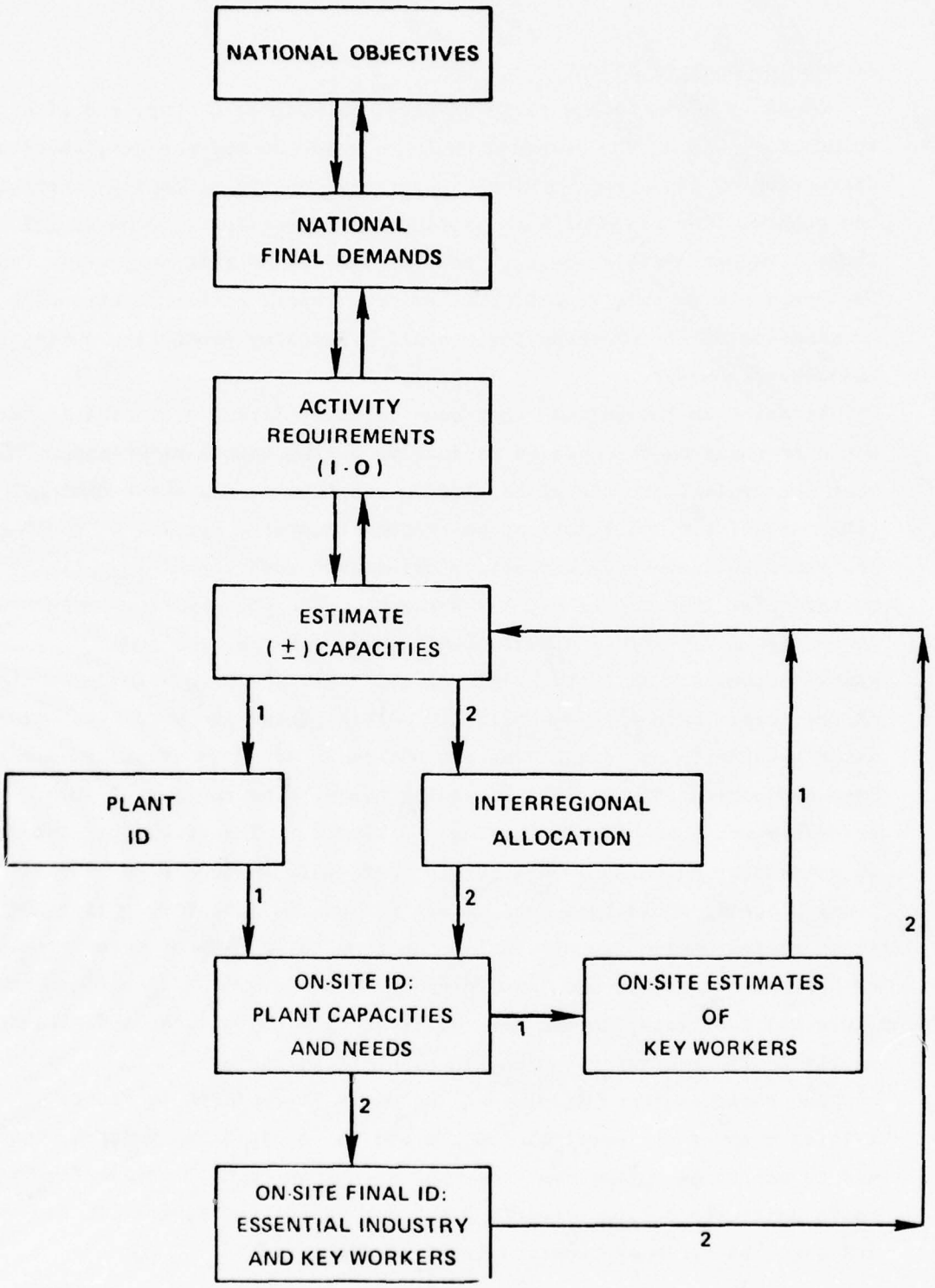


FIGURE 2

PLANNING STEPS

In the next step, a basic industrial production model based on input-output systematics would be used for transforming the statement of final demands into statements of the required levels of total production in each essential industry sector, at national and state levels of aggregation.

The required outputs of essential industry at national and regional levels could then be compared with actual capacity data[3] in risk and non-risk areas. Initial estimates of deficit and surplus capacity in host areas would then be established for each region and for the nation.

Given this initial guidance, local and regional planners would make on-site determinations of the suitability of specific facilities to meet specified production and service goals. These locally generated data on essential industry and key workers for risk and non-risk areas, together with estimated interregional requirements, would be returned to the national level for review. National level planners would then make an allocation of essential industry products and services among regions with deficits and surplus non-risk area production. Remaining deficits would be determined and would constitute estimated industry and key worker needs to be filled by risk area production in each region. National planners would then have to review initial objectives and final demands to determine whether any allowable modifications could be made that would reduce risk-area industrial activities.

Revised guidance from the federal level would be provided to local and regional planners for final implementation in the field. Local and regional planners would then conduct on-site investigations of risk area facilities and identify specific risk area facilities and production levels. Planners working with industry representatives could also assist in the development of facility and local State emergency plans.

The basic problem in such a comprehensive planning activity is that only limited progress can be made during periods of "normalcy" because of insufficient planning staff and motivation among industry representatives. Nonetheless, preliminary planning could be undertaken now that would assist current CR planning and speed industry planning during a crisis. The following sections describe the range of planning requirements and suggest currently feasible undertakings.

B. Estimating Crisis Relocation Production Requirements in the Food Sector (National Level)

1. Approach

The total required output of the food sector at the appropriate level of detail (4-digit level of the Standard Industrial Classification) was

determined by the use of input-output systematics. The basic equations are well-known and are summarized in Appendix B to this report. In summary, total production of a given type is equal to the final demand for the product and the sum of all interindustry demands. Since interindustry demands are ultimately determined by final demand for various products, total production can be determined from the knowledge of final demands for all products and the amount of input of one product to produce another. In input-output systematics, the assumption is made that the ratio of any particular input to a given output is a constant. These ratios or I-O coefficients can be determined at the requisite level of detail at the national level of aggregation from published Bureau of Census data.[4] Similar data are not available for all states or regions of the United States.

The underlying assumptions in I-O systematics can introduce significant errors in estimates of production requirements under conditions different from the peacetime conditions under which the basic data were obtained. The interindustry coefficients represent the sum of the dollar or physical quantity flows among industries for the economic conditions existing at a specified time. Each interindustry coefficient represents a mix of processes presented in common terms. In an emergency, the mix of products and the unit prices could change because of changes in demand, selective elimination of product lines, inefficient production, etc., so that the value of any coefficient could change. To reduce errors of this type, I-O relationships for this study are developed: (1) at a sufficient level of detail to limit the number of processes involved, and (2) as ratios to eliminate the effect of fluctuation in prices.

In this example, interindustry relationships were limited to the 32 food production sectors. The 32 food products considered in SIC Group 20* are listed in Table 5 along with the product number assigned in this study and the corresponding SIC industry code equivalence for each.

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*SIC Major Group 20: This group includes establishments manufacturing or processing foods and beverages for human consumption, and certain related products such as manufactured ice, chewing gum, vegetable and animal fats and oils, and prepared feed for animals and fowl.

Table 5

FOOD AND KINDRED PRODUCTS (SIC GROUP 20)--CATEGORIES USED IN CR PRODUCTION STUDY

Product Number	Product	SIC Code Equivalent (1972 Series)
1	Meat products	201
2	Creamery butter	2021
3	Cheese, natural and processed	2022
4	Condensed and evaporated milk	2023
5	Ice cream and frozen desserts	2024
6	Fluid milk	2026
7	Canned and cured sea foods	2091
8	Canned specialties	2032
9	Canned fruits and vegetables	2033
10	Dehydrated food products	2034
11	Pickles, sauces, and salad dressings	2035
12	Fresh or frozen packaged fish	2092
13	Frozen fruits, vegetables and specialties	2037-8
14	Flour and cereal preparations	2041,2043,2045
15	Prepared feeds for animals and fowl	2047-8
16	Rice milling	2044
17	Wet corn milling	2046
18	Bakery products	205
19	Sugar	2061-3
20	Confectionery and related products	2065-7
21	Alcoholic beverages	2082-5
22	Bottled and canned soft drinks	2086
23	Flavoring extracts and sirups, n.e.c.*	2087
24	Cottonseed oil mills	2074
25	Soybean oil mills	2075
26	Vegetable oil mills, n.e.c.*	2076
27	Animal and marine fats and oils	2077
28	Roasted coffee	2095
29	Shortening and cooking oils	2079
30	Manufactured ice	2097
31	Macaroni and spaghetti	2098
32	Food preparations, n.e.c.*	2099

*Not elsewhere classified.

Data for the final demand for each product, under normal conditions, were derived from a 1974 Department of Commerce report.[5] This same report provided total output for each product of Group 20, as well as input coefficients among products of Group 20. Basic data used and reference sources are listed in Table B.1 of Appendix B.

Crisis relocation personal food consumption levels are based on the standard prepared by the U.S. Department of Agriculture.[6] This standard was promulgated for use by governmental authorities at all levels, and provides for between 2,000 and 2,500 calories per person per day. The standard is given in the form of a basic food allowance, with a list of acceptable substitutes and substitution rates.

For the national level study, Standard Metropolitan Statistical Areas (SMSAs) were necessarily used as an approximation of risk areas since the required data disaggregated into risk areas were not readily available. Even the SMSA data require modification to be used in this application. The only reliable published data giving a breakdown of SMSA and non-SMSA production of individual food products are presented in the Census of Manufacturers.[4] These census data, because of confidentiality problems, are published only for SMSAs at the 2-digit level and at the 4-digit level for states. When the proposed computational procedure is implemented within the Federal Government, presumably the complete (4-digit) data for SMSAs or even risk areas could be used.

For the purposes of the present study, an estimation procedure was devised to give approximate values of the required 4-digit production data by SMSA. Percent of national production (4-digit) in each state was determined from given state and national data (4-digit). The resulting values were used together with the 2-digit data from each SMSA to give a normalized estimate of SMSA production at the 4-digit level. While this approximation could result in a significant error for any given single food product, the results in the aggregate for the national level should provide results suitable for this current exploratory study.

To examine the utility of maximizing production in non-risk areas, consideration was given to emergency expansion of production capacity in the non-risk areas. Data from a report of the National Planning Association[7] provided emergency capacity expansion factors that were fitted to the product categories used in this study. These factors are presented in Table 6.

Table 6

EMERGENCY CAPACITY FACTORS FOR FOOD AND KINDRED PRODUCTS

Product	Name	Emergency Capacity Factor
1	Meat products	1.99
2	Butter	2.08
3	Cheese	2.08
4	Evaporated milk	2.08
5	Ice cream	2.08
6	Fluid milk	2.08
7	Canned sea foods	2.82
8	Canned specialties	2.82
9	Canned fruits, vegetables	2.82
10	Dehydrated food	2.82
11	Pickles, sauces, dressings	2.82
12	Fresh or frozen fish	2.82
13	Frozen fruit, vegetables	2.82
14	Flour & cereal preparations	2.07
15	Animal feeds	2.07
16	Rice milling	2.07
17	Wet corn milling	1.80
18	Bakery products	1.91
19	Sugar	1.42
20	Confectionery	1.80
21	Alcoholic beverages	1.44
22	Soft drinks	1.80
23	Extracts, sirups, n.e.c.	1.80
24	Cottonseed oil mills	1.94
25	Soybean oil mills	1.94
26	Vegetable oil mills, n.e.c.	1.94
27	Animal fats and oils	1.71
28	Roasted coffee	1.80
29	Cooking oils	1.80
30	Manufactured ice	1.80
31	Macaroni, spaghetti	1.80
32	Food preparations, n.e.c.	1.80

n.e.c. - not elsewhere classified

Source: J.D. Norton, "Reported and Estimated Capacity, U.S. Mining and Manufacturing Industries 1957, 1962," Part II, National Planning Association, October 1963.

For this national level computation, it was assumed that there were no imported food items, and that exports of food were reduced by the same percentage as food consumption in the United States. To provide conservative results, it was further assumed that there would be no depletion of U.S. food inventories.

Preservation of food inventories might well be the policy adopted in a CR situation. Concern over the possibility of an attack might well dictate a policy of maintaining large food inventories. To reduce possible losses to food inventories, it might be desirable to decrease current inventories in the risk areas during the CR-Maintenance Phase while gradually increasing inventories in the non-risk areas. Storage capacity, especially for refrigerated products, could be a limiting factor in such a plan.

Using the procedures, data, and assumptions previously discussed, a series of four cases were computed to cover a reasonable range of CR policy conditions. The first case or base case included per capita demand, as given by the Department of Agriculture information previously discussed*, and normal peacetime capacities. In the second case, substitutes among surplus and deficit food production sectors were allowed if their nutritional value was consistent with maintaining the basic diet. In the third case, the base case demand was used but non-risk area production was allowed to expand as needed, up to the maximum levels specified by the emergency capacity expansion factors. In the fourth case, both substitution of food products and emergency capacity factors were allowed.

2. Results of Computations

a. Base Case Results

Conditions and results of the base case computations are given in Table 7. The per capita consumption (demand) is given in column 1 as percent of peacetime (normal) consumption. Production is limited to peacetime capacity levels, in non-risk areas. The allowed demands range from 0 to 100 percent of normal with a median value of about 50 percent. These reduced bases demonstrate once again the great margin by which production in the United States exceeds essential requirements. No consideration was given to production costs that might rise as a result of producing goods and services at varying rates. In actual practice, some accommodation for these cost factors might be considered.

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* 2000 to 2500 calories per day.

Table 7

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
NATIONAL BASE CASE (NORMAL PEACETIME CAPACITIES)

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	18%	25%	33%	0%	9%
2	Butter	0	0	0	0	60	0
3	Cheese	80	60	47	89	0	2
4	Evaporated milk	100	66	54	116	0	2
5	Ice cream	25	1	4	5	0	Neg.
6	Fluid milk	100	85	68	215	0	23
7	Canned sea foods	50	29	47	90	0	1
8	Canned specialties	25	10	25	34	0	1
9	Canned fruits,veg.	100	83	74	282	0	17
10	Dehydrated food	60	41	56	125	0	1
11	Pickles,sauces,dressings	40	22	40	65	0	1
12	Fresh or frozen fish	50	18	35	53	0	1
13	Frozen fruits,veg.	15	0	0	0	67	0
14	Flour & cereal prep.	60	36	44	80	0	3
15	Animal feeds	30	4	7	8	0	Neg.
16	Rice milling	0	0	0	0	436	0
17	Wet corn milling	30	0	0	0	18	0
18	Bakery products	70	54	61	155	0	28
19	Sugar	10	0	0	0	7	0
20	Confectionery	10	0	0	0	81	0
21	Alcoholic beverages	20	0	0	0	39	0
22	Soft drinks	25	0	0	0	12	0
23	Extracts,sirups,n.e.c.	25	2	6	7	0	Neg.
24	Cottonseed oil mills	50	16	21	27	0	Neg.
25	Soybean oil mills	50	9	12	13	0	Neg.
26	Veg.oil mills,n.e.c.	50	7	18	22	0	Neg.
27	Animal fats and oils	50	2	5	5	0	Neg.
28	Roasted coffee	60	45	65	183	0	1
29	Cooking oils	70	49	60	149	0	1
30	Manufactured ice	25	0	0	0	104	0
31	Macaroni,spaghetti	100	89	78	347	0	1
32	Food preparations,n.e.c.	80%	61%	63%	170%	0%	8%

Total Food Production in Risk Areas 33% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified Neg. - negligible

Resulting production in risk areas (column 2) also reflects a varied rate of production among products (0 - 89 percent). In all cases, the CR production has been reduced by a greater percentage than demands. This fact reflects the reduced interindustry requirements and the selective emphasis on production in the non-risk areas.

A measure of the emphasis of production in risk and non-risk areas is given in columns 3 and 4. Values reflect both the relative need for the products and the geographical distribution of the particular industry. For instance, fluid milk production (product 6) appears to be heavily concentrated in metropolitan areas, and it would be difficult to reduce levels of activity without a reduction in demand or inordinately large increase in non-risk production (215 percent in column 4). Requirements for increased non-risk area production to eliminate risk area production (column 4) provide an initial basis, together with knowledge of production expansion capabilities, of opportunities for major reductions in risk area production.

Determination of the surplus production capacity in non-risk areas (column 5 of Table 7) helps to flag the opportunities for substitution of products so as to reduce risk area production. For instance, rice milling (product 16), with a surplus production capacity of 436 percent, might provide greater amounts of this product and reduce requirements for other grains.

The total number of employees required to work in risk areas was reduced by these methods to 33 percent of the normal risk area food industry work force. This reduced work force (key workers) was distributed among the various food production industries as indicated in column 6 of Table 7. The values indicate to the planner the industries where efforts must be concentrated to reduce the number of key workers.

b. Modified Consumption (Second Computation)

The base case computations indicated that there was surplus production capacity of some items in the non-risk areas. Consequently, if the product of such sectors could be substituted for products requiring risk area production while maintaining dietary requirements, a net reduction in key workers at risk could be achieved. To explore the potential of this approach, substitutions were made following Department of Agriculture guidelines to make more complete use of such surplus production capacity.

The results of these substitutions are indicated in Table 8. In general, food industry key workers required in risk areas were reduced from 33 percent

Table 8

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
NATIONAL BASE CASE ALTERED BY SUBSTITUTION OF PRODUCTS

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	18%	24%	32%	0%	11%
2	Butter	25	Neg.	1	1	0	Neg.
3	Cheese	80	60	47	89	0	2
4	Evaporated milk	100	66	54	116	0	2
5	Ice cream	20	0	0	0	18	0
6	Fluid milk	100	85	68	215	0	29
7	Canned sea foods	50	28	47	88	0	1
8	Canned specialties	25	9	24	31	0	1
9	Canned fruits,veg.	100	83	74	282	0	22
10	Dehydrated food	60	42	56	127	0	2
11	Pickles,sauces,dressings	20	0	0	0	11	0
12	Fresh or frozen fish	30	0	0	0	6	0
13	Frozen fruits,veg.	50	26	38	62	0	4
14	Flour & cereal prep.	60	30	40	65	0	3
15	Animal feeds	25	2	5	5	0	Neg.
16	Rice milling	50	22	32	46	0	Neg.
17	Wet corn milling	40	0	0	0	36	0
18	Bakery products	55	35	50	100	0	23
19	Sugar	11	0	0	0	15	0
20	Confectionery	18	0	0	0	15	0
21	Alcoholic beverages	25	0	0	0	12	0
22	Soft drinks	27	0	0	0	4	0
23	Extracts,sirups,n.e.c.	20	Neg.	Neg.	Neg.	0	Neg.
24	Cottonseed oil mills	40	0	0	0	12	0
25	Soybean oil mills	40	0	0	0	19	0
26	Veg.oil mills,n.e.c.	45	0	0	0	33	0
27	Animal fats and oils	45	0	0	0	2	0
28	Roasted coffee	25	5	16	19	0	Neg.
29	Cooking oils	25	4	11	12	0	Neg.
30	Manufactured ice	25	0	0	0	113	0
31	Macaroni,spaghetti	80	67	72	261	0	1
32	Food preparations,n.e.c.	25%	0%	0%	0%	4%	0%

Total Food Production in Risk Areas 26% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified Neg. - negligible

(base case) to 26 percent (second computation). Further reductions could be achieved by developing optimal procedures for varying the final demand.

Comparison of the consumption levels (column 1) in Tables 7 and 8 indicates major reductions in the consumption (final demand) of some products (11, 12, 18, 28, 29, 31, and 32) which required high risk area production. These reductions are accompanied by significant decreases in required risk area production during CR. The final demand for other products (2, 13, 16, and 20) was increased to provide a balance of diet.

c. Emergency Capacity and Base Line Demand (Third Computation)

To test the sensitivity of risk area production levels to enhanced non-risk area production, base case demands were used together with application of emergency capacity factors[7] applied on non-risk area production sectors (see Table 9). As a result, the total of key workers in risk areas was reduced from the base case value of 33 percent to a value of 12 percent of food workers normally in risk areas.

Examination of column 2 of the table indicates that the risk area production of most required items has been reduced by a factor of 2 or more. Also, the risk area production of 14 sectors has been eliminated entirely. In addition, examination of column 5 indicates that a very high surplus of production capacity could exist for most food production sectors if expansion capabilities were fully used. With a policy of use of emergency expansion, consideration could be given to improving the diet of the population and employing a larger fraction of the work force.

d. Emergency Capacity and Modified Consumption (Fourth Computation)

In the fourth computation, both policies of emergency expansion of non-risk area production and substitutions to the diet were assumed. The resulting computations (shown in Table 10) indicated that the total number of food manufacturing workers in risk areas might be reduced to 6 percent of the normal work force in the food sectors. Only four products remain that would require production in risk areas. They are: fluid milk, canned fruits and vegetables, bakery products, and macaroni and spaghetti.

Again as in the preceding computation, a great surplus of non-risk area production capacity is observed (column 5) which suggests that appropriate modifications might be made to reduce further the need for risk area production. If employment of evacuees is a consideration, planners might want to

Table 9

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
NATIONAL BASE CASE ALTERED BY USE OF EMERGENCY CAPACITY FACTORS

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	0%	0%	0%	50%	0%
2	Butter	0	0	0	0	233	0
3	Cheese	80	0	0	0	10	0
4	Evaporated milk	100	4	4	4	0	Neg.
5	Ice cream	25	0	0	0	99	0
6	Fluid milk	100	42	34	51	0	32
7	Canned sea foods	50	0	0	0	48	0
8	Canned specialties	25	0	0	0	111	0
9	Canned fruits,veg.	100	30	26	35	0	17
10	Dehydrated food	60	0	0	0	25	0
11	Pickles,sauces,dressings	40	0	0	0	71	0
12	Fresh or frozen fish	50	0	0	0	85	0
13	Frozen fruits,veg.	15	0	0	0	371	0
14	Flour & cereal prep.	60	0	0	0	15	0
15	Animal feeds	30	0	0	0	92	0
16	Rice milling	0	0	0	0	1010	0
17	Wet corn milling	30	0	0	0	112	0
18	Bakery products	70	22	25	34	0	32
19	Sugar	10	0	0	0	52	0
20	Confectionery	10	0	0	0	226	0
21	Alcoholic beverages	20	0	0	0	100	0
22	Soft drinks	25	0	0	0	101	0
23	Extracts,sirups,n.e.c.	25	0	0	0	69	0
24	Cottonseed oil mills	50	0	0	0	53	0
25	Soybean oil mills	50	0	0	0	71	0
26	Veg.oil mills,n.e.c.	50	0	0	0	60	0
27	Animal fats and oils	50	0	0	0	63	0
28	Roasted coffee	60	26	36	57	0	2
29	Cooking oils	70	23	28	38	0	2
30	Manufactured ice	25	0	0	0	268	0
31	Macaroni,spaghetti	100	68	60	149	0	3
32	Food preparations,n.e.c.	80%	32%	33%	50%	0%	11%

Total Food Production in Risk Areas 12% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified Neg. - negligible

Table 10

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
NATIONAL BASE CASE ALTERED BY BOTH SUBSTITUTION OF PRODUCTS
AND USE OF EMERGENCY CAPACITY FACTORS

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	0%	0%	0%	50%	0%
2	Butter	25	0	0	0	107	0
3	Cheese	80	0	0	0	10	0
4	Evaporated milk	100	5	4	4	0	1
5	Ice cream	20	0	0	0	146	0
6	Fluid milk	100	42	34	51	0	57
7	Canned sea foods	50	0	0	0	50	0
8	Canned specialties	25	0	0	0	114	0
9	Canned fruits,veg.	100	30	26	36	0	31
10	Dehydrated food	60	0	0	0	24	0
11	Pickles,sauces,dressings	20	0	0	0	214	0
12	Fresh or frozen fish	30	0	0	0	199	0
13	Frozen fruits,veg.	50	0	0	0	74	0
14	Flour & cereal prep.	60	0	0	0	25	0
15	Animal feeds	25	0	0	0	98	0
16	Rice milling	50	0	0	0	42	0
17	Wet corn milling	40	0	0	0	146	0
18	Bakery products	55	3	5	5	0	8
19	Sugar	11	0	0	0	63	0
20	Confectionery	18	0	0	0	107	0
21	Alcoholic beverages	25	0	0	0	62	0
22	Soft drinks	27	0	0	0	87	0
23	Extracts,sirups,n.e.c.	20	0	0	0	80	0
24	Cottonseed oil mills	40	0	0	0	116	0
25	Soybean oil mills	40	0	0	0	132	0
26	Veg.oil mills,n.e.c.	45	0	0	0	159	0
27	Animal fats and oils	45	0	0	0	74	0
28	Roasted coffee	25	0	0	0	51	0
29	Cooking oils	25	0	0	0	60	0
30	Manufactured ice	25	0	0	0	283	0
31	Macaroni,spaghetti	80	46	50	101	0	3
32	Food preparations,n.e.c.	25	0	0	0	87	0

Total Food Production in Risk Areas 6% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified

determine what the maximum demand for food might be, and then determine which of these demands might be conveniently met out of surplus non-risk area production.

e. Evaluation of Results

The preceding computations illustrate the potential utility of I-O methodology as an aid to the CR industrial planning problem. Similar results could be developed for any other major category of industry. Results presented in this study do not warrant too detailed an interpretation, because of the inadequacies in the data used and other assumptions. Improvements can and should be made over time in the I-O coefficients and the information specifying risk and non-risk area production at the requisite level of detail (4-digit SIC).

Restriction of the examination of interindustry relationships to a small set of sectors can introduce additional errors, although in the case of the food sector these are acceptably small. Also, the use of results aggregated to the national level implies that all essential goods can be transported efficiently throughout the United States as needed to minimize risk area production. Also, the limitations imposed by existing arrangements among producers are not considered. As a result, the answer that can be developed at the national level provides only ideal objectives for industry, and it is to be expected that the actual field implementation would fall short of achieving these objectives. Nonetheless the reductions in risk area production observed in the calculations are so dramatic that the suggestion is probably warranted that a great potential exists for reducing risk area production by applying the principles examined in this study.

C. Estimating Food Manufacturing Requirements at the State Level

1. Approach

Production capacities, and to a lesser degree, CR demands would vary from one region of the United States to another. Consequently, to obtain a more realistic specification of regional industrial production requirements, calculations should be made for individual regions (such as the State level of aggregation). Data on industrial activities are gathered down to the facility level by the Bureau of Census and by Dun and Bradstreet, so that in principle the calculations at the State or locality level are feasible. Because of confidentiality restrictions, however, the Bureau of Census does

not publish data of the detail required (4-digit SIC) at the State or locality level of aggregation. Presumably, with a fully developed planning procedure functioning within the Federal government, the more detailed data would be made available in some form. For instance, detailed facility data (at the 4-digit level) might be aggregated into totals for all risk areas and totals for all non-risk areas within a given State.

Dun and Bradstreet facility data are the source information for calculating industry production requirements at the State and local levels used in present calculations.[8] The limits of accuracy of such data have been subject to question. For instance, questions have been raised as to whether reported employees are actually located at the stated address or whether they are actually located in several facilities.[9] While such uncertainties are important for some uses (i.e., damage assessment), they might not be too significant for present computations, since what is required is only the total aggregation of industrial activity (and employees) within a given risk area (or metropolitan area). The age of the data may also be a problem with some uses. This and other questions relating to the Dun and Bradstreet data remain to be resolved.

Interindustry requirements (or interindustry coefficients) are known to vary from one State to another. The MRIO model of the Federal Preparedness Agency[10] provides I-O data for the various States, but the data are not at a sufficient level of detail for present purposes. Consequently, in present calculations, it was assumed that the national I-O relationships[5] could be applied to the individual States. While this assumption introduces some error, the error is small in most instances, compared to the variations in sector production capacities among the various States. Thus, computations based on this assumption allow generation of a realistic pattern of variation of CR production requirements at the State level. Development of better and more detailed I-O data at the regional level is a subject of continuing interest in several Federal agencies, and improvements can be incorporated over time in the basic computational procedures used in this study.

Calculations for the State level were based on data for the State of Colorado. Demand and capacity values were adjusted to reflect State conditions including exports and imports among States. The same per capita demand was specified as for the nation in run II (Table 8) -- i.e., Department of Agriculture diet with substitutions using USDA guidelines. Total

output capacity for the State together with the net of exports and imports was assumed to be proportional to population, which implies that the net of production after exports and imports is consumed by the State population. Required total State CR production capacity is then determined from the estimated final demands and the national input-output data. The required risk area production determined from Dun and Bradstreet tapes is the residual after non-risk area production is deducted from the computed total State CR production.

2. Results

Two sample runs were made at the State level for the 32 food product sectors. In the first computation, production in any sector was restricted within peacetime capacity (i.e., conditions were identical with those of the national base case, Table 8). The second computation allowed expansion of production capacities up to the limit set by the emergency capacity factors[7] (i.e., conditions identical with the national case shown in Table 10).

Results for the Colorado State base case are given in Table 11. The required production in risk areas (column 2 of Table 11) ranges from zero to 89 percent, with this highest value being attributed to fluid milk production. The aggregate risk area production level over all food sectors was estimated as 38 percent of normal, which is higher than the 26 percent calculated in the comparable national case. This difference reflects in part the implicit assumption in the national calculations of perfect distribution of products over the United States.

Results for the Colorado State case of production expanded by using emergency capacity factors is given in Table 12. The range of risk area production (column 2 of Table 12) is from zero to 78 percent of normal, with the highest value again attributed to the production of fluid milk. Total food product employees needed in risk areas were reduced to 20 percent as compared to 6 percent for the comparable national case. While the reductions for the State cases are considerably less than for the national computations, the results still indicate a significant potential of planning for reducing production and key workers in the risk areas.

In Table 13 the risk area production requirements for the State and national computations are compared: columns A and B for normal production; columns C and D for emergency production. The table shows that for the majority of product sectors, the risk area production for Colorado is equal to, or

Table 11

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
COLORADO BASE CASE WITH PRODUCT SUBSTITUTION

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	45%	95%	1831%	0%	60%
2	Butter	25	20	37	59	0	Neg.
3	Cheese	80	76	100	1898	0	3.5
4	Evaporated milk	100	0	0	0	28	0
5	Ice cream	20	12	57	131	0	1
6	Fluid milk	100	89	90	909	0	5.7
7	Canned sea foods	50	0	0	NA	NA	0
8	Canned specialties	25	30	100	NA	NA	Neg.
9	Canned fruits,veg.	100	0	0	0	15	0
10	Dehydrated food	60	56	100	NA	NA	0
11	Pickles,sauces,dressings	20	18	75	301	0	0.7
12	Fresh or frozen fish	30	0	0	NA	NA	0
13	Frozen fruits,veg.	50	27	40	66	0	0.6
14	Flour & cereal prep.	60	51	98	4408	0	6.3
15	Animal feeds	25	0	0	0	92	0
16	Rice milling	50	0	0	NA	NA	0
17	Wet corn milling	40	0	0	0	273	0
18	Bakery products	55	50	95	1949	0	13.4
19	Sugar	11	0	0	0	42	0
20	Confectionery	18	0	0	0	42	0
21	Alcoholic beverages	25	0	0	0	349	0
22	Soft drinks	27	12	38	62	0	4
23	Extracts,sirups,n.e.c.	20	24	100	NA	NA	Neg.
24	Cottonseed oil mills	40	0	0	NA	NA	0
25	Soybean oil mills	40	0	0	NA	NA	0
26	Veg.oil mills,n.e.c.	45	18	100	NA	NA	Neg.
27	Animal fats and oils	45	29	96	2388	0	1.3
28	Roasted coffee	25	24	100	NA	NA	0.8
29	Cooking oils	25	0	0	NA	NA	0
30	Manufactured ice	25	0	0	0	274	0
31	Macaroni,spaghetti	80	73	100	NA	NA	0.8
32	Food preparations,n.e.c.	25%	17%	60%	149%	0%	0.8%

Total Food Production in Risk Areas 38% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified Neg. - negligible NA - not applicable

Table 12

FOOD AND KINDRED PRODUCTS, PRODUCTION DURING CR--
COLORADO BASE CASE ALTERED BY USE OF EMERGENCY CAPACITY FACTORS
WITH PRODUCT SUBSTITUTION

Product	Name	Demand (% of Normal)	Risk Area CR Production (% of Normal)	% Total CR Production in Risk Areas	% Increase in Non-R.A. Production to End Risk Area Production	% Surplus Production in Non-Risk Areas	R.A. Employees Needed (% of Total CR Employees)
1	Meat products	50%	43%	90%	870%	0%	87%
2	Butter	25	0	0	0	31	0
3	Cheese	80	76	100	912	0	Neg.
4	Evaporated milk	100	0	0	0	166	0
5	Ice cream	20	2	10	11	0	1
6	Fluid milk	100	78	79	385	0	4
7	Canned sea foods	50	0	0	NA	NA	0
8	Canned specialties	25	30	100	NA	NA	Neg.
9	Canned fruits,veg.	100	0	0	0	224	0
10	Dehydrated food	60	56	100	NA	NA	Neg.
11	Pickles,sauces,dressings	20	7	30	42	0	1
12	Fresh or frozen fish	30	0	0	NA	NA	0
13	Frozen fruits,veg.	50	0	0	0	70	0
14	Flour & cereal prep.	60	50	95	2078	0	3
15	Animal feeds	25	0	0	0	298	0
16	Rice milling	50	0	0	NA	NA	0
17	Wet corn milling	40	0	0	0	572	0
18	Bakery products	55	48	91	973	0	3
19	Sugar	11	0	0	0	248	0
20	Confectionery	18	0	0	0	155	0
21	Alcoholic beverages	25	0	0	0	547	0
22	Soft drinks	27	0	0	0	11	0
23	Extracts,sirups,n.e.c.	20	24	100	NA	NA	Neg.
24	Cottonseed oil mills	40	0	0	NA	NA	0
25	Soybean oil mills	40	0	0	NA	NA	0
26	Veg.oil mills,n.e.c.	45	18	100	NA	NA	Neg.
27	Animal fats and oils	45	28	93	1355	0	Neg.
28	Roasted coffee	25	24	100			Neg.
29	Cooking oils	25	0	0	NA	NA	0
30	Manufactured ice	25	0	0	0	574	0
31	Macaroni,spaghetti	80	73	100	NA	NA	Neg.
32	Food preparations,n.e.c.	25%	8%	28%	38%	0%	1%

Total Food Production Risk Areas 20% (key workers assumed proportional to production)

n.e.c. - not elsewhere classified Neg. - negligible NA - not applicable

Table 13

COMPARISON OF COLORADO STATE AND NATIONAL RESULTS
FOR REQUIRED RISK AREA PRODUCTION*

		Normal Production		Emergency Capability	
		A	B	C	D
Product	Name	State	National	State	National
1	Meat products	45%	18%	43%	0%
2	Butter	20	neg	0	0
3	Cheese	76	60	76	0
4	Evaporated milk	0	66	0	5
5	Ice cream	12	0	2	0
6	Fluid milk	89	85	78	42
7	Canned sea foods	0	28	0	0
8	Canned specialties	30	9	30	0
9	Canned fruits, veg.	0	83	0	30
10	Dehydrated food	56	42	56	0
11	Pickles, sauces, dressings	18	0	7	0
12	Fresh or frozen fish	0	0	0	0
13	Frozen fruits, veg.	27	26	0	0
14	Flour & cereal prep.	51	30	50	0
15	Animal feeds	0	2	0	0
16	Rice milling	0	22	0	0
17	Wet corn milling	0	0	0	0
18	Bakery products	50	35	48	3
19	Sugar	0	0	0	0
20	Confectionery	0	0	0	0
21	Alcoholic beverages	0	0	0	0
22	Soft drinks	12	0	0	0
23	Extracts, sirups, n.e.c.	24	neg	24	0
24	Cottonseed oil mills	0	0	0	0
25	Soybean oil mills	0	0	0	0
26	Veg. oil mills, n.e.c.	18	0	18	0
27	Animal fats and oils	29	0	28	0
28	Roasted coffee	24	5	24	0
29	Cooking oils	0	4	0	0
30	Manufactured ice	0	0	0	0
31	Macaroni/spaghetti	73	67	73	46
32	Food preparations, n.e.c.	17%	0%	8%	0%

n.e.c. - not elsewhere classified Neg - negligible

*Column A from Table 11, column B from Table 8, column C from Table 12, column D from Table 10.

higher than, comparable national results, again reflecting the efficient nationwide distribution implicit in the national results. Sectors for which the values of risk area production are zero in the national results but positive in the State results can be interpreted as opportunities for added imports into the State to reduce risk area production. Sectors where the State value is zero and positive for the national case can be viewed as opportunities for possible added export from the State.

An example of imports into Colorado under the assumption of normal levels (columns A and B) of production would be vegetable oil mills (product 26). With emergency production (columns C and D) in the United States, other opportunities for imports would include meat (product 1) and cheese (product 3), among others. Examples of possible exports from Colorado include condensed and evaporated milk (product 4), among others. These results are illustrative only, because of the approximations in the data base. In addition, any results of this type would have to be validated in the field. For instance, the export of certain food products might be feasible from the production point of view but not from the point of view of transportation and storage.

Further balancing could be achieved to cause the risk area production of States and the national case to converge. However, such a plan would result in placing more workers at risk in one section of the country to reduce the number at risk in some other section. This aspect is one of a number of policy decisions that might have to be contemplated in the course of establishing a national plan.

D. Planning at the Local Level for Industrial Production

1. General Considerations

Planning factors developed in the preceding pages could identify essential production categories and approximate production levels. This general guidance will then have to be translated into specific assignments to individual facilities and organizations in various localities. Steps required to complete planning at the local level include:

- o Identifying specific facilities and organizations
- o Obtaining planning information on specific industrial plants.
- o Developing of emergency production plans for essential plants
- o Developing an overall support plan for essential industries in each risk (or non-risk) area.

In the following section, consideration is given primarily to the planning problems in the risk area with special reference to the Colorado Springs area.

2. Identification of Facilities for Essential Production

Most facilities producing required essential goods and services in a locality can be determined from currently codified industrial data generally available in the region or locality. Industrial indexes prepared by regional associations, local chambers of commerce, or other sources are helpful and often indicate the specific product in terms of the SIC code of the principal product or service. The local telephone book is an immediately available and useful source of information on general products or services for most local firms. Recent Dun and Bradstreet listings would be especially useful at the local level in identifying principal products, size of organization, location, and telephone contact, among other items.

Since the guidance from the State and Federal levels might set production goals in risk areas in each category below the normal levels, not all facilities producing a given product would need to be designated as essential. Depending upon the policy adopted for industry planning, criteria for selection might be established for screening the initial list of facilities. Among the criteria that might be suggested for screening facilities would be: (1) adequate size of operations, (2) high level of cooperation from the facility management, and (3) relative self-sufficiency.

Selection of the larger firms in any given category of production would appear to be useful in industrial planning. The larger firms are more likely to have adequate management procedures and data and would be more likely to be able to anticipate problems and costs of CR production. Use of the larger firms would also tend to minimize the number of firms and the amount of planning needed to achieve readiness to produce the required level of product or service. Other advantages of selecting larger firms might include: larger and better managed inventories, availability of personnel to participate in the planning process, more experience working with government, greater awareness of the production system of which they are a part, greater and more flexible financial capabilities, less sensitivity to absenteeism, greater in-house support capabilities, better established relationships with outside support services, etc.

Another key criterion would relate to the degree of cooperation that could be expected from any given organization or facility. Since there is no present

requirement for an organization to participate in defense planning, obtaining the requisite level of participation by the firm might be a key factor in determining the success or failure of the local industrial planning effort. Recent experience in Colorado Springs[11] indicated a high degree of cooperation with a brief telephone survey of emergency capabilities. However, the degree of cooperation can be expected to be less with respect to detailed efforts at industrial planning requiring a considerable commitment of time by company personnel. Also, the development of data related to production and costs might be viewed with some concern by the firm. Development of incentives for such planning might be useful, such as guarantees of preferential treatment during crisis, priority on resupply, financial assistance, participation in post-CR programs, assurances of confidentiality, tax write-offs, etc.

3. Information for Local Area and Industrial Facility Planning

a. Economic Data

Economic data would have to be collected from each selected industrial facility as a basis for validating potential to produce desired output and determine required support requirements, and as a basis for setting up the emergency procedures to implement essential production during CR. The economic data might not be the only data needed from the organization. Other requirements for emergency planning might impose additional information needs on the facility or firm. Thus in Colorado Springs, data from firms on in-house transportation, emergency equipment, medical supplies, etc. have been acquired.[11]

Types of economic data required from each selected industrial facility would include the following:

- o Facility identification
- o Facility location and contact point
- o Primary product description and capacity
- o Total worker and key worker information
- o Inventory data
- o Support requirements (industrial)
- o Financial characteristics and support requirements
- o Other technical or operational characteristics.

Primary product description should be related to the SIC category to permit use with other planning information. Capacity data would include normal capacity (units, dollars of sales, etc.) and if known, possible emergency expansion of capacity (non-risk area facilities). Estimates of total workers and key

workers will be needed in order to develop housing and transportation requirements for evacuating them, for commuting to risk area facilities, and for estimating payroll requirements and other financial support. Inventory data will be needed to determine length of time that the plant can function without resupply and to identify suppliers that might have to be added to the list of essential industries.

Support requirements would include not only inventory suppliers but needs in terms of utilities, transportation, communications, etc. Financial characteristics data would include mechanics of payment (payroll, etc.), financial resources, and financial arrangements (banks used, credit, loans, etc.). Other technical and operational characteristics peculiar to the plant would be needed to allow interfacing with the emergency production system in the locality or state.

b. Survey Approaches

Survey approaches to obtain the data will be an important factor in the success of the planning effort. Preliminary experience in the Colorado Springs area suggests that both telephone surveys and on-site interviews have a role in obtaining the needed data. The size of the effort also suggests that a mail survey might play a useful role.

In 1977, the Colorado Springs Civil Defense Office conducted a telephone survey of business establishments to obtain data useful in CR emergencies. The survey form used is shown in Figure 3 and the types of establishments contacted are shown in Table 14.

From this telephone survey, Table 15 presents selected industrial data for a number of essential-industry types. Most of the types of facilities shown (with the exception of banking, hospitals, and government services) indicated a relatively small employment (8 to 38). With these small sizes of organizations, it is probably unrealistic to expect much in the way of facility planning for CR emergencies. At present, a standardized approach to planning might be applied by the local planning staff using minimal facility information, with plan augmentation during crisis when a higher level of cooperation from the facility staff could be anticipated.

In the data selected and in the survey, the number of key workers identified generally appears to be close to or equal to the total number of workers.

Figure 3

SURVEY FORM FOR OBTAINING DATA FROM ESSENTIAL FACILITIES, INDUSTRIES, AND AGENCIES

Colorado Springs/El Paso Co. | Mrs. Brown | 8-22-77
COMMUNITY | NAME OF PERSON REPORTING | DATE

Western Foods | 2523 West Boulder | 632-9778
NAME OF FACILITY/AGENCY | ADDRESS | PHONE

INDICATE PRODUCT/SERVICE Grocers GOV'T OR PRIVATE SECTOR Private

AVG. NO. OF EMPLOYEES 100 EST. NO. CLASSED AS ESSENTIAL FOR CRP 30

	No.	Type	Radio Equipped
NO. & TYPE OF COMPANY OWNED/LEASED VEHICLES	4	1 truck, 3 cars	yes - not CB

DO THEIR OWN MAINTENANCE No SPARE PARTS SUPPLY No HOW MANY DAYS ON HAND N.A.

HAVE THEIR OWN FUEL STORAGE: HEATING No WILL LAST HOW LONG N.A.

VEHICULAR No WILL LAST HOW LONG N.A.

HAVE EMERGENCY POWER No NO. DAYS OF FUEL N.A.

ANY IN-HOUSE MEDICAL FACILITIES No WHAT TYPE N.A.

MAINTAIN INVENTORY OF RAW PRODUCTS Yes HOW LONG BEFORE RE-SUPPLY NEEDED 2 weeks

ANY IN-HOUSE COMMUNICATIONS SYSTEM Yes WHAT TYPE Intercom

IF RADIO COMMUNICATIONS SYSTEM, IS IT LICENSED TO COMPANY/GOV'T ENTITY —

NO. BASE STATIONS 1 NO. MOBILE UNITS 4

FREQUENCIES — OPERATING RANGE-BASE STATION(S) 25 miles

MOBILE UNITS 4

	Location	Emergency Pwr	Fuel Supply	Fuel for how long
BASE STATIONS	2523 West Boulder	No	N.A.	N.A.

	No.	Address	Phone	Emergcy Power	Fuel Supply	Fuel For How Long
CONTROL POINTS	4 mobile units					

DOES SYSTEM INTERCONNECT WITH OTHER SYSTEMS —

	Name	Address	Phone
IF SO, WHICH OTHER SYSTEMS	—		

INFORMATION FOR THIS FORM OBTAINED BY: MAIL ✓ PHONE ___ IN-PERSON ___ OTHER ___

CRP FORM OS - 2 (LOCAL REPRODUCTION OF THIS FORM IS AUTHORIZED)

Table 14

TELEPHONE SURVEY OF INDUSTRIES IN COLORADO SPRINGS*

BAKERY (Wholesale)
BOTTLERS
DAIRY (Wholesale)
FUEL
GASOLINE (Wholesale)
OIL
GROCERS (Wholesale)
MEAT PACKING
PRODUCE
AIRCRAFT SERVICING/MAINTENANCE
AMBULANCE
BEARINGS
BLOOD BANKS
BOILER REPAIRING
BRAKE SERVICE
BURGLER ALARM SYSTEMS
CEMETERIES
COMMUNICATIONS/UTILITIES
  Newspaper
  Public Service
  Primary Radio Stations
  Telephone
  Television
  Electric Light and Power
  Gas Company
  Printers
  Communication Equipment
  Printing Supplies
  Contractor's Equipment & Supplies-Rental
TRANSPORTATION
  Air
  Rail
  Taxi
  Trucking
DATA PROCESSING EQUIPMENT
DATA PROCESSING SUPPLIES
ELECTRIC MOTOR REPAIR
ELECTRONIC EQUIPMENT/SUPPLIES
ENGINES, DIESEL REPAIR
FIRE ALARM SYSTEMS
FUNERAL DIRECTOR
FURNACES, SUPPLIES/PARTS
HOSPITALS
ICE
INDUSTRIAL GASES
LABORATORIES, MEDICAL
MACHINE SHOPS
PEST CONTROL
PLUMBING WHOLESALE/MANUFACTURING
REFRIGERATING EQUIP. PARTS/SUPPLIES
RENDERING COMPANY
TOILETS, PORTABLE
WELDING
WELDING EQUIPMENT/REPAIR
WELDING EQUIPMENT/SUPPLIES
MANUFACTURING
  Aircraft Equipment, Parts & Supplies
  Aluminum Foundries
  Automotive
  Boxes
  Carburetors
  Chemicals
  Contractors/Construction
  Electrical/Industrial Apparatus
  Electronics
  Fabricating-Lubricating
  Farm Machinery
  Glass
  Machine Parts
  Oil Wholesalers
  Optical Instruments
  Packing & Crating Services
  Paper Products
  Paving Mixtures & Blocks
  Pharmaceutical
  Prestressed Concrete
  Pumps
  Solvents
  Steel Distributors
  Steel Fabricators
  Warehouse (Storage)

*Colorado Springs Civil Defense Office

Table 15

DATA FOR SELECTED COLORADO SPRINGS INDUSTRIES

Type Industry	Employees (average)	Key Employees (average)	Resupply Time (days)	No. of Vehicles (average)	Vehicle Fuel Supply (days)
Bakeries (wholesale)	21	NA	1	17	21
Dairies (wholesale)	38	37	1	26	5
Gasoline (wholesale)	8	8	1	8	NA
Grocers (wholesale)	30	30	?	7	0
Meat Packers	16	16	10	6	14
Produce	16	16	1	3	15
Ambulance Service	28	28	NA	9	21
Trucking Service	8	8	NA	12	0
Hospitals	660	640	Variable	0	0
Packing and Crating	30	30	NA	18	7
Boxes	14	5	30	2	NA
Banking	75	40	NA	2	0
Sheriff's Dept.	200	150	7	71	7
Utilities (power)	345	300	NA	46	0

NA - not available

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While this might reflect the fact that in small companies, most workers are directly engaged in the production processes, it is likely that the number of key workers has been overestimated for CR purposes. To obtain a more realistic estimate of key workers, the respondent at the facility would probably need more information about the purpose and scope of the CR operation and the role of his facility in this operation, such as the type of product to be produced, production levels, packaging for bulk use, distribution scheme, likely duration, etc.

Resupply times are highly variable depending upon the production process. In the sample, the times range from one to 30 days. Facilities generally require resupply in one to a few days, which would require that their suppliers or possibly the entire supply system would have to function at some minimal level to maintain essential production. The food industry is a well-known example of the need for maintenance of the entire system.

The data tended to show a significant degree of self-sufficiency in many industries with respect to transportation. Also in many cases, company-maintained fuel reserves could make a significant contribution to maintaining supply over part or all of the CR-Maintenance Phase. Local planners would find it necessary to examine these resources in more detail to determine the contribution under the changed demand conditions of CR, and to provide outside support, as required, for essential facilities that lack sufficient transportation.

An on-site survey of selected facilities appears to provide a better approach to obtaining economic data at the level of detail that will be required for facility production planning. However, such on-site surveys require considerably more time and manpower than the telephone or mail surveys, so that the on-site survey might have to be restricted to much fewer facilities. The telephone or mail survey is a good first step to screening the possible candidates by determining the general importance of the operation and the likelihood of cooperation from the organization involved.

c. Conducting the On-Site Survey

The on-site survey would best be conducted with a structured survey instrument. For example, a prototype instrument of this type is illustrated in Figure 4. Before attempting to complete such a survey instrument, the person making the survey should provide certain information and assurances to the facility representative. A general description of the CR option and the

Figure 4

INDUSTRIAL SURVEY FORM

NAME OF ORGANIZATION: National Oil Company

ADDRESS: 213 No. 12th St., Colorado Springs PERSON CONTACTED: K.H. Smith, City Manager,

TELEPHONE:

ESSENTIAL PRODUCTS OR SERVICES: SIC CODES:

Gasoline and diesel fuel storage and distribution for National stations in Colorado Springs

ESSENTIAL PRODUCT CAPACITY: 123,000 gallons storage capacity

OTHER PRODUCTS AND SERVICES: Other petroleum products delivered to all customers

AVERAGE NUMBER OF WORKERS: 8 NUMBER OF KEY WORKERS: 3

HOW LONG COULD ESSENTIAL PRODUCTS OR SERVICES BE PRODUCED (ASSUMING CONTINUATION OF MUNICIPAL SERVICES SUCH AS ELECTRICITY, WATER, GAS, ETC.)?

Average 50,000 gals/day in summer and 22.000 gals/day in other seasons (supply exhausted in 2-6 days). Supply would probably be exhausted during the CR initiation phase.

IF LESS THAN 2 WEEKS, WHAT INPUTS WOULD BE REQUIRED?

Product or Service	Quantity	Organization and Location
motor fuel	123,000 gal mo.	National refinery, Denver Wyco pipeline, Fountain

IF MANUFACTURING OR WHOLESALE FACILITY, HOW LONG COULD NORMAL DELIVERIES BE CONTINUED WITHOUT ADDED PRODUCTION OR RE-SUPPLY?

2-6 days

WHAT ARE YOUR NORMAL ARRANGEMENTS FOR TRANSPORTATION OF YOUR PRODUCTS?

2 company tank trucks (1 - 3000 gal, 1 - 2200 gal)

WHAT OFFICE OR LOCATION MAKES OUT PAYROLL CHECKS? PAYS OTHER BILLS?

Ponca City, Oklahoma. Checks forwarded by mail.

Figure 4 (concluded)

-2-

WHAT INFORMATION ON FINANCIAL ASPECTS IS RECORDED LOCALLY? HOW TRANSMITTED?

Sales records forwarded to Ponca City by mail.

ON WHAT BANKS ARE PAYROLL CHECKS DRAWN?

Doesn't know.

DOES THE COMPANY HAVE BANK ACCOUNTS IN ANY BANKS IN HOST AREAS? WHICH BANKS?

No

WHAT OTHER PROBLEMS MIGHT BE ENCOUNTERED IN OPERATING DURING A CRISIS RELOCATION?

A "bottom loading facility" whereas "top loading" more common in area. Thus their tank trucks might be of limited use for other facilities.

Facility has railroad siding and pumping equipment so that capacity could be increased temporarily.

Absenteeism probably not a problem since most of the staff can perform most or all required functions.

This facility supplies 14-15 % of sales of its products in city. There are 10 other suppliers of these services.

Other Notes:

This facility could be closed down after supplies are exhausted and fuel could be shipped in by truck directly from the refinery and pipeline terminal.

State tax reports indicate gas sales by company and locality.

role of essential industry should be provided so that the facility representative can enter into the discussion in a creative manner. The voluntary, non-confidential nature of the interview should be clearly stated to the representative so that he will understand the appropriate limits of information that he should provide. Depending upon government policy decision up to the time of the interview, the person making the survey should provide any other information related to established government policies that might increase incentives for industry participation in the planning process (i.e., priorities in financial support, resupply, government contracts, etc.).

In obtaining information from the facility representative, it is necessary to supply enough information so that the representative can provide a relevant answer. For example, with respect to essential products and services, the specific product required, production goal, product delivery and packaging, etc. should be described so that the representative can determine the number of key workers, the production level, and possible financial impact of production and delivery changes. It might result that the original production goal might not be reasonable (because of cost of loss of by-products, inefficient level of operation, etc.), in which case information could be gathered as to more efficient production goals for the facility. An example for Colorado Springs would be the production at Sinton Dairies, Inc. Elimination of any by-product to fluid milk, such as creamery butter, would increase costs of producing the remaining products. Also, operations below 100 percent would adversely affect unit costs.[12]

4. Financial Issues in Local Industrial Planning

Any change in industrial operations of the facility will have a corresponding financial impact. Problems of immediate interest would include payroll and other operating capital needs and implementing procedures. Smaller companies generally do business with banks in the same community or a surrounding service area, so that payroll checks and loans are generally made with local banks. Facilities that are part of a larger regional or national company might have more complex procedures. Checks of larger companies are often produced by computer in one city and drawn on a bank in an entirely different region of the United States. With the curtailment of mails, payroll checks could not be delivered using normal procedures. To make payroll checks or any other disbursements to workers available, advance planning would be required. Many of the larger companies with accounts in banks throughout the service

region could arrange for some disbursements for payroll and other essential payment through accounts in host area banks by augmenting balances and developing payment and emergency record procedures in advance.

As an example, the Colorado Interstate Gas Company office in Colorado Springs transmits data on employee hours by remote terminal to the company's office in Houston, Texas. At this location, computerized systems produce the payroll checks and then these checks are mailed to the individual or a designated bank in Colorado Springs or elsewhere. The checks are drawn against company accounts in the Continental Illinois Bank of Chicago.[13] Consequently, if payroll checks or any disbursement to employees were to be made available, some modifications in the standard procedures would be required. One such procedure would be to pay out funds from accounts currently located in host area banks, with some standardized level of payment not requiring determination of actual hours worked, and with readjustments made subsequent to the crisis relocation. Many of the smaller companies would have manual accounting procedures and would therefore be less dependent upon computer service centers and communications than the larger companies.

Many companies, especially the smaller companies, would have great difficulty in meeting payrolls following curtailment of incoming payments of accounts receivable. Some form of credit would have to be arranged for such companies as part of the industrial planning process, if they are expected to make payments to key employees during the CR-Maintenance Phase, or to continue operations in the immediate aftermath.

5. Technical and Operational Problems in Local Industrial Planning

Implementation of facility plans would also be dependent upon the identification and resolution of key technical and operational problems that would restrict the capacity of the facility to function as a part of an emergency system. As an example, the utility of an oil company depot in Colorado Springs as part of a gasoline supply system might depend upon solution to the compatibility problems in tank truck loading. The depot and associated tank trucks are a "bottom loading" facility while most other depots and trucks in the area are "top loading."[14] Dairy production provides another example. While a dairy firm could increase deliveries of milk to host areas, the amounts available might be constrained by limitations on available commercial storage of refrigerated products in these areas.[12]

Alternate and more efficient methods of operating in an emergency should be identified in on-site interviews and planning efforts. In the case of the oil depot, instead of resupplying the depot, tank trucks could run directly from the refinery or pipeline to the users.[14] The problem of refrigerated products storage might be ameliorated by scheduling more frequent pickups at the wholesale outlets or congregate care centers by users of the products. Delivery of the product (fluid milk) could also be made in larger containers (6-gallon) of which there is a 30 day supply in the Colorado Springs area.[12]

6. Essential Facility Planning Guidelines

The preceding investigations suggest the economic planning required for any facility designated as an essential facility. Among the information would be: identifier and descriptive data, substantive information on inputs and outputs, designation of specific key workers, plans for host area accommodations and transportation, financial plan to assure functioning during and after CR, emergency plans for production during CR and for reconversion to peacetime production.

The exact format and details contained in such a facility plan should be the subject of further investigation. However, a brief survey of some of the major factors can be made here. A prototype listing of detailed requirements is presented in Figure 5. The identifier data should be sufficient to allow the local and regional planner to quickly categorize the industry as to product, organization, location, and identification of principal company contact. Description should contain not only a listing of essential products and services but also non-essential activities together with the relative importance of each (e.g., percent of normal sales). It would generally be better to select a facility with 90 percent of activities considered essential than a facility with only 10 percent essential. The higher the level of production, the more efficient the production, and the smaller the added costs of production.

Substantive information on inputs and outputs should include identification and requirements from key suppliers: identification and requirements of those organizations designated as recipients of the facility's products and services; and current inventory data relating to essential product production. In order for the facility to function, key suppliers would have to be identified and arrangements would have to be made with local and regional planners to assure that these suppliers or alternate suppliers were designated as essential, and

Figure 5

COMPONENTS OF A COMPANY PLAN FOR CRISIS RELOCATION
(ESSENTIAL INDUSTRY)

Identifier Information:

- Organization name
- Facility location
- Facility name
- Contact person
- Telephone number

Description of Products and Services:

- Essential services
  - Name
  - SIC identification
  - % of sales
- Non-essential services
  - Name
  - SIC identification
  - % of sales

Key Supply Inputs and Key Suppliers:

- Name of company
- Type
- Quantity
- Contact

Inventories:

- Essential products or services
  - Finished inventories
    - By name
    - Normal supply in days
  - Unprocessed, in-process
    - By name
    - Normal supply in days

Run-out Production Time

Priority Customers (updated during crisis):

- Name
- Location
- Type
- Quantity
- Contact

Key Workers:

- Names
- Schedules
- Functions

Host Area Plan:

- Evacuation site for workers (essential, non-essential)
- Contacts with host area government and agencies
  - Names of agencies
  - Services
  - Contacts

Financial Plan: Accounts to be used.

- Bank: function, location, contacts
- Payment policy for workers, for suppliers
- Invoicing and accounts receivable plan during and after crisis
- Financing plan on return from CR

Figure 5 (concluded)

Conversion or Shut Down Plan:

- Items or services to be produced during CR-Maintenance Phase
- Production lines or equipment to remain in operation
- Operating conditions, schedules, etc.
- Checklist of actions for conversion to CR production
- Assignments for carrying out functions

CR-Reconstitution Plan:

- Schedule of reconversion to peacetime production
- Inventory replenishment
- Checklist of actions for reconversion
- Assignments of functions

that plans for supplier support were completed. Examples might be transportation companies for delivering products; continued supplies of fuel, electricity, and water; and possibly packaging for products, etc.

Because of changed production objectives, not all customers would be supplied with the product of the essential facility and not in standard amounts. Priority users of the product must be specified in the plan: whether they are to support final demand (such as food items), or to supply some other essential industry (e.g., containers for food items, etc.). Priority specification would assure efficient levels of production and efficient distribution of the product or service. Part of this effort would be to determine whether the customers would continue to function in the CR period, what amounts would be expected, and where delivery of the products or services would be made.

Because of the desirability of limiting the number of workers in risk areas, efforts would be made to limit the number of suppliers to an essential facility. To the extent possible, consideration would be given to functioning on manufacturers' inventories. In the facility plan, possible bottleneck items in the inventory would have to be identified. Using this information and specified production levels, the planner should estimate the time that the facility could produce without resupply of various inventory items (i.e., run-out production time). If this time were to meet the criteria for duration of production, then the supplier might not be included as an essential producer, or other usable inventories should be identified and earmarked for use. Consideration given to identifying essential facilities and assigning production levels would take into account the inventory problem.

Having determined production requirements, industry planners should determine the type and number of production workers required in the facility. Rosters of individual names should be developed together with locater data, and plans should be made to organize and train these individuals at an appropriate time prior to CR (i.e., possibly in the pre-CR crisis period). Specific operations to be performed by various individuals should be assigned, and the schedule for accomplishing these operations should be set up.

The integration of the facility's key workers and their families into the host area plan should also be developed. Location and space designated for this group should be identified, and means of transportation developed. Names of agencies, services, and contact points in the designated host area should

be part of the facility plan. This type of integrated plan will help to keep the work force together during the CR-Initiation Phase; provide the basis for rapid start-up of emergency production; provide some assurance to key workers that their families will be cared for; and prevent absenteeism before, during, and after CR initiation.

Financial planning for emergency operations will be an important part of the facility plan. If some payment mechanism involving cash payments were to be adopted for the CR-Maintenance Phase, then the facility would have to assure the availability of working capital for this period, and determine the sources of such capital (current accounts, new bank credit, etc.). If the company has bank accounts in the host area banks, possibilities for transfers of funds to such accounts, and payments using these accounts should be investigated. Arrangements would have to be made as to the amount, timing, and mechanisms for paying workers. Minimal acccounting procedures should be planned by the company for post-CR reconciliation of payments and receipts. Since some companies use bank or service center accounting and payment services, which may not be functioning, expedient manual accounting and record storage procedures might have to be devised. Possible financial requirements for rapid post-CR start-up would be one of the key considerations in developing the plan.

The plans for conversion to CR production and reconversion to post-CR production should be developed by each facility. The plans should indicate stepwise modifications to produce the required products and services, including production lines and equipment to remain in operation, operating conditions and schedules, and assignments of key personnel. Other features could include: use and control procedures for inventories and equipment, modified distribution plans, etc. Reconversion plans should include ordering schedules for depleted inventories, schedules for start-up of activities and re-employment of workers, and other items.

7. Local/Regional Support of Essential Industry

Local and regional planners would play key roles in the development and implementation of essential-industry production plans. As discussed earlier, local and regional planners would be deeply involved in identifying specific production facilities and assisting in development of specific facility production plans. In addition, local and regional plans must provide for the other necessary support services and capabilities not directly associated with a single production facility.

For production requirements to be fulfilled, the individual facilities must be able to function as a part of a local and regional production system. To meet this requirement, the local and regional plans must include provisions for the infrastructure necessary to support the production system -- i.e., such inputs as utility services, supplies, transportation control, security, communications, and other services. The plan must also consider the jurisdictional interactions needed to support risk area production (e.g., interactions between risk and non-risk areas, and between local and State operations). The economic/industrial considerations would be imbedded in a more general plan. Some of the features of such a plan and the scheduling for their implementations were developed by Rainey.[15] In this present study, consideration is restricted to economic/industrial elements of the local and regional support plan. Major elements are indicated in Figure 6.

The general information requirements for essential industial facilities have been discussed previously. In the plan it would be especially important to distinguish between the primary facilities (e.g., those that must produce on a regular basis during CR) and the secondary facilities (e.g., those that might have to support production on an "on call" or intermittent basis). There is a tendency for local planning to include every type of business that could conceivably be needed during CR. However, the basic concept is to reduce the requirements for presence in the risk area to a minimum. The local/regional plan could simply assure that the key contact and key workers for secondary operations are on call in the host areas. This provision implies a requirement for maintaining the integrity of such secondary organizations during the CR-Maintenance Phase.

Local and regional efforts would also have to include plans for the disposition and support of key workers required to operate essential industry in risk areas. Key worker support would include the provision of close-in housing for key workers and their families, as well as shelter in and out of the risk area, and commuting arrangements. Details of this type of plan are included in the basic CR guidance.[16] From the economic viewpoint, provisions would have to be made to finance this operation and to provide a workable record and payment mechanism for products and services used in these operations (see Section III).

In order for the essential facilities to function, the planning must ensure that the support services would be provided. Some of the support, such as

Figure 6

PLANNING ELEMENTS FOR LOCAL/REGIONAL
SUPPORT OF ESSENTIAL INDUSTRY

- o Identification and Characterization of Essential Industry
  - Primary
  - Secondary
- o Key Worker Support
  - Hosting
  - Sheltering
  - Commuting
- o General Support Services
  - Utilities
  - Transportation and Traffic Control
  - Security of Facilities, Supplies, etc.
  - Communications
- o Special Support Services
  - Standby Capabilities (i.e., fire, medical, etc.)
  - Mutual Aid
- o Jurisdictional Financial Plan
  - Authorized Payments and Procedures
  - Records
  - Sources of Funds
- o Schedule of Implementation
- o Assignments and Responsibilities for Support Services
- o Public Information on Economic/Industrial Affairs
- o Reporting Requirements and Procedures
- o CR-Reconstitution Plan

names and requirements from subcontractors and local suppliers, should be part of each facility plan. Local and regional planners would have to ensure that such suppliers were part of the essential-industry list or that suitable alternates were provided. In addition, other general support requirements would have to be identified and provided by the local and regional plan, including the provision of utility services. These would usually consist of both a local outlet and a regional supplier, as well as other services such as transportation, security, traffic control, communications, etc. On the basis of the accumulated information on essential-industry production and other activities, the local and regional planners would have to work with support service organizations to determine the demand levels that would be generated and the activity levels required of the support service organizations.

Illustrative of the planning problems involving both the industry and local and regional planners is the change in demands placed upon utilities. With the movement of people from risk areas and the shutdown of risk area business, the demand for utility services will decrease in metropolitan areas and increase in non-metropolitan areas. These areas are often served by different companies and have different maximum load service capabilities.[17] Recent investigations in Colorado[18] have indicated that with proper control of demand in host areas, electric power demands could be met. A similar situation faces the natural gas industry, where the metropolitan areas are served primarily by one set of companies (Colorado Interstate Gas Company), and the host area by another company (Western Slopes Natural Gas Company).[13] Initial indications are that the Western Slopes capacity would be sufficient to meet requirements in the host areas except for winter months when gas flow rate would be normally close to capacity.[19] In cases of possible capacity constraints, local and regional plans would have to include procedures for control of demand in host areas.

Change in demand for services on a regional level creates other problems and opportunities that should be at least identified by local and regional planners. In the case of the reduction in demand for the Colorado Interstate Gas Company, added costs would be incurred because of prior "take and pay"*

*"Take and pay" contracts require an industry to buy specified amounts of gas from producers during specified periods (i.e., per day, week, or month). Losses from this and other sources would likely be reflected in increased service rates in the post-CR period.

agreements for the purchase of gas from suppliers, and because of the drop in demand during the CR-Maintenance Phase. Some options might also exist for use of excess available natural gas as a means of preparing for post-attack recovery. Local utilities in Colorado Springs and elsewhere could convert quickly to use of natural gas[20] and thus could conserve reserves of coal which would survive a nuclear attack better than the natural gas system. Coal could be used in the postattack period to fuel remaining power stations,* and a variety of other facilities.

Special support needs would have to be considered in local and regional planning. Such needs consist of the unique requirements for local and State government services brought about by the CR conditions, and might include the obligations of each jurisdiction toward others in the CR-Initiation and CR-Maintenance Phases (e.g., mutual aid agreements). Included in these requirements would be those directly identified with economic/industrial operations--i.e., payments for government employees and contractual services during the emergency, assignment of risk area employees to host area jurisdictions for economic activities, expedient use of government equipment for transfer of currency, etc.

Each jurisdiction would also need to develop a financial plan for operations during and after CR. The plan would have to include mechanisms for payment including source of funds, means of transfer of funds, use of funds for purchases, etc. Of particular importance in this and other forms of emergency would be the preplanning as to the type of records to be kept of activities and expenditures. These would provide some ongoing control over operations and also provide the basis for settlements with other government agencies and jurisdictions.

The CR operations would not end with the resolution of the international crisis. Careful provision would have to be made for the return of the population and the rapid resumption of the normal economy. In the industrial sphere, local and regional planners would have to examine the support requirements to start up inactive industry, and the added requirements of industry production during the CR-Maintenance Phase. Disruptions of supply because of run-down in inventories, slow start-up, delays in return of employees, financial difficulties, etc. could be factors needing prompt attention by government agencies.

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*Thirty-six percent of generation capacity is outside the risk areas (reference 18).

These and other elements, such as schedules of implementation, assignment of responsibilities, public information on economic system, etc., should all be an integral part of the total local and regional CR plan. Information of this type would assist the national level in assessing the total requirements and problems of CR operations, and would assist local and regional authorities in the orderly implementation of the plan.

E. Planning Possibilities under Current Conditions

It has been recognized that current planning for civil defense emergencies is always limited by the available government planning resources and the degree of cooperation from the private sector. This consideration holds for emergency industrial planning as it does for other types of civil defense planning. Nonetheless, useful planning results can be, and have been, achieved within these limitations. Under current conditions, planning for industry would probably have to be done primarily by government planners with limited support from industry.

At the national level, it would appear feasible to establish the minimal national CR production levels by industrial sector for population subsistence and possibly for other clearly specified demands (i.e., military, etc.). Similar estimates could be made for State level production if existing detailed data were made available by the Bureau of Census. Such national and State level estimates would provide useful guidance for identification of essential facilities at local and regional levels and would provide a more accurate method of estimating the numbers of key workers and associated logistic requirements.

Selective planning at regional, local, and facility levels would provide a useful basis for rapid completion of planning during crisis. Currently, planners could develop local industrial data bases containing facilities from industrial sectors designated as essential. Using national and regional planning criteria, this data base could be screened to identify in each local area a selected group of facilities that would be earmarked for additional planning efforts. While the development of complete facility plans for all essential facilities during peacetime is probably unrealistic, such plans could be developed now for key support facilities such as utilities, major banks, fuel production, etc. Companies in these industries are usually large and closely regulated, and have generally been engaged in emergency planning. In the case

of utilities, highly developed plans for many types of emergency already exist which could be adapted to the CR situation. Major commercial banks are also familiar with emergency planning for civil defense and have already undertaken some civil defense measures (i.e., remote storage of records). Development of detailed plans for such supporting facilities would ease the planning problems faced by other industrial facilities as well as contribute to the development of local and regional government CR plans.

Selective development of facility plans in other industries might also be possible. Some of the major companies in various essential industries could be motivated to develop such plans. The plans could then be used as examples by other facilities in the same industry, prior to or during crisis. Information from sample plans could also be used at regional and national levels to develop guidance and planning factors for current industrial planning. Such selective planning under day-to-day peacetime conditions over a period of time would result in a rudimentary capability for conducting crisis relocation operations. More importantly, during the early stages of a deepening crisis, when there is likely to be greater interest and cooperation in civil defense, the results of such selective planning would be available for use as the starting point in a surge program for a rapidly improving capability.

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V. ESTIMATION OF ECONOMIC IMPACT OF CRISIS RELOCATION

A. Summary of Types of Economic Impact on Elements of the Economy

The previous report in this series[1] identified qualitatively the impact of CR upon various elements of the economy: the individual, non-financial business, financial institutions, and local/State government. Each element was shown to have its own characteristic problems and to contribute to the problems of the economy as a whole. Identification of these problems and their proper positioning in time with respect to the crisis is the required initial step to quantitative estimation of economic impact and the development of measures to ameliorate these effects. Table 16 presents information summarizing some of the major problems affecting the economic elements over the various phases of the CR emergency (pre-CR Crisis, CR-Initiation, CR-Maintenance and CR-Reconstitution).

During the pre-CR Crisis Phase, the individual would be faced with reduced income and reduced access to liquid assets at a time when increased individual demand would occur for many products and services. Business would be operating under these conditions of changed demand and would face increased absenteeism of staff as well as changed policies among other business firms (i.e., changed production, prices, inventory policy, etc.). Business could also find restrictions placed on use of liquid assets and credit which could impede production. Financial service organizations, such as commercial banks, would face increased withdrawals, emergency banking regulations, and reduced availability of interbank loans. Local and State governments could be affected by a reduction in certain types of tax and service revenue, increased demands for payments, restrictions on liquid assets, increased costs associated with emergency preparations, and general cash flow problems.

The initiation of CR would seriously disrupt financial and other business operations in both risk and non-risk areas. During this period of several days, transactions between individuals and operating businesses might be very limited by lack of an acceptable means of exchange. Financial services normally in risk areas would probably not function during this period until employees had been relocated and emergency banking procedures instituted. Local and State governments might incur greatly expanded costs associated with performing CR emergency functions.

Table 16

SUMMARY OF PROBLEMS TO BE FACED IN CRISIS RELOCATION

Operational Phase	Individual	Business	Financial	Local & State Government
Pre-CR Crisis	Selective unemployment Changed consumption Reduced savings Reduced access to savings & investments	Production shutdowns Inventory liquidation Deferral of payments and expenditures Reduced access to investments Reduced access to credit	Increased withdrawals Reduced savings Reduced receivables Reduced interbank funds Manipulation of controls	Reduced tax receipts Increased costs Delayed interest payments Increased cash flow
CR-Initiation	Stoppage of income Emergency costs Cash shortage Unacceptability of checks and credit cards	General shutdown Freeze on assets and payments Security problems Distribution stoppage	Shutdown of risk area bank services High service demands in host areas Security problems Shutdown of security exchanges	Curtailed service income Greatly increased emergency costs Restricted access to liquid assets
CR-Maintenance	Loss of employment income CR-Maintenance expense Cash shortage Restricted access to liquid assets Overdue obligations Security of assets	Shutdown of most risk area business Support of essential industry Expansion of host area industry Stoppage of accounts receivable Distribution problems	Control of withdrawal Credit restrictions Increased net borrowed reserves Reduced interbank borrowing Reduced profits Reduced debt payments	Reduced regular income Increased emergency costs Controlled access to funds Accelerated payment Dependence on inter-government revenue
CR-Reconstitution	Slow re-employment Lower income Reduced liquid assets Overdue obligations Changed consumption patterns Reduced savings	Slow buildup of production Slow buildup of demand Depleted inventories Inadequate working credit Production inefficiencies Loss of asset values Reduced financial stability Reduced access to credit	Check clearing backlog High level of float Maintenance of bank liquidity Difficulties with meeting credit demands Record reconciliation Low savings rate Phasing out of controls	Reduced revenue Inter-government claims Increased welfare costs Payment of accrued obligations Depleted liquid assets Reduced asset values Reduced tax base

The CR-Maintenance Phase, with an expected duration of one to several weeks, would include the resumption of limited economic activity, but many of the economic problems would continue to increase in difficulty. The individual would find himself in an unfamiliar environment, displaced from peacetime employment, with little currency on hand, and restricted access to credit. While government guidelines specify that essential support be provided to those with inability to pay, many individuals would be unable to supplement the basic subsistence provided and would be under pressure because of the continuing accumulation of bills from prior obligations. Other evacuees with cash might be able to compete for goods and services with the indigenous host area population, creating the need for some form of controls. Business in risk areas would be limited primarily to essential industry. For closed business enterprises, costs would continue to accumulate. Concern would also be expressed about the security of facilities and other assets left in risk areas. Essential industries in risk and non-risk areas would need financial support to continue production in the face of higher production costs. State and local governments in host areas would experience greatly increased costs associated with maintaining the relocated posture.

The magnitude of many of the problems created by the crisis would become apparent after the peaceful resolution of the crisis. During this CR-Reconstitution Phase, many individuals might still experience unemployment and lower income because of slow start-up of some businesses. At the same time, the accumulation of overdue obligations would further strain the individual's financial situation. To ameliorate this condition, the Federal guidance suggests the possibility of a moratorium on payment of bills.[2] Nonetheless, the bills would have to be paid eventually and probably should not be too long delayed if business recovery were to occur promptly. Business would have to deal with demands changed by the losses to customers' incomes. Small to moderate sized businesses, which depend heavily upon uninterrupted payment of accounts receivable, might experience considerable difficulty in resuming operations because of depleted working capital, depleted stocks, and the further delays in payments caused by the moratorium.

Banks would undertake to reinstitute normal procedures and work off the transaction items (checks, etc.) accumulated during the CR-Maintenance Phase. Thus banks would be under pressure to meet a greatly expanded demand for credit from businesses resuming operations. Maintenance of bank financial structure

and liquidity could also be strained by a slowdown in receipt of debt service payments, lower savings rates by individuals and businesses, and higher costs of interbank borrowing. Local and State government would experience substantial increases in welfare cost and unemployment payments, while trying to recover some of the costs of services delivered during the CR emergency. The financial condition of some local governments might be further strained by reduced taxes and service revenues.

B. Costs of CR Maintenance

At this point in the understanding of CR operations and events, cost estimates related to crisis relocation must be considered to be speculative. Nonetheless, such estimates can at least assign general cost dimensions to significant CR activities and give some understanding of the relative costs. Relative costs, in turn, could provide an initial basis for identifying relative need for increased efficiency or modifications of approaches in CR operations. The approximate costs of CR activities could also be useful in comparisons with the costs of other crisis events giving rise to the CR operation.

For the purpose of deriving initial cost estimates, a number of assumptions about the CR operations have to be made. In the current context, it was assumed that about 80 percent of the population of all U.S. urban areas would be relocated and that 90 percent of all risk area workers would be relocated or otherwise displaced from usual employment (i.e., only 10 percent of risk area employees continuing there as essential workers). All host area employees were assumed to continue at normal employment. The base period used for calculations was 1975. Table 17 presents a summary of results in terms of daily costs and cumulative costs for a two-week CR-Maintenance period.

For the individual, the principal cost would be the loss of salary because of shutdown of employers' establishments in the risk areas. Over 73 percent of workers are employed in urban areas,[3] so that after allowing for essential workers, about two-thirds of the U.S. non-government work force would be without usual employment. If alternative work opportunities and compensation were not provided, the loss would be approximately $1.3 billion per day in 1975 terms.[4] This loss would probably not be completely absorbed by workers because of deferred payments by employers under pre-existing agreements, unemployment benefits, alternative work assignments in host areas, etc. A possibility also exists that part of the loss of salaries could be made up by accelerated

Table 17

SELECTED DIRECT COSTS ASSOCIATED WITH CR-MAINTENANCE PHASE

Cost Factor	Direct Cost (1975) $Billion/day	Direct Cost (1975) $Billion in 2 Weeks
Salaries (non-government)	$1.3	$18
Risk area business (MVA)*	2.0†	28†
Risk area business (fixed costs)§	0.35	5
Financial sector (added costs)Δ	0.02	0.3
State and local operations added cost≠	0.3	4
Subsistence of evacuees	0.5	7
Other evacuation costs: commuting	0.03	0.4
relocation and return	N.A.	2
Shelter upgrading and recovery (for evacuees)	N.A.	6-18
Local government revenue loss	0.05	0.7
TOTAL	$2.5	$43-55

*Less government, financial, and agriculture

†Not included in total

≠Own personnel only; 12-hour day plus minimum operating logistics

§Not including salaries

ΔAdded check clearing costs plus interest loss due to 15% depletion of demand deposits

production and longer work hours after peaceful crisis resolution. However, as will be discussed later, worker income could increase or decrease in the early post-CR period depending upon government policies adopted during that period.

Losses to private businesses in risk areas from shutdown could also be significant. Again, allowing for essential industry, about two-thirds of the production (value added) in the United States would be curtailed. In value added terms, the cost would be about $2.0 billion per day. Actual losses might be reduced by above average production in the post-CR period. Actual expenditures or accrued costs during the period would be related to business fixed costs. For all businesses, fixed costs are about 17 percent of total expenditures or about $0.35 billion per day. Fixed costs would be higher for selected industries such as manufacturing (30 percent) and utilities (46 percent).[4]

As discussed in the preceding section, the financial sector would have a number of unique problems in CR. With banks functioning to maintain a payment mechanism, the cost per transaction might increase by 50 to 100 percent; however, the number of transactions might be maintained well below normal so that added total costs to banks might not be significant. Some losses would occur because of interest forgone in delays in check clearing and debt payment. The principal costs as suggested in the preceding sections would be the losses in income consequent to withdrawals by depositors, and other asset management problems. Withdrawal of 10 to 15 percent could equal the banks' total liquid assets (excluding float).[1] Within these assumptions, total added costs to banks could be about $0.02 billion per day.

Subsistence costs of the evacuees would be another significant cost associated with the CR operation. Feeding of evacuees could vary widely depending upon the mode of feeding, payment policies, and other factors. Using the mass feeding approach common with the Red Cross and other relief agencies (feeding each individual two hot meals every day), employing volunteer labor for low skill positions, etc.), cost is estimated at about $5 per day per individual, or about $0.5 billion per day for all evacuees. Free feeding of all the population would cost over $1 billion per day. It is customary in emergencies to use public buildings for lodging evacuees, with the relief agency paying only for additional maintenance costs during the occupancy period.[5] In CR, commercial buildings are also used so that there is an "opportunity cost" associated with

alternate (regular) use of the space. However, these costs are negligibly small compared to other subsistence costs.

Relocation (to and from the host areas), using a mix of buses and private automobiles and a relocation distance averaging 100 miles, would result in a cost of about $2 billion. Commuting costs (10 percent of risk area workers), assuming 40 miles (one-way) by a mix of private autos and buses (3.5 persons/car) could result in a cost of $0.03 billion per day. These figures assume full allocation of standard auto costs to the miles driven. If fixed costs are not considered, then total costs would be only about one-half to one-third those indicated above.

Shelter costs would be another variable adding significantly to the costs of a CR operation. These costs would depend upon a number of factors that are at present only partly understood, including the number and type of shelters and shelter mixes, the policy relating to reimbursement for labor on shelters, the degree of completeness of property recovery subsequent to CR resolution, and other factors. As the basis for a cost estimate for present purposes, it was assumed that fallout protection was provided in host areas for 100 million evacuees with one-half of these in upgraded shelter in existing buildings and one-half in expedient shelters. Host area residents were assumed to develop their own protection using instructions from the local government agencies.

Using recent estimates of shelter space costs for these types of shelters,[6] total costs could range from $6 to $18 billion depending upon payments made to unskilled labor (ranging from 0 to $6.85 per hour). Of these amounts, recovery costs of property after the termination of the relocation is estimated to range from $2.6 to $7 billion.

Cost to local and State government would result from losses of revenue and the costs associated with emergency operations consequent to the CR operation. Local government in the risk areas would suffer losses of some taxes (i.e., sales, etc.) and revenue for various services normally provided to the population (e.g., city owned utilities, homeowner services, fees, fines, tolls, etc.). Estimated costs for all risk area cities would be about $0.05 billion a day, which represents a small fraction of total city revenues. State revenues would be affected primarily by a reduction in the taxes levied against economic activity (i.e., sales taxes, income taxes, gas taxes, etc.), all of which would suffer during the CR-Maintenance Phase and thereafter.

Major costs to local, State, and Federal governments would be associated with the control and maintenance of the CR operation. In a sense, these costs can be considered to be deferred defense costs which probably should be considered part of total defense effort. However, for comparative purposes, estimates of some of the principal costs have been presented in Table 17. These costs could equal or exceed the costs incurred initially by private business and individuals. Under traditional concepts, government employees would continue to receive or accrue salary payments during the CR-Maintenance Phase and would be assigned tasks to assist in the support of CR operations. Total local and State operations costs (own personnel only) and subsistence of evacuees are estimated at about $1.0 billion per day ($0.5 billion for subsistence, and $0.3 billion or more for operations). The use of contractor personnel and military personnel could increase operations costs significantly.

Costs that might be attributed to CR might well be considered in terms of private sector costs and government sector costs. The actual identification of which costs will be paid by which sector is as yet still unresolved. In the present estimates, we examine the case where the private sector meets the costs and losses related to private economic activities, for a 2 week CR-Maintenance Phase and the government funds all essential services to evacuees and all costs of emergency operations and shelter construction. Under these ground rules, initial estimates indicate a total initial cost in the private sector to be on the order of $20-25 billion (this figure includes losses of salaries and private business fixed costs). Government costs with this approach might be in the range of $20-30 billion. This would include the costs of shelter construction, movement and commuting of evacuees, subsistence of evacuees, and losses of government revenues during the CR period.

These are large but sustainable costs in view of the crisis situation and not unreasonable in light of other defense costs incurred during this same period. The strictly CD defense costs are, in effect, payment on a defense system long deferred, and thus might be viewed as part of the defense budget. The expenditures by the government for services in this period might be desirable in any case, since such payments tend to reduce losses of individuals and businesses and thus provide a better basis for rapid recovery after the peaceful resolution of the crisis.

C. Method for Estimating Economic Impact of Crisis Relocation

1. General Considerations

The implications of direct losses to the economic system can be studied with the use of macroeconomic models. One such model is TEMCRIS II, originally formulated to forecast the impact of a shock, such as crisis relocation, on the economy as a whole. The model comprises 19 equations which allow determination of 19 endogenous variables as a function of 17 variables determined outside the model (exogenous variables). Because TEMCRIS II is a macroeconometric model, these variables are aggregated at the national level; thus, the model includes no sectoral detail on particular industries or products. In overall structure, TEMCRIS II is an aggregate model, for included among the dependent variables are all the non-governmental components of final demand (with the exception of net exports and inventory changes): consumer expenditure on durables and non-durables, gross investment on residential and other structures and equipment, and demand for and supply of credit funds by major categories.

The model has been designed to serve as a tool to aid in policy decisions, allowing the screening of alternative policies. Thus, it can provide insight as to which policies are inferior, and which bear further investigation. Various Federal agencies are involved in formulating the national policies in event of a national crisis, and TEMCRIS II is designed to serve as a bridge between DCPA and other agencies concerned with carrying out the national planning.

The following pages present the background for, and usefulness of, a model capable of appraising economic impacts resulting from disruptive events; and the general approach for developing such a model. The development of TEMCRIS II is then presented, followed by a description of the model, some of the results derived by testing its capability for analysis of scenarios and alternative policies, and the sensitivity of the results in expressing transient impacts on the economy.

2. Background for Use of Models

Regardless of measures taken to control economic problems during crisis relocation, substantial losses to the economy are inevitable. Such losses would be greater than those historically associated with a natural disaster, but certainly much less than those associated with a major war. As indicated in the preceding section, losses up to the beginning of the CR-Reconstitution Phase would probably be on the order of tens of billions of dollars. Although

these losses could be absorbed by the economy, prompt actions would be required to prevent continued economic dislocation in the subsequent period.

Major questions include the distribution of losses among specific economic sectors and the ability of the economy to absorb these losses without unacceptable increases in interest rates and unemployment, or losses in GNP, personal income, consumption, and other unfavorable outcomes. The speed of the national economy's return to normal in the crisis relocation aftermath will depend on government measures taken to control and ameliorate the impact of the initial losses. Final decisions relating to government measures may not now be possible; however, the effectiveness of future decisions would be enhanced by establishing the general dimensions of the initial losses, and by analyzing the impact of such losses on the recovery in subsequent periods. Such information would also allow assessment of the relative effectiveness that could be expected from alternative economic policies designed to increase the pace of recovery after crisis relocation.

Appraisal of the ultimate economic impact can proceed by making estimates of the initial economic conditions after relaxation of CR, and then tracing the resulting impact of these conditions through the economic system. This approach requires the use of economic models that allow prediction of economic effects over time.

3. Approach for Estimating Economic Impact

The changes in the income, expenditures, and assets of various individual economic units, when taken in the aggregate, constitute the economic losses initially sustained by the national economy from crisis relocation. The approximate overall impact can be determined for any given CR scenario by examining the specific impact of losses on various economic sectors (e.g., individual, business, etc.). The basic steps in the analysis of the economic impact are:

- o Develop crisis situations and identify major characteristics of alternative scenarios that have an impact on the economic sectors.
- o Determine the extent of the economic disruption and loss for each economic sector during each of the crisis phases, for each of the various crisis scenarios.
- o Relate the economic loss for each major economic sector to various aggregate measures of the national economy.
- o Determine the economic consequences of these losses.
- o Analyze the relative effectiveness of alternative governmental policies

in ameliorating losses incurred by major economic sectors during the crisis phases.

- o Determine policies that best contribute to the recovery of the national economy.

Since the economic impact of crisis relocation is highly dependent on the events before and during relocation of the population, it is necessary to identify the major characteristics of alternative scenarios that affect income, expenditure, and assets of the economic units. Relevant characteristics include the intensity of the crisis confrontation, the length of the crisis buildup phase, the degree of implementation of crisis relocation, the length of the relocation maintenance phase, the nature of economic activity during the maintenance phase, and the extent of delays in resuming pre-crisis levels of economic activity. These characteristics in varying degrees determine the extent of economic losses on the specific economic sector.

Once the characteristics of alternative crisis scenarios have been identified, the extent of the economic loss on each major economic sector during each of the crisis phases can undergo analysis. The magnitude of the disruption to, and resultant loss on, each economic sector during each of the CR phases can be determined in such terms as: work time lost; production lost, reduction in earnings; buildup of obligations; reductions in profits; changes in personal and business savings; losses in income of businesses; and reduction in the amount of individual, business, and local government liquid assets.

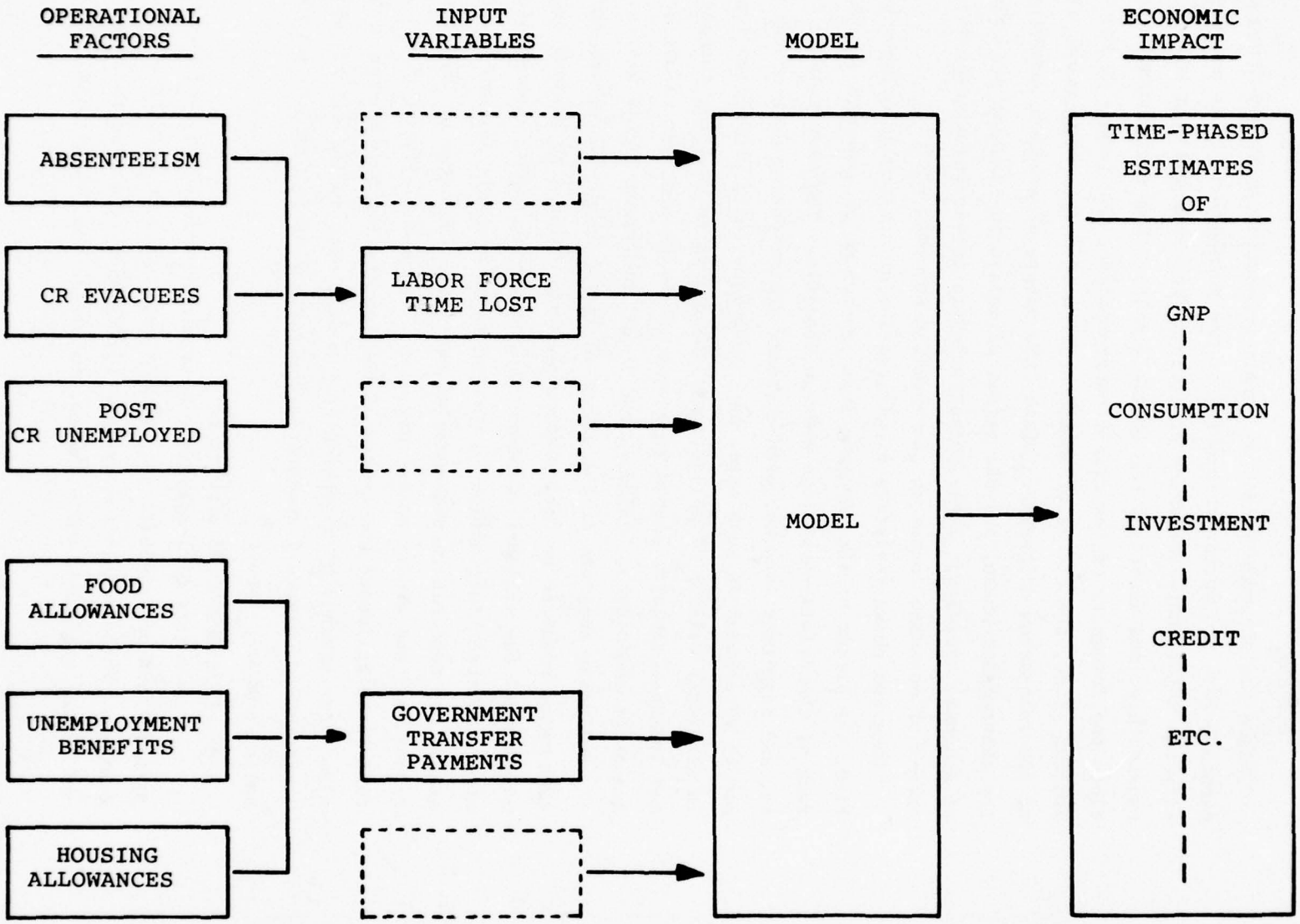
Following analysis of the extent of the economic disruption and loss on each major economic sector, consequences are related to various aggregate measures of the national economy. An econometric model that explicitly recognizes important interactions occurring in an economic system can be used to assess the economic consequences of the losses incurred on GNP, consumption, investment, and credit market behavior. Transient effects of the initial losses that could influence the course of the economy for many months or years can also be determined by an appropriate model, such as TEMCRIS II, which is presented next. Figure 7 summarizes the various steps that are involved in estimating economic impact.

4. Development of TEMCRIS II

A variety of large-scale econometric models are used by various federal agencies and other public and private organizations to forecast the nation's economy. These models are systematically used to assess the impact of monetary and fiscal policies, and at times, to assess the likely impact of specific

Figure 7

ECONOMIC IMPACT ESTIMATION



economic disruptions such as the recent oil embargo and coal strikes. Although an existing large-scale model could be used to analyze the impact of crisis relocation, the model would not allow the assessment of widely differing policies that are scenario dependent within the constraints of available time and resource.

A simplified econometric model was developed, therefore, specifically for the purpose of studying economic impact in the crisis aftermath, and was presented in the Phase I report. The original model used only nine equations, and was based on national annual economic data for the period 1955 through 1974. In the exercise of the original model, it was found that annual data submerged interactions that occurred within the time period of a year, an undesirable characteristic in forecasting impacts of short-term events. In addition, it was found that wide-ranging variations in the elements entering into any one variable could be obscured when only nine equations were used to appraise impacts on the national economy.

TEMCRIS II was then developed to improve the capabilities of the original model. The data base for TEMCRIS II consists of the national quarterly economic data for the past 13 years, published by the U.S. Department of Commerce and the Federal Reserve Board, instead of national annual economic data, which were used in the original model. Furthermore, in TEMCRIS II, monetary values are expressed in terms of real 1972 dollars, information that became available after the original model was developed. In addition, to provide the finer breakdown of variables deemed necessary, the original nine equations were increased to 19, with an accompanying increase in the number of variables. For instance, where the original model contained a single variable, Availability of Credit Funds, TEMCRIS II contains that variable, and component parts, such as Availability of Funds to the Household Sector, Availability of Funds to the Business Sector, and the Availability of Funds to the Government Sector. Tests indicate that the additions serve the present needs of the model to allow screening of alternative policies in terms of transient impact on the economy. The policies tested are only illustrative; however, results are discussed to illustrate the capabilities of the model. A requirement exists to undertake a careful cost/benefit analysis of promising policy alternatives. Such analysis may require further modifications within TEMCRIS II.

5. Variables Used in TEMCRIS Model

Table 18 summarizes the various macroeconomic variables that are used in TEMCRIS II. Some variables, characterized as endogenous variables,

Table 18

DESCRIPTION OF THE MODEL VARIABLES

Variable Description	Symbol
Endogenous Variables	
Consumption Expenditures for Non-Durable Goods and Services ($ billion)	CEEG[a/]
Consumption Expenditures for Durable Goods ($ billion)	CEDG[a/]
Gross Investment in Residential (Household) Structures ($ billion)	GIRS[a/]
Gross Investment in Other Structures and Equipment ($ billion)	GISE[a/]
Percent Change in Prices (based on the GNP Price Index, 1972=100)	PCHP[a/]
Demand for Credit Funds Advanced to the Household Sector in the Credit Market ($ billion)	DCFH
Demand for Credit Funds Advanced to the Business Sector in the Credit Market ($ billion)	DCFB
Demand for Credit Funds Advanced to the Government (Federal, State, Local) Sector in the Credit Market ($ billion)	DCFG[a/]
Availability of Credit Funds to the Household Sector in the Credit Market ($ billion)	ACFH[a/]
Availability of Credit Funds to the Business Sector in the Credit Market ($ billion)	ACFB[a/]
Availability of Credit Funds to the Government (Federal, State, Local) Sector in the Credit Market ($ billion)	ACFG[a/]
Interest Rates for Households	INTH[a/]
Interest Rates for Business	INTB[a/]
Interest Rates for Governments	INTG
Excess between Demand and Availability of Total Funds in Non-financial Sectors in the Credit Market ($ billion)	DCF-ACF
Availability of Total Funds Raised in the Credit Market ($ billion)	ACF
Gross National Product Gap, i.e., difference between capacity and actual gross national product ($ billion)	GNPG[a/]
Disposable Income, the total after-tax income per household from productive activity or transfer payments ($ billion)	DINC[a/]
Government (Federal, State, Local) Budget Surplus in Receipts over Expenditures ($ billion)	GBS[a/]

a/ These variables also occur as lagged variables.

Table 18 (concluded)

Exogenous Variables	
Personal Savings Measure, or the percent of disposable personal income that is saved	PSM
Business Savings Measure, expressed as the ratio of the sum of capital consumption allowances plus undistributed profits less inventory evaluation adjustment, to gross national product	BSM
Corporate Profitability Measure, or the percent change in the ratio of manufacturing corporations profits after taxes to stock holders equity	CPM[a/]
Labor Force Time Lost, or that percentage of the total potential available labor forces man-hours lost by umemployment and economically caused part-time employment	LFTL[a/]
Total Tax Measure, the ratio of the sum of indirect business taxes plus corporate tax liabilities plus social security contributions and personal tax payments, to the gross national product	TTM
Government (Federal, State, Local) Expenditures for Goods and Services ($ billion)	GEGS
Total Member Bank Reserves Required on Deposit with Federal Reserve Bank plus Vault Cash ($ billion)	TMBR
Demand for Credit Funds Advanced to the Foreign Sector in the Credit Market ($ billion)	DCFF
Availability of Credit Funds to the Foreign Sector of the Credit Market ($ billion)	ACFF
Demand Deposit and Time Savings Accounts ($ billion)	DDTS
Credit Market Instruments ($ billion)	CMI
Other Sources of Credit Market Funds ($ billion)	OSCF
Gross National Product Capacity, expressed as dollar potential under conditions of "full" employment ($ billion)	GNPC
Government (Federal, State, Local) Transfer of Payments to Persons ($ billion)	GTP
Net of Exports Less Imports of Goods and Services ($ billion)	NEX
Other Sources of Disposable Income ($ billion)	OSDI
Other (Net) Government Expenditures ($ billion)	OGEX

a/ These variables also occur as lagged variables.

are postulated to be jointly dependent on each other as well as being affected by other variables. Values of the endogenous variables are the results sought by the economic model. Other variables, characterized as exogenous variables, are postulated to have an impact on the economic system and to affect the endogenous variables, while not being affected by them. "Lagged" variables (both endogenous and exogenous) have values of one or two of the preceding quarters, and are assumed to affect variables in the current quarter. Sources of data and detailed descriptions of several variables are included as part of Appendix C.

6. Functional Description of TEMCRIS II

The econometric model consists of a system of stochastic equations (each equation is not an exact relationship but is subject to random disturbances) that must be simultaneously solved. Each equation reflects a presumably stable relationship among the variables in the economy, and is based on the observed values of the national quarterly economic data base. The equations making up the model are given below in symbolic form. Lagged forms of the variable are indicated by use of an "L" preceding the symbol. Detailed specification of each equation is included in Appendix C.

Equation 1

CEEG = f(PCHP, DINC, LCEEG, LFTL, GTP) plus a random error. Equation 1 states that the current level for consumption expenditures for non-durable goods and services depends on current price changes, on the current level of disposable income, on recent expenditures for non-durable goods and services, on the current extent of lost labor time, and on the current level of government payments to persons. All other considerations affecting the current level of consumption expenditures for non-durable goods and services are included in the error term.

Equation 2

CEDG = f(CEEG, PCHP, DINC, LCEDG, PSM, LFTL, LLFTL) plus a random error. Equation 2 states that the current level of consumption expenditures for durable goods depends on current expenditures for non-durable goods and services, on current price changes, on the current level of disposable income, on recent expenditures for durable goods, on the current extent of personal savings, on the current extent of lost labor time, and on the recent extent of lost labor time. All other considerations affecting the current level of consumption expenditures for durable goods are included in the error term.

Equation 3

GIRS = f(ACFH, INTH, LGIRS, LDINC, PSM) plus a random error.
Equation 3 states that the current level of investment in residential structures depends on the current availability of credit funds to the household sector of the credit market, on the current level of interest rates for households, on the recent level of investments in household structures, on the recent level of disposable income, and on the current extent of personal savings. All other considerations affecting the current level of investment in residential structures are included in the error term.

Equation 4

GISE = f(ACFB, INTB, LGISE, LGNPG, LCPM, TTM) plus a random error.
Equation 4 states that the current level of investments in structures and equipment other than household depends on the current availability of credit funds to the business sector in the credit market, on the current level of interest rates for business, on the recent level of investments in structures and equipment other than household, on the recent level of the Gross National Product gap, on the recent corporate profitability, and on the current level of the total tax measure. All other considerations affecting the current level of investments in structures and equipment other than household are included in the error term.

Equation 5

PCHP = f(GNPG, LPCHP, LGBS, LLFTL) plus a random error.
Equation 5 states that the current level of percent change in prices depends on the current level of the Gross National Product gap, on the recent level of the percent change in prices, on the recent level of the government budget surplus, and on the recent extent of lost labor time. All other considerations affecting the current level of the percent change in prices are included in the error term.

Equation 6

DCFH = f(DCFB, INTH, DINC, LDCFH, LINTH, PSM) plus a random error.
Equation 6 states that the current demand for household credit funds depends on the current demand for business credit funds, on the current level of interest rates for households, on the current level of disposable income, on the recent demand for household credit funds, on the recent level of interest rates for households, and on the current extent of personal savings. All other considerations affecting the current demand for credit funds for households are included in the error term.

Equation 7

DCFB = f(DCFG, INTB, LGISE, LDCFB, LINTB, BSM, DCFF, LCPM) plus a random error.
Equation 7 states that the current demand for credit funds in business depends on the current demand for credit funds advanced to the government, on the current level of interest rates for business, on the recent level of investments in structures and equipment other than household, on the recent demand for business credit funds, on the recent level of interest rates for business, on the current level of

the business savings measure, on the current demand for credit in the foreign sector, and on the recent corporate profitability. All other considerations affecting the current demand for credit funds in business are included in the error term.

Equation 8

DCFG = f(INTG, GBS, LDCFG, LGNPG, TTM) plus a random error.
Equation 8 states that the currend demand for credit advanced to the government depends on the current level of government interest rates, on the current level of the government budget surplus, on the recent demand for credit advanced to the government, on the recent value of the Gross National Product gap, and on the current level of the total tax measure. All other considerations affecting the current demand for credit advanced to the government are included in the error term.

Equation 9

ACFH = f(INTH, GNPG, LACFH, LFTL, TMBR, DDTS, OSCF) plus a random error.
Equation 9 states that the current availability of credit funds for households depends on the current level of household interest rates, on the current level of the Gross National Product gap, on the recent availability of credit funds for households, on the current extent of lost labor time, on the current level of total member bank reserves, on the current level of demand deposit and time savings, and on the current extent of other sources of credit funds. All other considerations affecting the current availability of credit funds for households are included in the error term.

Equation 10

ACFB = f(INTB, GNPG, LACFB, CPM, TMBR, DDTS, CMI, OSCF) plus a random error.
Equation 10 states that the current availability of credit funds for business depends on the current level of business interest rates, on the current level of the Gross National Product gap, on the recent availability of credit funds for business, on the current corporate profitability, on the current level of total member bank reserves, on the current level of demand deposit and time savings, on the current level of credit market instruments, and on the current extent of other sources of funds. All other considerations affecting the current availability of funds for business are included in the error term.

Equation 11

ACFG = f(INTG, GNPG, LACFG, TTM, TMBR) plus a random error.
Equation 11 states that the current availability of credit funds for the government depends on the current level of interest rates for government, on the current level of the Gross National Product gap, on the recent availability of credit funds for the government, on the current level of the total tax measure, and on the current level of the total member bank reserves. All other considerations affecting the current availability of credit funds for government are included in the error term.

Equation 12

INTH = f(PCHP, INTB, INTG, $(ACFH-DCFH)_{calc}$, LINTB, LGNPG) plus a random error.

Equation 12 states that the current level of interest rates for households depends on the current level of the percent change in prices, on the current level of interest rates for business, on the current interest rates for government, on the calculated difference between the current availability of and demand for credit funds for households, on recent interest rates for households, and on the recent level of the Gross National Product gap. All other considerations affecting the current level of interest rates for households are included in the error term.

Equation 13

INTB = f(PCHP, INTH, INTG, $(ACFB-DCFB)_{calc}$, LINTB, LGNPG) plus a random error.

Equation 13 states that current interest rates for business depend on the current level of the percent change in prices, on the current level of interest rates for households, on the current level of interest rates for government, on the calculated difference between the current availability of and demand for business credit funds, on the recent level of business interest rates, and on the recent level of the Gross National Product gap. All other considerations affecting the current level of interest rates for business are included in the error term.

Equation 14

INTG = f(PCHP, INTH, INTB, $(ACFG-DCFG)_{calc}$, LINTB, LGNPG) plus a random error.

Equation 14 states that the current interest rates for governments depend on the current level of the percent change in prices, on the current interest rates for households, on the current interest rates for business, on the calculated difference between the current availability of and demand for government credit, on the recent level of interest rates for business, and on the recent level of the Gross National Product gap. All other considerations affecting the current level of interest rates for governments are included in the error term.

Equations 15 to 19

The five remaining equations are algebraic identities and are introduced to complete the system of equations. These equations are also shown in Appendix C.

As seen, the structure of TEMCRIS II is recursive -- that is, the equations include lagged endogenous variables in the set of exogenous variables. In a recursive equation, with lagged endogenous variables included among the exogenous variables on the right-hand side of the equation, the current quarter change in the endogenous variable will become next quarter's lagged endogenous variable. With such a recursive structure, the estimated coefficients no longer reflect the total impact of the change in the exogenous variables on the endogenous variables. Therefore, one must calculate a set of derived coefficients or multipliers. These multipliers are the forecasting structure of TEMCRIS II.

Finally, in the testing of the system, the current quarter data are not used to re-estimate TEMCRIS II; the system as currently formulated assumes that structural integrity of the model is maintained throughout future time periods.

A schematic of the TEMCRIS II model, summarizing the various interactions, is shown in Figure 8.

D. Initial Testing of TEMCRIS Under CR Scenarios

The TEMCRIS II model was used to analyze the impact over time of crisis relocation scenarios in the nation's economy. Three crisis scenarios were defined to illustrate the potential usefulness of the model in relocation situations. The three scenarios differ mainly in the length of time that the risk area population is maintained in host areas. The scenarios are:

- o Scenario A: Relocation maintained for a one-week period.
- o Scenario B: Relocation maintained for a two-week period.
- o Scenario C: Relocation maintained for a four-week period.

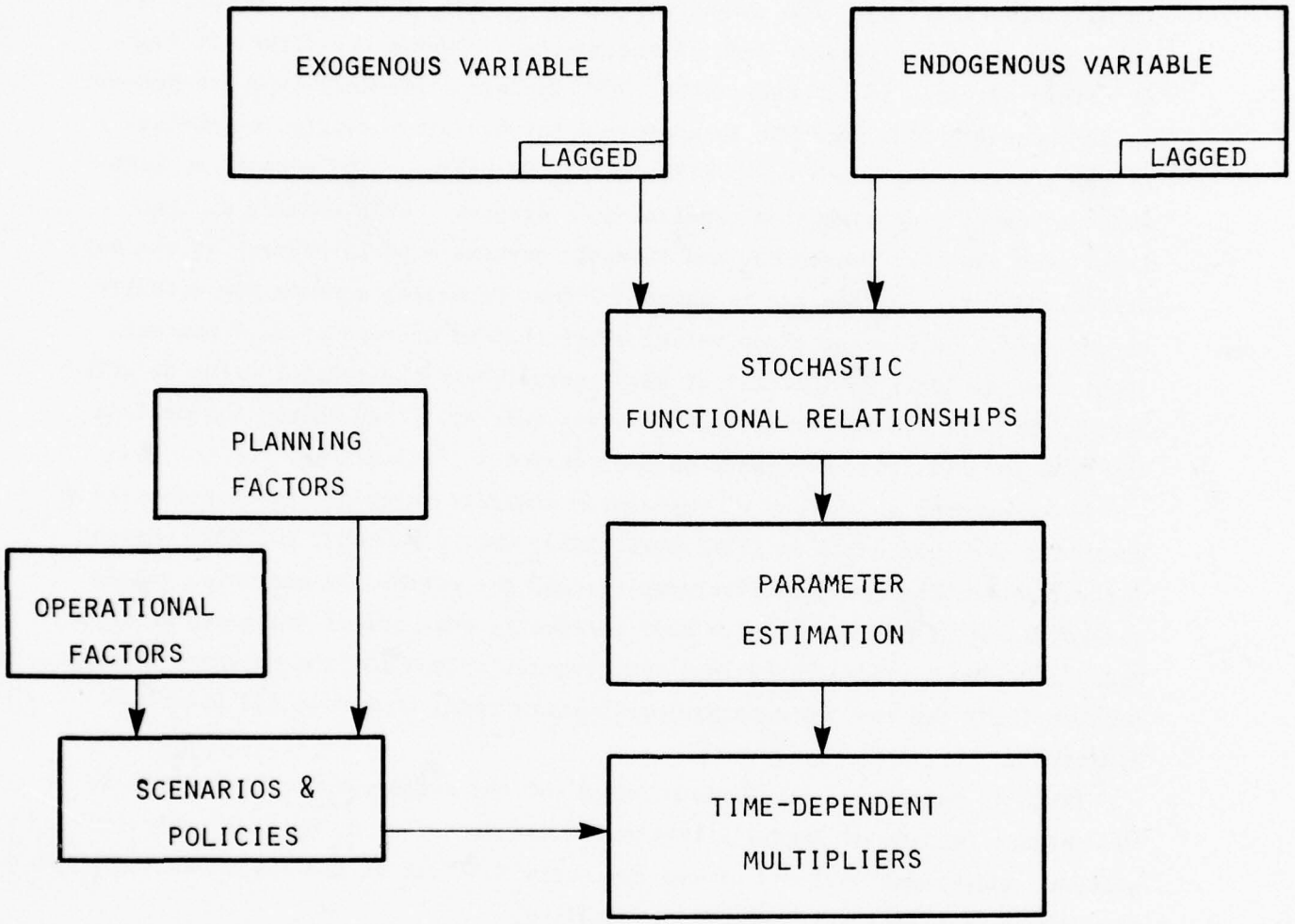
In addition to these three scenarios, three hypothetical policies were formulated to illustrate how the impact of the crisis situation could be reduced. The policies that were selected are not necessarily preferred choices; their purpose is only illustrative.

For each scenario, values for the exogenous variables were defined. Once these values are specified, the impact on the endogenous variable over time can be calculated. Three methods were used to determine the values assigned to the exogenous variable; generally, the values depend on the details of the specific scenario. The methods are:

- o Time phasing of events during the crisis quarter (TEMCRIS uses quarterly data) and analytical determination of the averaged change during that quarter. This method is used for: labor force time lost (LFTL), demand deposits and time saving (DDTS), government expenditures on goods and services (GEGS), credit market instruments (CMI), government transfer payments (GTP), and net exports (NEX). (The method used will be illustrated subsequently.)
- o Use of regression analysis (as a submodel -- see Appendix C) to relate certain exogenous variables which reflect subtle changes to other exogenous variables. Exogenous variables treated in this manner are: personal savings measure (PSM), business savings measure (BSM), corporate profitability measure (CPM), total tax measure (TTM), and demand (and supply) of credit funds by foreigners (DCFF (ACFF)).
- o Use of simple functional forms to show the relationship of a specific exogenous variable to another specific exogenous variable. Exogenous variables treated in this manner are: other government expenditures (OGEX) related to GEGS; other sources of credit funds (DSCF) related to DDTS; other sources of disposable income (OSDI) related to OGEX; GNP capability related to a normal peacetime increase in capacity; and total

Figure 8

SCHEMATIC OF TEMCRIS II



SPECIFICATION OF MODEL

- 19 EQUATIONS IMPLYING 19 CONTROLLABLE ENDOGENOUS VARIABLES (14 ARE LAGGED)
- 17 "NON-CONTROLLABLE" EXOGENOUS VARIABLES (2 LAGGED)
- ESSENTIALLY A DEMAND APPROACH

member bank reserves (TMBR) related to demand deposits and time savings (DDTS).

As an example of an exogenous variable treated by the time-phasing of events during the crisis quarter, consider labor force time lost and a two-week CR-Maintenance period. The actual relocation period is assumed to occur between the sixth and seventh week of the quarter. During the first six weeks of crisis tension, it is assumed that LFTL increases linearly from 8.8 percent to 20 percent. (The increase is accounted for by self-motivated evacuation.) At the start of the sixth week, LFTL sharply increases to 66 percent as full-scale evacuation of risk area population is ordered. LFTL remains at that level over the next two weeks, and linearly decreases to 13 percent at the end of the quarter. (A time lag is assumed before returning persons are actually re-employed.) A plot of these values shows that an average of 31.7 percent labor time is lost, an increase of 22.9 percent over the initial value of LFTL during the last quarter prior to the crisis quarter. Time-phased assumptions are made for all other exogenous values treated in this manner.

As an example of the use of regression analysis, each of the aforementioned variables were regressed on LFTL, DDTS, TMBR, CMI, GTP, OGEX, AND NEX. Having determined the estimated coefficients through the regression analysis, values determined by crisis events were used to specify this set of exogenous variables. Under a two-week crisis situation, illustrative values for the personal savings measure (PSM) and the business savings measure (BSM) were 0.48 and 0.13, respectively.

Table 19 summarizes the various values of the exogenous variables used in the initial testing of TEMCRIS. While the values appear to be reasonably consistent, additional analysis of the appropriate levels of the exogenous variables for future application of TEMCRIS is required.

In the testing of TEMCRIS under crisis relocation scenarios, three hypothetical policies were considered for each of the three scenarios that were developed. Several common assumptions apply to all three policies that were used in the initial testing of the TEMCRIS model. These are:

- Halt withdrawals from the banking system: initial withdrawals, $-15.0 billion
- Close financial security exchanges: initial loss, $-12.5 billion
- Waive bank reserve requirements: initial depletion, $-2.6 billion
- Net exports frozen, NEX = 0

Table 19

ILLUSTRATIVE INITIAL VALUES OF EXOGENOUS VARIABLES

Variable	Scenario A(1 wk)	B(2 wk)	C(4 wk)
PSM(%)	1.31	.48	- 1.46
BSM(rate)	.16	.13	.10
CPM(%)	8.26	1.13	-10.29
LFTL(%)	19.1	22.9	27.7
TTM(rate)	.16	.17	.18
GEGS($b)	5.0	13.1	27.0
TMBR($b)	- 3.1	- 4.0	- 5.0
DCFF($b)	-23.8	-29.1	-41.6
DDTS($b)	-18.0	-23.4	-29.1
CMI($b)	-12.5	-25.0	-50.0
OSCF($b)	-36.0	-46.8	-58.2
GNPC($b)	28.5	28.5	28.5
GTP($b)	0	0	0
NEX($b)	- 6.2	-12.5	-35.0
OSDI($b)	- 1.7	- 4.4	- 9.1
OGEX($b)	1.0	2.6	5.4
Constant	0	0	0

In addition, the policy assumptions include:

- Government expenditures on goods and services including subsidized minimum wage employment in host areas.

	Scenario			
	A(1 wk)	B(2 wk)	C(4 wk)	% subsidized
	(billions of dollars)			
Policy 1	$20.0	$28.1	$42.0	20%
Policy 2	35.0	43.1	57.0	40%
Policy 3	50.0	58.1	72.0	60%

- Government transfer payment to unsubsidized families that are evacuated

	Scenario			
	A(1 wk)	B(2 wk)	C(4 wk)	subsidy/wk
	(billions of dollars)			
Policy 1	$7.2	$14.4	$28.8	$100
Policy 2	8.1	16.2	32.4	150
Policy 3	7.2	14.4	28.8	200

It is emphasized that these are illustrative policies only. Their purpose is to indicate the potential usefulness of the TEMCRIS model.

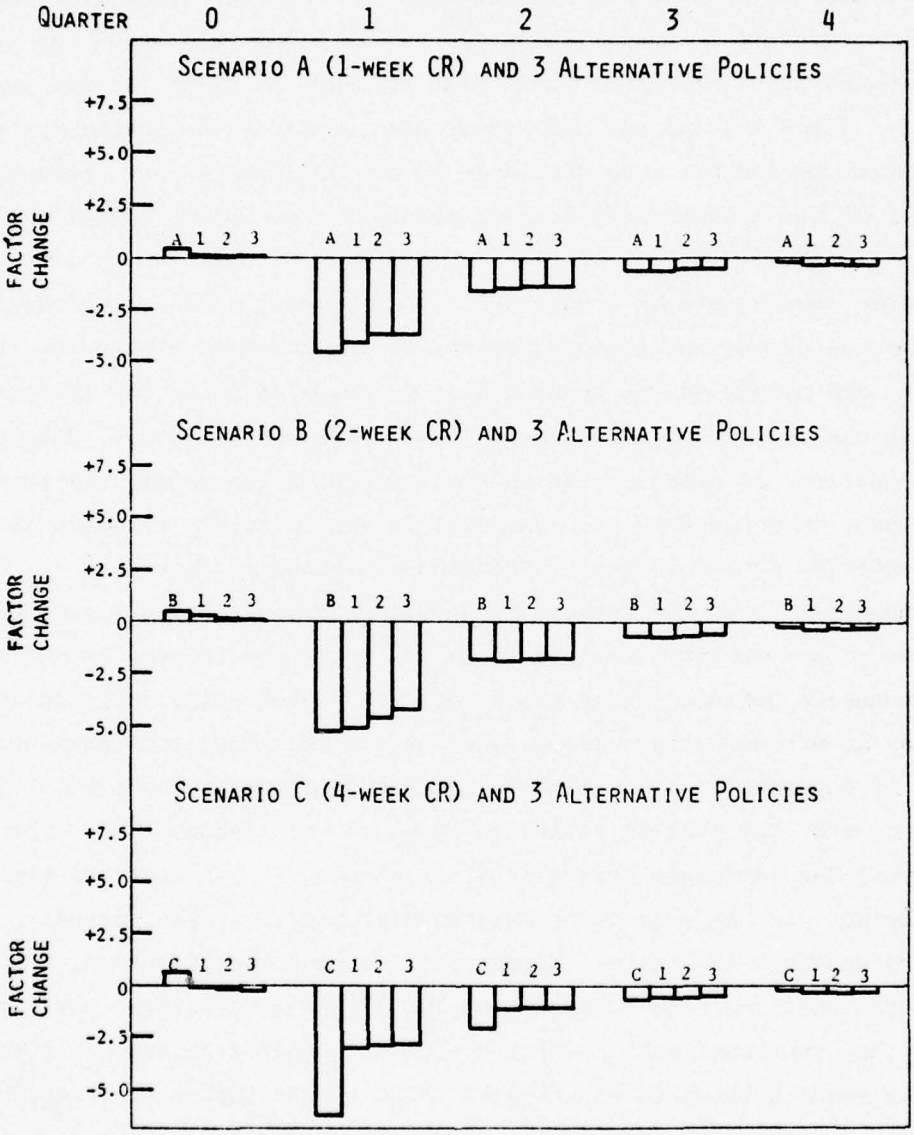
A series of figures is presented, showing the impact on several key economic variables as a result of crisis relocation and as a result of implementing the illustrative policies. For each of these figures, the quarter that is shown as zero represents the quarter in which population relocation occurs. During that quarter, the impact of the policies is also shown. The following four quarters show the subsequent economic impacts of the crisis events that occurred in the quarter. In each figure the percentage change is relative to the corresponding pre-crisis value of that economic variable.

Figure 9 shows the percentage change in prices as measured by the GNP price deflator. For each scenario, prices during the crisis quarter show a relatively small change. In subsequent quarters, prices follow a deflationary pattern. Although it would be expected that prices of essential goods would follow an inflationary pattern, at least during the early quarters, the reduced level of total demand results in an overall reduction in prices. The deflationary pattern is dampened out by the fourth quarter.

Figure 9

RELATIVE FACTOR OF VARIATION IN PRICES (PCHP)

FOR 3 SCENARIOS AND 3 POLICIES



SCENARIO A - 1 WEEK CR
SCENARIO B - 2 WEEK CR
SCENARIO C - 4 WEEK CR

POLICY 1 - MODEST GOVERNMENT INTERVENTION
POLICY 2 - MODERATE GOVERNMENT INTERVENTION
POLICY 3 - STRONG GOVERNMENT INTERVENTION

NOTE: 0 QUARTER REPRESENTS QUARTER IN WHICH CR MAINTENANCE PHASE OCCURS.

Although the results of the impact of CR on interest rate are not reproduced here, the interest rates also show a reduction. Since interest rate movements are correlated with price movements, that reduction is expected.

Figure 10 shows the impact on gross investment in residential structures. As anticipated, residential structures investment is adversely affected throughout the time period shown. The primary reason for this reduction stems from the reduced level of credit funds that are made available to the household sector. (This initial analysis shows that credit funds in the post-crisis relocation period are made available to the business sector primarily in support of the assumed mobilization production decisions formulated during the crisis period.)

Gross investments in structures and equipment, on the other hand, show an increase during the post-CR period, as indicated in Figure 11. These increases are mainly due to governmental purchase of goods and services, including the postulated mobilization production expenditures. When contrasting the scenarios, it appears that in the absence of intervening government policies, investment in structures and equipment is significantly affected in an increasingly adverse manner as the CR-Maintenance period is increased.

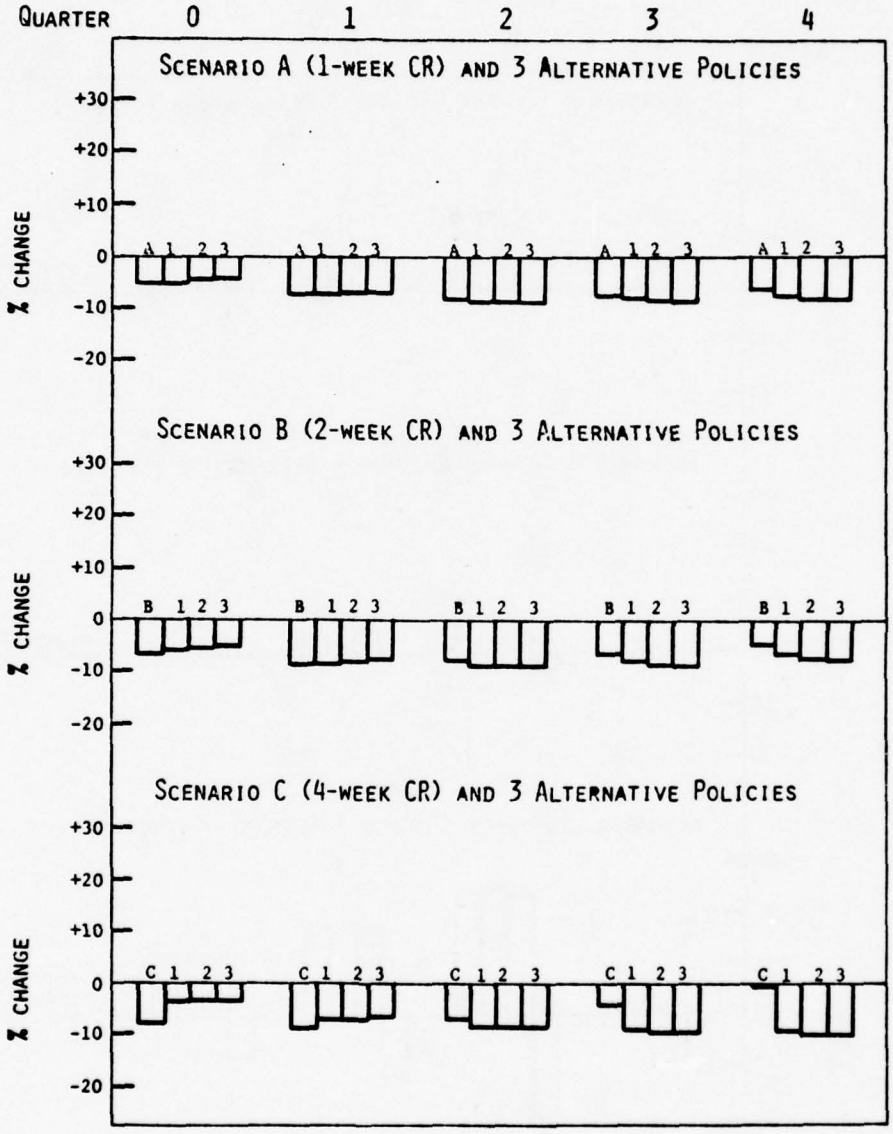
Figure 12 shows the impact on the Gross National Product gap. In the absence of governmental policies, the gap increases between 30 and 40 percent during the CR period. Under the 1 week and 2 week crisis relocation scenarios, the gap is subsequently reduced; however, in the absence of governmental policies, a net of 9 percent and a net of 20 percent increase, respectively, in GNP gap persists over the post-CR period as shown in the figure. Under the 4 week CR scenario, the increases generally occur in the GNP gap over the time period considered. In the absence of governmental policies, the increase in GNP gap under Scenario C is a net of 52 percent. Beyond the CR period, the differences among the policies tend to become small. For all scenarios considered, it is clear that continual governmental action is required during the post-CR period.

The results shown in the figures indicate the impact experienced in the CR quarter or subsequent time periods. During each of these subsequent periods, additional consequences of the scenarios as well as the policies would also influence the major economic variables. These additional impacts can usually be incorporated in computer runs; however, these runs were not undertaken during the current study effort.

Figure 10

PERCENT CHANGE IN GROSS INVESTMENT IN RESIDENTIAL STRUCTURES (GIRS)

FOR 3 SCENARIOS AND 3 POLICIES



SCENARIO A - 1 WEEK CR
SCENARIO B - 2 WEEK CR
SCENARIO C - 4 WEEK CR

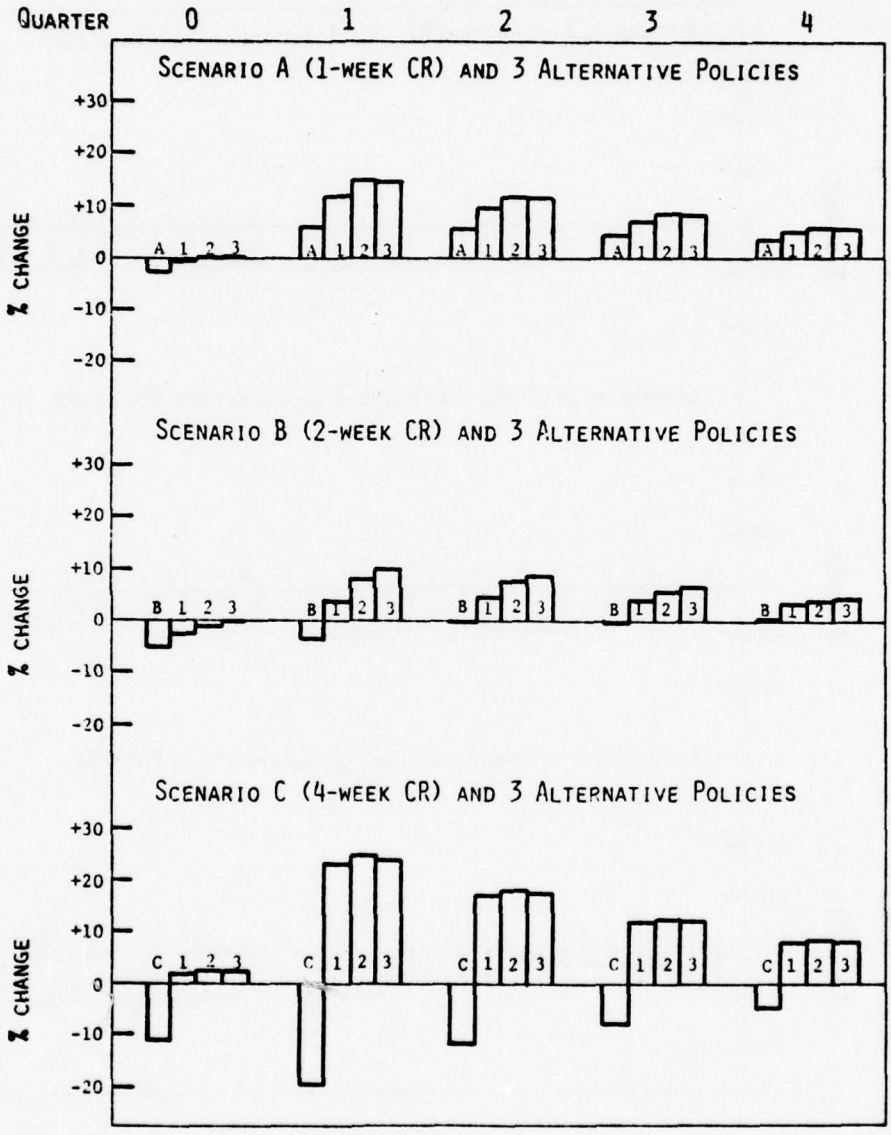
POLICY 1 - MODEST GOVERNMENT INTERVENTION
POLICY 2 - MODERATE GOVERNMENT INTERVENTION
POLICY 3 - STRONG GOVERNMENT INTERVENTION

NOTE: 0 QUARTER REPRESENTS QUARTER IN WHICH CR MAINTENANCE PHASE OCCURS.

Figure 11

PERCENT CHANGE IN GROSS INVESTMENT IN STRUCTURES AND EQUIPMENT (GISE)

FOR 3 SCENARIOS AND 3 POLICIES



SCENARIO A - 1 WEEK CR
SCENARIO B - 2 WEEK CR
SCENARIO C - 4 WEEK CR

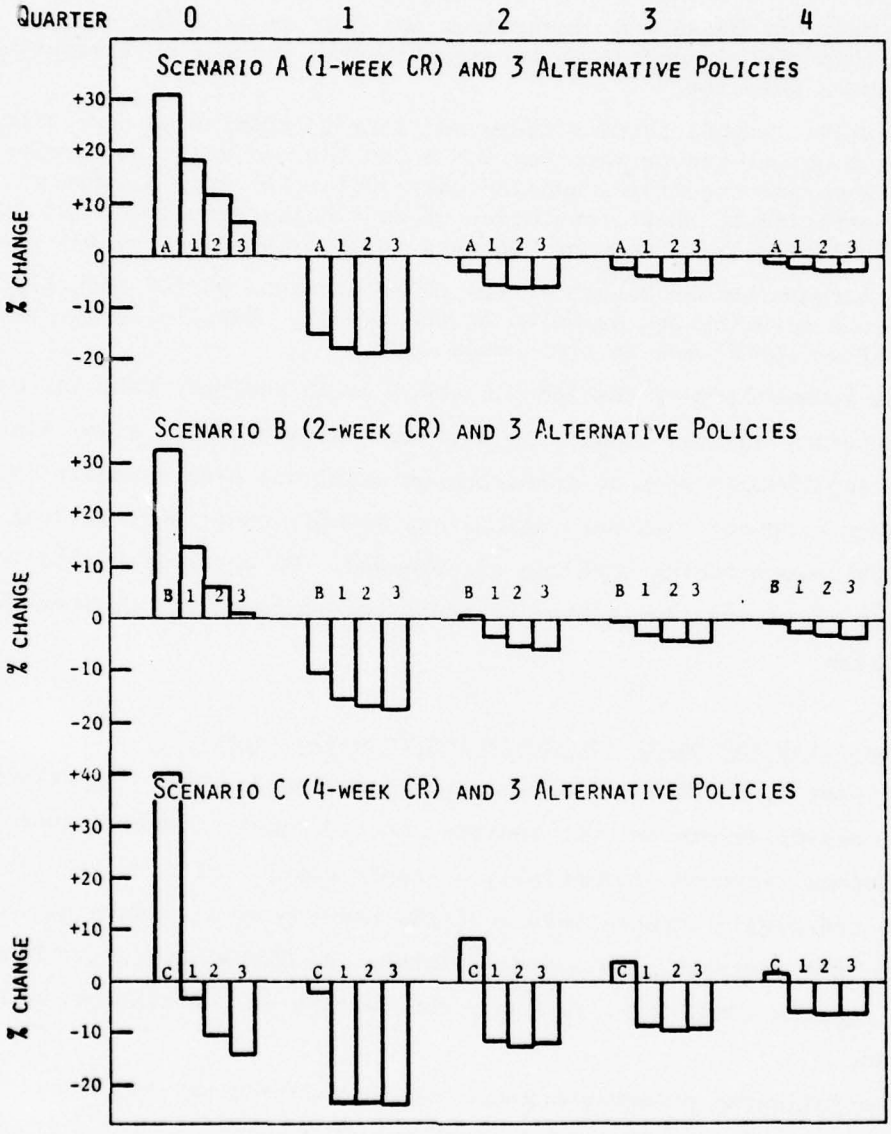
POLICY 1 - MODEST GOVERNMENT INTERVENTION
POLICY 2 - MODERATE GOVERNMENT INTERVENTION
POLICY 3 - STRONG GOVERNMENT INTERVENTION

NOTE: 0 QUARTER REPRESENTS QUARTER IN WHICH CR MAINTENANCE PHASE OCCURS.

Figure 12

PERCENT VARIATIONS IN GROSS NATIONAL PRODUCT GAP (GNPG)

FOR 3 SCENARIOS AND 3 POLICIES



SCENARIO A - 1 WEEK CR
SCENARIO B - 2 WEEK CR
SCENARIO C - 4 WEEK CR

POLICY 1 - MODEST GOVERNMENT INTERVENTION
POLICY 2 - MODERATE GOVERNMENT INTERVENTION
POLICY 3 - STRONG GOVERNMENT INTERVENTION

NOTE: 0 QUARTER REPRESENTS QUARTER IN WHICH CR MAINTENANCE PHASE OCCURS.

Testing has not proceded far enough to where definitive statements can be made about the significance of the results. However, some generalized outcomes of these tests appear to indicate:

- o The economic system is stable under the type of economic shocks imposed. After a period of significant fluctuation, economic variables appear to return to pre-crisis norms.
- o Most of the severe disruptions are over in a period of 1 to 2 years. This period appears to be significantly reduced by appropriate government policies.
- o While initial shock effects are largely eliminated over time, resumption of normal growth rate may not occur for the policies examined (e.g., government policies applied only during the crisis quarter). It is anticipated that stipulation of continuing government assistance and policies in subsequent quarters would bring about normal growth patterns.
- o Increasing the length of the CR-Maintenance period significantly increases the severity and duration of the impact. Especially notable is moving from the 2 week to the 4 week case.

The feasibility of the TEMCRIS model as an analytic tool for weighing alternative policy choices appears to have been established. Also, the feasibility of linking TEMCRIS with an input-output model has been recently accomplished (see next section). As both models are jointly exercised, greater insights into the issues facing DCPA can be obtained. To accomplish this task, further analysis of alternative scenarios and alternative policy choices should be undertaken.

E. Improving the Basis for Analyzing Economic Impact

As stated, TEMCRIS II is essentially a demand model. Important industry-level considerations are not included in the model. These industry-level considerations represent essentially a supply model. Efforts to combine both demand and supply aspects into a single model have also been pursued as part of the DCPA contract, and a model linking the TEMCRIS model with an input-output model appears promising. However, the testing of the combined model has been limited.

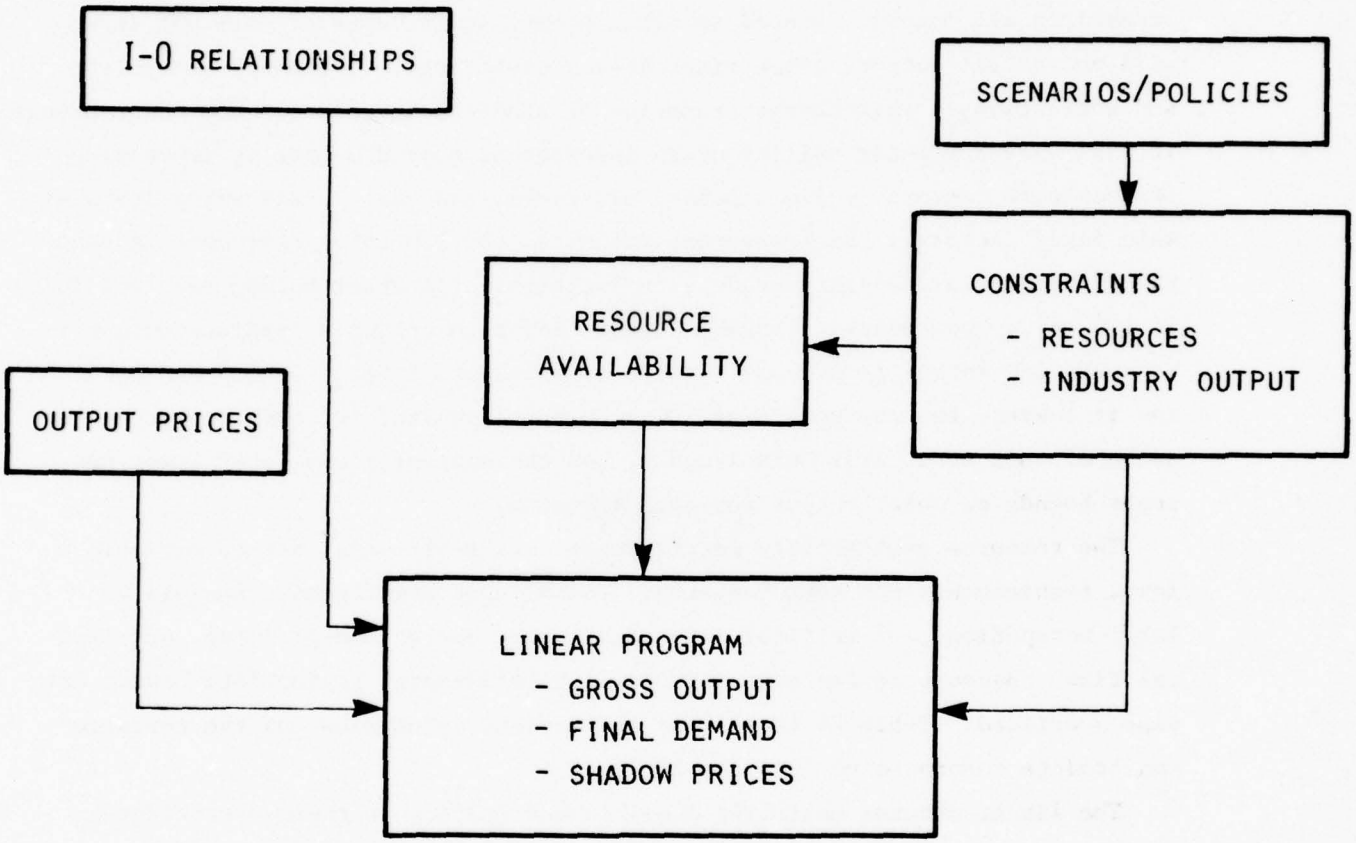
The following paragraphs describe the input-output model (summarized as a schematic in Figure 13), and discuss how that model is linked with TEMCRIS.

1. Linear Program Input-Output Model

The Linear Program Input-Output model (or LP I/O) maximizes final demand subject to an 85-industry input-output (I/O) matrix and a 116 resource availability matrix. The objective function actually maximizes the sum of

Figure 13

SCHEMATIC OF LINEAR PROGRAM INPUT-OUTPUT MODEL



SPECIFICATION OF MODEL

- 85 INDUSTRY SECTORS; 85 X 85 TABLE OF I-O RELATIONSHIPS
- 116 RESOURCE UTILIZATION BY INDUSTRY; 116 X 85 TABLE OF RESOURCE AVAILABILITY
  - 40 LABOR OCCUPATIONS
  - 67 CRITICAL MATERIALS
  - 8 ENERGY END-PRODUCT USAGE
  - 1 CAPITAL FLOW REQUIREMENT
- ESSENTIALLY A SUPPLY APPROACH

final demand across the 85 industries, where final demand is defined as that part of each industry's total output which is not used as input to another industry's production, but instead is consumed.

The 85-industry I/O matrix represents an 85-order set of fixed-factor production functions; a fixed-factor production function is one in which an expansion (contraction) in output can only occur with a proportionate increase (decrease) in all inputs. Stated in other words, an increase of only one input will not affect output, given fixed factor technology. (Although convenient and conventional, this characterization of production processes has shortcomings: it will understate the ability of an industry to expand output by increasing its variable factors -- i.e., labor, materials, and fuel -- and using its available fixed factors.) Each separate column in the I/O table represents a separate fixed-factor industry-production function. (In other words, each row in an I/O matrix represents a separate input and each column a separate output.) When the I/O matrix is post-multiplied by a vector of total output and each row is summed, the row sums equal total output required for each industry. Because of this structural relationship, one can appropriately enter lower and upper bounds on total output for each industry.

The resource availability matrix represents a 116-order set of variable input requirements for each industry. These input requirements include 40 labor occupations, 67 critical materials, eight energy end-products, and capital flow. Because of the same structural relationship, appropriate bounds are also specified. Table 20 identifies the various industries and the resource constraints incorporated into the LP I/O.

The linear program maximizes final demand subject to these constraints. The optimizing algorithm chosen was a quasi-Newton method; this method requires less computer space and results in faster convergence.

The solution of each LP I/O consists of a set of final demands by industry. Because of the Leontief balance equation, these imply a set of industry total outputs. As output, certain values are obtained, known as shadow prices, and they represent the solution to a problem equivalent to that which is originally solved. Their interpretation is the following: for the upper bound on total output, they represent the value of one dollar increase of the upper bound; for the lower bound, the value of one dollar decrease; and for the resource upper bound, the value of a one unit increase in the bounds.

Table 20

INDUSTRIES AND RESOURCE CONSTRAINTS USED IN TEMCRIS/LP I-O MODEL

Industries

1. Livestock and Livestock Products
2. Other Agricultural Products
3. Forestry and Fishery Products
4. Agricultural, Forestry and Fisheries Services
5. Iron and Feralloy Ores Mining
6. Nonferrous Metal Ores Mining
7. Coal Mining
8. Crude Petroleum and Natural Gas
9. Stone and Clay Mining and Quarrying
10. Chemical and Fertilizer Mineral Mining
11. All New Construction
12. Maintenance and Repair Construction
13. Ordnance and Accessories
14. Food and Kindred Products
15. Tobacco Manufactures
16. Broad and Narrow Fabrics, Yarn and Thread Mills
17. Misc. Textile Goods and Floor Cover
18. Apparel
19. Miscellaneous Fabricated Textile Products
20. Lumber and Wood Products Except Containers
21. Wooden Containers
22. Household Furniture
23. Other Furniture and Fixtures
24. Paper and Allied Products Except Containers and Boxes
25. Paperboard Containers and Boxes
26. Printing and Publishing
27. Chemicals and Selected Chemical Products
28. Plastics and Synthetic Material
29. Drugs, Cleaning and Toilet Preparations
30. Paint and Allied Products
31. Petroleum Refining and Related Industry
32. Rubber and Misc. Plastics Products
33. Leather Tanning and Industrial Leather Products
34. Footwear and Other Leather Products
35. Glass and Glass Products
36. Stone and Clay Products
37. Primary Iron and Steel Manufacturing
38. Primary Nonferrous Metal Manufacturing
39. Metal Containers
40. Heating, Plumbing and Fabricated Structural Metal Products
41. Stampings, Screw Machine Products and Bolts
42. Other Fabricated Metal Products
43. Engines and Turbines
44. Farm Machinery
45. Construction, Mining, Oil Field Machines and Equipment
46. Material Handling Machines and Equipment
47. Metal Working Machines and Equipment
48. Special Industry Machines and Equipment
49. General Industry Machines and Equipment
50. Machine Shop Products
51. Office, Computing, and Accounting Machines

Table 20 (continued)

52. Service Industry Machines
53. Electrical Industry Equipment and Apparatus
54. Household Appliances
55. Electric Light and Wiring Equipment
56. Radio, TV, and Communication Equipment
57. Electric Components and Accessories
58. Misc. Elec. Machines, Equipment and Supplies
59. Motor Vehicles and Equipment
60. Aircraft and Parts
61. Other Transportation Equipment
62. Scientific and Controlling Instruments
63. Optical, Ophthalmic, and Photographic Equipment
64. Miscellaneous Manufacturing
65. Transportation and Warehousing
66. Communications, Except Radio and TV Broadcasting
67. Radio and TV Broadcasting
68. Electric, Gas, Water, and Sanitary Services
69. Wholesale and Retail Trade
70. Finance and Insurance
71. Real Estate and Rental
72. Hotels, Personal and Repair Services, Except Auto
73. Business Services, Including R & D
74. Auto Repairs and Services
75. Amusements
76. Medical, Educational Services, and Nonprofit Organizations
77. Federal Government Enterprises
78. State and Local Government Enterprises
79. Direct Allocation and Transferred Imports
80. Business Travel, Entertainment and Gifts
81. Office Supplies
82. Scrap, Used and Secondhand Goods
83. Federal, State and Local Governments
84. Rest of the World Industry
85. Household Industry

Resources: Labor Force

1. Engineers, Technicians
2. Life and Physical Scientists
3. Mathematical Specialists
4. Engineers, Science Technicians
5. Med. Workers Excluding Technicians
6. Health Technologists and Technicians
7. Technicians, Excluding Health
8. Computer Specialists
9. Social Scientists
10. Teachers
11. Writers, Artists, Entertainers
12. Other Professional, Technical
13. Buyers, Sales, Loan Managers
14. Admin., Public Inspectors
15. Other Managers, Officials, Prop.
16. Sales Workers
17. Stenos, Typists, Secretaries

Table 20 (continued)

18. Office Machine Operators
19. Other Clerical Workers
20. Construction and Craft Workers
21. Blue Collar Workers, Supervisors, n.e.c.*
22. Metal Working Craft Workers, Excluding Mechanics
23. Mechanics, Repairers, Installers
24. Printing Trade Crafts Workers
25. Transport., Public Utilities, Craft
26. Other Crafts, Kindred Workers
27. Semi-Skilled, Metal Working
28. Semi-Skilled, Textile
29. Semi-Skilled, Packing and Inspecting
30. Other Operators, Excluding Transport.
31. Transport Equipment Operators
32. Cleaning Service Workers
33. Food Service Workers
34. Health Service Workers
35. Personal Service Workers
36. Protective and Service Workers
37. Private Household Workers
38. Laborers, Excluding Farm
39. Farm and Farm Managers
40. Farm Laborers, Supervisors

Resources: Critical Materials

(TH - Thousand)

41. Aluminum - TH Short Tons
42. Aluminum Oxide, Fused - Short Tons
43. Antimony - Short Tons
44. Asbestos, Amosite - Short Tons
45. Asbestos, Chrysotile - Short Tons
46. Bauxite, Refractory - TH Long Dry Tons
47. Beryl - Short Tons - 11 percent BEO Concentrates
48. Bismuth - TH Lb
49. Cadmium - TH Lb
50. Castor Oil - TH Lb
51. Chromite, Chemical - TH Short Tons
52. Chromite, Metallurgical - TH Short Tons Gross Wt.
53. Chromite, Refractory - TH Short Tons Gross Wt.
54. Cobalt - TH Lb Contained
55. Columbium - TH Lb
56. Copper - TH Short Tons
57. Cordage Fibers, Abaca - Million Lb
58. Cordage Fibers, Sisal - Million Lb
59. Diamond Dies, Small - Number
60. Diamond, Industrial Bort - TH Carats
61. Diamond, Industrial Stone - TH Carats
62. Feathers and Down - TH Lb
63. Fluorspar, Acid Grade - TH of Short Dry Tons

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* n.e.c. - not elsewhere classified.

Table 20 (concluded)

64. Fluorspar, Metallurgical - TH of Short Dry Tons
65. Graphite, Natural, Ceylon - Short Tons
66. Graphite, Natural, Malagasy - Short Tons
67. Graphite, Other - Short Tons
68. Iodine - TH Lb
69. Jewel Bearings - TH of units
70. Lead - TH Short Tons
71. Manganese, Battery Natural - Short Tons
72. Manganese, Battery, Synthetic Dioxide - Short Tons
73. Manganese Ore, Chemical A & B - Short Tons
74. Manganese, Metallurgical - TH Short Tons
75. Mercury - 76 Lb/Flask
76. Mica, Muscovite Block - TH Lb
77. Mica, Muscovite Film, 1 and 2 Quality - TH Lb
78. Mica, Muscovite Splittings - TH Lb
79. Mica, Phlogopite Block - Lb
80. Mica, Phlogopite Splittings - TH Lb
81. Molybdenum - TH Lb Contained Molybdenum
82. Nickel - Short Tons Contained
83. Opium - Lb
84. Platinum Group, Iridium - Troy Oz
85. Platinum Group, Palladium - TH Troy Oz
86. Platinum Group, Platinum - TH Troy Oz
87. Pyrethrum - Lb
88. Quartz Crystals - TH Lb
89. Quinidine - TH Avoir Oz
90. Quinine - TH Avoir Oz
91. Rubber - Long Tons
92. Rutile - Short Tons
93. Sapphire and Ruby - TH Carats
94. Shellac - TH Lb
95. Silicon Carbide, Crude - Short Tons
96. Silver - TH Troy Oz
97. Talc, Steatite Block and Lump - Short Tons
98. Tantalum - TH Lb
99. Thorium Oxide - Tons
100. Tin - Long Tons
101. Titanium Sponge - Short Tons
102. Tungsten - TH Lb Contained
103. Vanadium - Short Tons Metal Equivalent
104. Vegetable Tannin, Chestnut - Long Tons
105. Vegetable Tannin, Quebracho - Long Tons
106. Vegetable Tannin, Wattle - Long Tons
107. Zinc - TH Short Tons

Resources: Energy

108. Natural Gas and Similar Products
109. Coal
110. Light Hydrocarbons Gases
111. Gasoline and Naphthas
112. Fuel Oil
113. Other Petroleum Products
114. Coke
115. Electricity

Capital Flow

116. Capital Flow

In summary, the linear program or LP I/O represents the supply side of the economy and TEMCRIS II, the demand side (except for the credit market system which is self-contained in TEMCRIS II).

2. Interaction Between TEMCRIS and LP I/O

The effect of any given shock scenario is generated through the sequence of interactions between TEMCRIS, a quarterly econometric model, and LP I/O. The linear program common to each scenario is the base LP I/O which maximizes final demand, given appropriately specified peacetime relative prices and bounds on gross outputs and resource availability. These interactions are described graphically in Figure 14. As seen, system connection is contained in the BRIDGE program. The following discussion will trace the flow of system connections beginning with a description of the base LP I/O cases.*

In the base case, LP I/O takes as input the data and structure as specified in the previous section and maximizes GNP. Program output in the form of GNP and the industry final demands measures the productivity of the economy and its 85 sectors during the base or normal period. The economy's performance in quarters subsequent to the specified emergency scenario is measured against output in this base quarter.

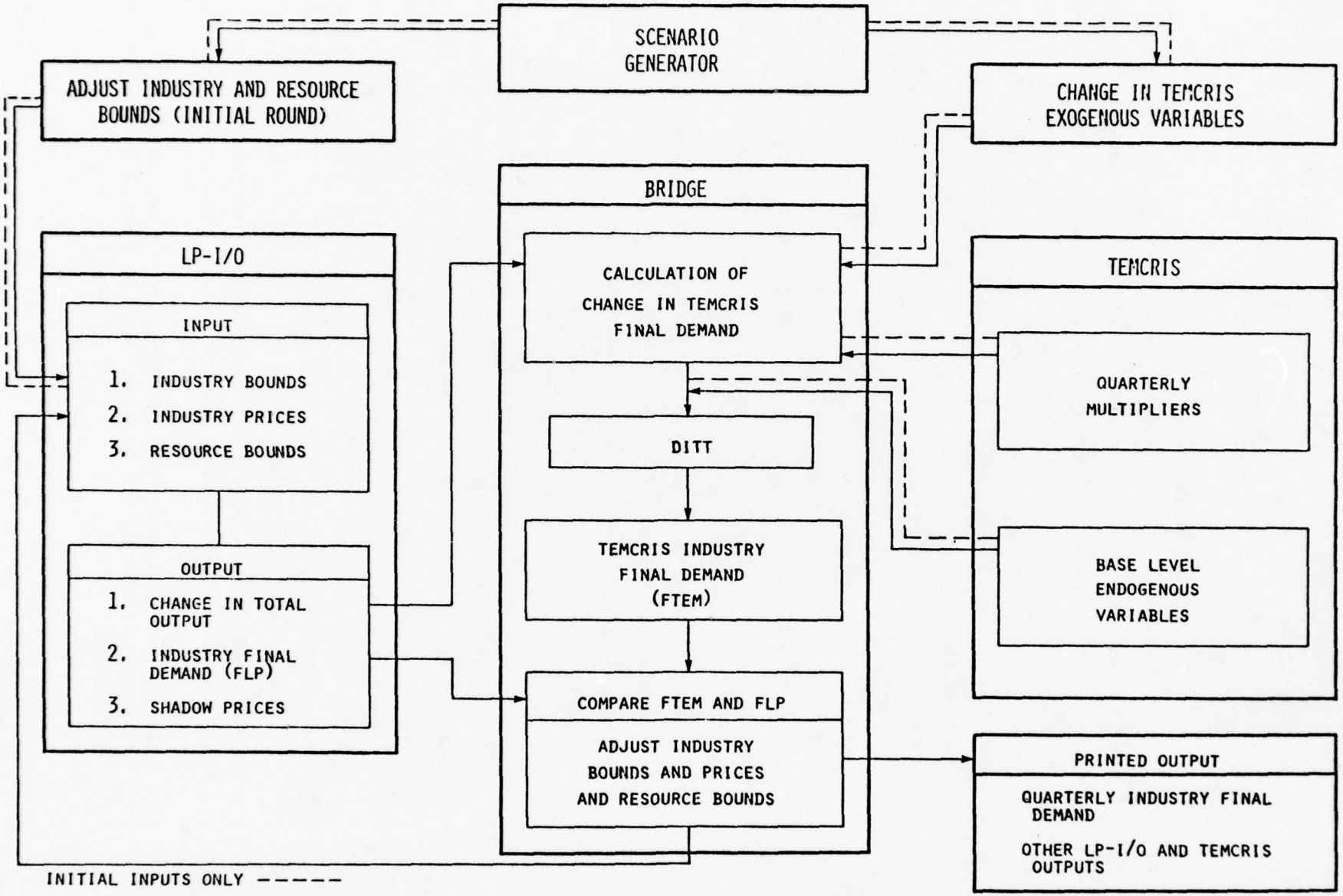
The introduction of the emergency scenario occurs through changes in any of the industry or resource bounds in LP I/O. In the representative computer runs, the emergency scenario impacted only on the upper bounds of total output. When entered into the linear program these decreased upper bounds translated into a reduced set of industry final demands and reduced GNP. These reductions measure part of the impact of the emergency scenario. The remainder of the impact is measured first by passing these results to TEMCRIS which uses them to alter LP I/O's prices and bounds, and second by re-running LP I/O with these new prices and bounds to obtain a new set of final demands and GNP which reflect the total impact of the emergency. The difference between the GNP from this second iteration of LP I/O and the base run represents the measure of reduced GNP capacity (which is the exogenous variable GNPC in TEMCRIS).

The loop described above between LP I/O and TEMCRIS is the basic loop performed by the BRIDGE program. The function of this loop is to compare the final demand separately generated by LP I/O and TEMCRIS and to use the shadow

*This material is from "TEMCRIS LP I/O Model," Frank Trinkl, et al., prepared by Center for Planning and Research, Inc. for Federal Preparedness Agency, August 1978.

Figure 14

TEMCRIS-LP I/O ECONOMIC MODEL



prices also generated by LP I/O to calculate new prices and bounds for a further iteration of LP I/O. The loop through BRIDGE is the same each time and each loop through moves the model downstream one quarter except for the first loop in the emergency scenario which was mentioned above. In all quarters subsequent to the emergency, a pair of iterations of LP I/O and then BRIDGE represents one quarter's performance of the economy. Output from BRIDGE helps track this performance quarter by quarter. The various calculations within the BRIDGE program are now discussed.

The BRIDGE program accepts as input the industry demand from LP I/O and calculates industry final demands from TEMCRIS in order to compare the two. BRIDGE calculates TEMCRIS final demands by first determining the components of economy-wide final demand and then "fanning" these components out to industry final demands by use of the DITT matrix. In general terms, the steps involved are as follows.

First, BRIDGE forms the product of the TEMCRIS multipliers and a vector of changes in its exogenous variables; this product is a vector of changes in endogenous variables. Both the TEMCRIS multiplier matrices and the changes in the exogenous variables are inputs to the BRIDGE program. In this way, TEMCRIS enters the system.

A specific scenario and policy response determine these exogenous changes. In every scenario and policy, the calculation of one exogenous variable, the change in GNP capacity, remains the same; it is the difference between the sum of final demands in last quarter LP I/O and base quarter LP I/O. Among the exogenous variables, the principal policy instruments used in testing the model are government expenditures in goods and services (GEGS) and transfer payments (GTP). As indicated, the changes in several exogenous variables are products of a sub-model relating these variables to the remaining exogenous variables. Therefore, only changes in certain exogenous variables need be specified. (These variables to be specified are labor force time lost, demand and time deposits, government expenditures, total member bank reservies, credit market instruments, government transfers to persons, and net exports.) A separate vector of exogenous changes associated with the emergency is entered for each quarter subsequent to the emergency. Separate policies for each quarter can be included by analyzing a policy in terms of each exogenous variable. Therefore, input for the exogenous changes consists of a series of vectors, a separate vector for each scenario or for each policy option (as appropriate) in each quarter.

(In understanding the derivation of the changes in the endogenous variables, recall that the TEMCRIS II multipliers are the period-specific derived coefficients; they are derived from the estimated equations because of the recursive structure of TEMCRIS II. The product of the impact multipliers and first-quarter exogenous changes equals the first-quarter endogenous changes. The product of the first-period interim multipliers and first-quarter exogenous changes plus the product of the impact multipliers and second-quarter exogenous changes equal the second-quarter endogenous changes, etc.)

Second, after calculating the quarter-specific changes in the endogenous variables, BRIDGE accepts the quarter-specific levels of the components of final demand from the TEMCRIS model. Most of these components are among the TEMCRIS endogenous and exogenous variables: consumer expenditure on non-durables (CEEG); consumer expenditure on durables (CEDG); gross investment in residential structures (GIRS); gross investment in other structures and equipment (GISE); and government expenditures on goods and services (GEGS). The conventional structure of final demand separates inventory changes from gross nonresidential investment; these, however, were grouped into GISE in TEMCRIS II. Similarly, BRIDGE disaggregates total government expenditures into state and local government expenditures and Federal expenditures. BRIDGE allocates these latter aggregated variables into their components by using their relative 1974-75 shares. Export and import changes are entered as parameters in BRIDGE. These changes in the components of final demand are added to their 1974-75 levels as reported in the national accounts to derive the quarterly components of final demand.

Third, BRIDGE fans out these components of economy-wide final demand into an 85-industry vector of final demands by use of the demand impact transform tables (DITT). These final demands represent TEMCRIS industry level final demands.

Fourth, on an industry by industrv basis BRIDGE compares TEMCRIS final demand and LP I/O final demands. If the former exceeds the latter, BRIDGE modifies the previous run's LP I/O industry prices. The modification requires adding the industry's relative shadow price to its price in the previous run and normalizing this sum. The relative shadow price is the ratio of a given industry's shadow price on upper bound output to the sum of upper-bound-output shadow prices. Normalizing adjusts the sum of all these new prices to equal the industry vector dimension of 85. (In general, normalizing requires finding the

product of the non-normalized term and the ratio of the desired sum over the actual sum.) This normalized industry price will be input to the current LP I/O run. It reflects changes in relative prices only. The economic implication of this decision rule is that only excess demand increases prices and that prices are sticky downward. This interpretation is consistent with this relative price adjustment where only shadow prices for industries with excess demand enter the calculation explicitly but all prices are affected by the renormalization procedure.

The shadow prices referred to above are part of the output from LP I/O. These shadow prices on upper bound output represent the value of increasing that industry's upper bound by one unit. A non-zero shadow price indicates that industry output is at the upper bound and the value of increasing the upper bound is positive. If the shadow price is zero, industry output is less than the upper bound and the value of increasing the bound is therefore zero. These shadow prices reflect the marginal valuation of an increase in output. The shadow prices on lower bound output, referred to below, have a symmetric interpretation: a non-zero price represents the value of decreasing that bound by one unit and allowing reallocation away from that industry. In the case of resource bounds, the shadow price is the value of relaxing the upper bound constraint by one unit.

After determining normalized relative prices for each industry, BRIDGE then applies a separate macroeconomic price adjustment. It forms the product of each normalized relative price and the estimated change in the GNP deflator (PCHP), a TEMCRIS endogenous variable. This product is the industry price used as input in the next quarter by LP I/O. Including this separate macro effect is appropriate given the strong probability of short-run disequilibrium between aggregate demand and aggregate supply in the emergency scenario. TEMCRIS policy adjustments enter through user-specification of the exogenous variables, particularly government expenditures (GEGS); depending on this specification, the disequilibrium may still exist.

Fifth, BRIDGE examines the lower bounds on industry output. It reallocates resources away from less productive industries by decreasing these industry bounds. BRIDGE decreases the bounds for those industries whose final demand from TEMCRIS is less than the final demand from LP I/O and whose output is at the lower bound as indicated by a non-zero shadow price. Negative excess demand exists in those industries and total output would increase if the lower

bound on output were relaxed to allow this industry's resources to move to more productive opportunities in other industries. Therefore, BRIDGE computes the relative shadow price for each of these industries and decreases their lower bound by a product of this relative shadow price and a market reaction factor. This reaction factor reflects market inertia in responding to relative prices during the emergency scenario. Despite this hypothesized sluggishness, BRIDGE is relying on market forces to reallocate output from these industries. Finally, BRIDGE sums these reallocations and transfers part of this reduction in industry capacity to the upper bounds.

Sixth, BRIDGE modifies the industry upper bounds. It increases the bounds for those industries whose final demand from TEMCRIS exceeds its final demand from LP I/O -- indicating excess demand for output -- and whose output is at the upper bound as indicated by a non-zero shadow price. Because of the excess demand in this industry, total output would increase if the upper bound on output were relaxed to allow additional resources to enter this industry. These additional resources come first from the transfer from the less productive industries, discussed above, and second from any overall increase in the economy's output. This second factor equals the quarter-to-quarter increase in GNP capacity. Recall that the emergency scenario primarily impacts on the upper bound reductions. In the quarters subsequent to the emergency, GNP gradually increases and this quarter-to-quarter increase is allocated to the more productive industries.

The actual allocation of this additional capacity to given industries relies on the upper bound shadow prices. BRIDGE computes the relative shadow prices in those industries where TEMCRIS final demand exceeds LP I/O final demand. BRIDGE then finds the product of this relative shadow price and this additional capacity which again is the sum of the resources shifted from less productive industries and a portion of the quarter-to-quarter increase in GNP. Because the upper bounds indicate potential industry capacity, BRIDGE does not allow reductions in the upper bounds even if this additional capacity is negative due to GNP reductions subsequent to the emergency.

In its final procedure, BRIDGE adjusts the bounds on resource availability for labor and capital. In the case of labor, the bounds are decreased by using the relative unemployment rates in the individual labor occupations to allocate aggregate labor force time lost, a TEMCRIS exogenous variable. Unemployment rates by occupation are taken to be a given occupation's share of total unem-

ployment; consequently, if aggregate labor force time lost is positive, the potential availability of each occupation will decrease as measured by a fall in the labor resource bounds. Finally, BRIDGE changes the previous run's LP I/O capital investment upper bound by adding the net change in investment during the current run. The amount of this net change comes from one of the endogenous variables in TEMCRIS (GIRS).

In summary, the BRIDGE program alters the prices and bounds in LP I/O by comparing final demand in LP I/O and TEMCRIS, and then adjusting the prices and bounds using straightforward procedures. This adjustment does not attempt to reach quarter-by-quarter convergence between demand as measured by TEMCRIS and supply as measured by LP I/O. Instead, BRIDGE attempts to track the economy's movement through a disequilibrium period recognizing that during this period most markets will not fully clear.

The feasibility of linking the TEMCRIS econometric model with the linear program input-output model has been established. However, while limited testing of the TEMCRIS-LP I/O model has been undertaken, an additional developmental effort appears warranted. Among the improvements that might be incorporated into the TEMCRIS-LP I/O model are:

- Update and audit TEMCRIS data base using primary government publications.
- Incorporate the latest available input-output table (the "A" matrix) into the LP I/O model.
- Refine the lower bounds on total output through the use of the Leontief balance equation.
- Integrate price change expectations into TEMCRIS.
- Integrate uncertainty in interest rate equations.
- Incorporate inventory changes into TEMCRIS.
- Expand the government sector in TEMCRIS to include expenditures on non-military goods and services and on military procurement.
- Affect systematic changes in the DITT matrix relying on relative price changes.
- Treat upper and lower bound symetrically through the use of shadow prices.
- Incorporate emergency expansion factors as they affect the bounds of the LP I/O model, as well as of the allocation of primary inputs to essential industries.
- Incorporate inventory use of critical industry sector-by-sector.

Some or all of these improvements would enhance the utility of the TEMCRIS-LP I/O model in analyzing the impact of various crisis events on the nation's economy.

It is judged that the TEMCRIS-LP I/O model represents a consistent and useful framework for assessing alternative policies designed to reduce the economic losses associated with emergency situations within the logic of benefit-cost concepts.

References for Section V

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4. "Statistics on Income 1970: Business Income Tax Returns," IRS Pub. 16, April 1974, Department of Treasury.
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Appendix A

OUTLINE OF CR IMPACT FACTORS ON THE BANKING SYSTEM
by
FEDERAL RESERVE BANK OF KANSAS CITY

Appendix A

OUTLINE OF CR IMPACT FACTORS ON BANKING SYSTEM

BY FEDERAL RESERVE BANK OF KANSAS CITY

In response to inquiries made by the study team through the Federal Preparedness Agency and Defense Civil Preparedness Agency, the Federal Reserve Bank of Kansas City undertook to comment on the crisis relocation planning requirements for the banking system. The general conclusion of the review was that present commercial bank emergency plans were incapable of handling any large scale relocation to host areas. The difficulty was attributed primarily to inadequate vital records stored off-premises and the fact that such records might not be accessible to host area banks. Planning options identified were:

A. Declaration of bank holiday

B. Moratorium on all check activity

C. Prepositioning of crisis banks' account records in host areas

D. Prepositioning of currency and coin

E. General administration of all host area banks' activities.

MEMORANDUM

July 26, 1977

Mr. Hamilton:

Attached is an outline that lists the possible National crisis situations expected that would require relocation of the public, the most significant factors that would impair the banking system, and a list of options or actions that would keep the banking system intact and viable during the crisis relocation period thereby making possible post crisis reconstruction of records and resumption of normal operations.

The outline is based on situations and assumptions which would confront the Tenth Federal Reserve District if the crisis relocation is necessary. Department of Defense, Defense Civil Preparedness Agency has published two documents, Guide for Crisis Relocation Contingency Planning, CPG-2-8-C-1, dated January, 1976; and Reception/ Care Planning for Crisis Relocation, dated January, 1976 which contain a description of the situations and assumptions upon which the State of Colorado Crisis Relocation is being developed. If required, copies of the pertinent portions of these manuals can be sent to the Denver Branch.

The Crisis Relocation Plan for Fremont County, Colorado includes the following situations and assumptions.

Situations

1. A nuclear attack on the U. S. would most likely be preceded by a period of international tension and crisis. Sufficient time would be available for protective actions to be taken, including the temporary relocation of residents of possible target areas to lower risk areas.

2. The potential adversary capable of initiating a nuclear attack, the Soviet Union, has well-established plans to evacuate the residents of its major cities, should an intense crisis occur. Soviet plans anticipate relocation of the urban population over a three-day period. It is probable that there will be up to 72 hours available for the banking industry to implement emergency plans.

3. The Colorado State Crisis Relocation Plan provides for the redistribution of supply channels for food, fuel, and other essential goods to Fremont County and other host counties sufficient for the augmented population when relocation occurs.

4. Fremont County has been assigned about 38,000 relocatees from the Colorado Springs risk area. Most people to be hosted in Fremont County are employees and dependents of critical governmental and industrial organizations whose facilities in the Colorado Springs area must be kept in operation by commuting of work shifts.

Assumptions

1. Relocation of the population from the risk areas to the host counties will occur only at the direction of the Governor of Colorado, generally at the request or order of the President of the United States.

2. The State of Colorado will advise local authorities of the possibility that a crisis relocation will be ordered at least six hours prior to the actual order from the Governor.

3. Some portion of Colorado Springs' population, estimated to be between 10 and 20%, can be expected to leave during an intense crisis prior to any advice or order to relocate.

4. Initial arrival of relocatees assigned to Fremont County and en route through it will occur within two hours after notification to relocate.

5. Initial relocation movement will be completed in a period not to exceed three days.

6. Minimum duration of the relocation period will be seven days; the maximum is uncertain but for planning purposes, is assumed to be several weeks.

7. Each relocating family will have been instructed to bring sufficient bedding and clothes for the immediate family and special medicines needed and food for the first three days.

8. The relocation period may be terminated by peaceful resolution of the crisis or by nuclear attack on the U. S. Both contingencies must be planned for.

9. Food and gasoline will be available both en route to and in the host areas.

Our own contingency plans for nuclear attack give wide latitude for curtailment of operations under the Board of Governors of the Federal Reserve System Emergency Regulation No. 1. Section 4 of this regulation states "any Federal Reserve Bank or branch may temporarily curtail, limit, suspend or delete any or all of its operations and functions to such an extent and for such period as it may deem necessary if located in an area which is unsafe because of enemy or defense action, or if essential personnel or physical facilities become unavailable, or if the effective performance of its operations and functions has been impaired as a result of an attack; provided that the Board of Governors shall be notified as soon as practicable of any action taken pursuant to this section; provided further, that operations shall be resumed when the cause of curtailment, suspension, or delegation has been remedied, removed, or dissipated." A bank holiday probably could be implemented under that Regulation until the situation was stabilized.

U. S. Treasury Department Emergency Banking Regulation No. 1, Section 2 states, "Any Federal Reserve Bank, Federal Home Loan Bank, banking institution, or branch may temporarily curtail, limit, suspend, or delegate any or all operations and functions if located in an area which is unsafe because of enemy or defensive action, or if essential personnel or physical facilities become unavailable. Operations and functions of any Federal Reserve Bank, Federal Home Loan Bank, banking institution, or branch which have been so curtailed or suspended shall, as soon as practicable, be resumed when the cause of such curtailment or suspension has been remedied, removed or dissipated."

Present commercial bank emergency plans are generally incapable of handling any large scale relocation of our population to the host areas. The primary weakness of the commercial banks in emergency planning lies in the fact that they do not have adequate vital records stored off-premises. Therefore, unless the records of the risk area banks are stored in the host areas or in a central storage area which is readily accessible to the host area banks, verification of accounts and records would not be possible.

From our study of the impact of crisis relocation on the banking system, we conclude that crisis plans developed for use of the banking system should provide for:

1. maintaining the public's confidence in the banking system,

2. keeping the economy stable by providing essential services,

3. maintaining flexibility among banks for utilization of resources, and

4. providing for reconstruction of all critical records.

D. I. White
Assistant Vice President

Attachment

OUTLINE OF NATIONAL CRISIS RELOCATION IMPACT FACTORS ON BANKING SYSTEM

I. General

A. Types of crises that could be expected (scenarios).

1. National crisis where certain major cities were expected to be attack targets and considered to be crisis areas and evacuation to designated host area counties was ordered.

2. National crisis where all major cities were expected to be attack targets and considered to be crisis areas and evacuation to designated host area counties was ordered.

3. National crisis where all major cities and some host area counties were expected to be targets of attack and evacuation of crisis areas was ordered.

4. National crisis where no information was available as to targets, and major cities and host areas were considered possible targets because of accuracy limitations of weapons expected to be used in attack.

B. Public confidence factor impact on banking system in crisis situation.

1. Decline could result in run on banks forcing banks to attempt to convert their assets into cash.

C. Credit vs. cash reserve mix in banking transactions and their impact on ability of banks to serve the public in crisis situations.

1. Cash reserves make up small percentage of bank holdings.

a. Consist of currency and coin in vault.

2. Cash reserves in bank held to minimum daily needs.

a. Difficult and expensive to protect.

b. Not an earning asset.

c. Additional cash easily obtained from another local bank, correspondent, or Reserve Bank.

3. Bulk of business is in credit transactions, i.e., accounting entries, transfers of funds, etc.

a. Fast communications important factor in credit transactions.

b. Confidence that contractual obligations will be met.

II. Initial public reaction factors that would affect banking system.

A. Public's desire to gather together all negotiable valuables prior to evacuation.

1. Gold, silver, diamonds, negotiable U. S. Treasury securities, currency, coin.

a. Attempt to retrieve valuables from safe deposit boxes.

b. Withdrawals in cash from demand and time accounts.

B. Public will try to use telephone to locate family members.

1. Overloaded telephone facilities in telephone system.

a. System cannot handle excess of approximately 30% simultaneous usage.

C. Mass immediate evacuation.

1. Few employees left to operate bank equipment, handle necessary bank business and shut-down procedures.

2. Auto transportation impossible due to jammed streets.

3. Possible utility service interruption from lack of personnel to man utilities plants.

D. Immediate deterioration of public mores.

1. Security problems to protect premises and valuables.

a. Lack of personnel.

b. Rioting and looting.

III. Define crisis areas and host areas and effect on banking services in crisis relocation.

A. Crisis areas are all major cities and some smaller cities with high priority targets.

1. How many people to be relocated.

2. From what specific areas will each come.

3. Evacuation routes and proximity to crisis area banks.

4. Distance that must be travelled to host areas.

B. Host areas are specific counties in reasonable proximity to crisis areas that are considered low target priority. These counties protected from blast effect and radiation fallout.

III. B. 1. Specific counties and numbers of people to be relocated in each county.

2. Banking facilities available.

a. Number and size of banks.

b. Experienced banking personnel available in host areas.

c. Vault cash reserves in host areas.

1. Individual banks.

2. Commercial businesses.

3. Estimates in hands of public.

d. Bookkeeping capability and capacity.

1. Off-premises computers.

2. On-premises computers.

3. Data processing equipment (punch card and tab).

4. Other bookkeeping equipment.

5. Adding machines and calculators both electric and battery operated.

(a) Printing capability.

3. Office supplies and printing capability in host area.

4. Utilities and back-up emergency power availability.

5. Transportation capability from county to county and town to town.

a. Vehicle availability.

b. Air transportation (helicopter, light aircraft).

c. Distances to be travelled.

6. Claimancy Priorities.

a. Supplies.

b. Fuel (gasoline, diesel oil, etc.).

c. Utilities.

III. B. 6. d. Vehicles.

e. Personnel (experienced).

f. Food.

7. Communications.

a. Telephone facilities and priorities for use.

1. County to county within area.

2. Outside area.

b. Ham radios.

c. CB radios.

IV. Expected immediate service impact on crisis area banks upon notification of evacuation if banks are open.

1. Heavy increase in withdrawal activity.

a. Demand and time accounts.

b. Safe deposit boxes.

2. Heavy demand for transfers of funds to host area banks.

3. Possible demand to withdraw U. S. Treasury securities from safekeeping accounts.

V. Expected initial service impact on host area banks.

1. Some withdrawal of demand and time deposits.

2. Temporary increase in check and credit card transactions.

3. Reduction in cash flow as permanent residents withhold currency and coin deposits.

4. Interruption of electrical services as local power companies are forced to wholly supply electrical power to their service area from their own generators.

5. Absentiism as some local employees decide to relocate their families to what they think are safer areas than the host areas.

6. Disruption of normal check collection process creating heavy float and disruption of settlement process.

V. 7. Inability to use off-premises computer to update bank accounting records forcing those banks who are dependent on off-premises computer centers to establish procedures at local level for account posting.

8. Necessity to upgrade physical security to protect bank's cash assets.

9. Increase in stolen and forged checks in host areas and necessity to examine incoming checks from bank's regular customers to determine validity of signature.

VI. Options for maintaining a viable banking system under the various crisis situations.

A. Declare a bank holiday upon announcement of crisis and notification of relocation.

1. Should extend until after attack and some assessment of damage is made.

2. Effect would be to:

a. prevent run on bank's cash assets.

b. prevent chaotic situation where banks are trying to meet their customers' requests with minimum or no staff.

c. reduce possibility of robbery or looting of bank.

d. put pressure on those who are ordered to relocate by temporarily freezing their funds on deposit. (This will only work if steps are taken to preposition bank records so that accounts can be used in host area banks).

e. provide a pool of experienced employees that will be available for use by host area banks.

f. provide time for shut-down and transportation of bank records.

B. Place moratorium on all check activity both individual and commercial.

1. Effect would be to:

a. freeze all records so that reconstruction can be conducted at later date.

b. eliminate additional float and stabilize the available funds of each geographical area.

VI. B. 1. c. ability to concentrate experienced personnel resources on necessary activities.

C. Prepositioning of crisis banks' account records in central location in host area.

1. Effect would be to:

a. provide an accurate base for reconstruction of accounts in host area so that crisis banks' customers will have available funds.

b. provide an accurate base for reconstruction of crisis banks' records after crisis is over.

c. reduce necessity for government guaranteed credits or loans to relocated public.

D. Prepositioning of currency and coin.

1. Effect would be to:

a. provide additional cash to supplement vault cash reserves of host area banks.

(1) Vault cash reserves will probably be inadequate to cover needs of relocated population and host area residents.

(2) Currency, coin, and hard mediums of exchange along with barter will probably account for the bulk of payments on transactions during the relocation period.

(3) Host area banks will probably have to rely on cash available in host area banks and in hands of public.

(4) Probability that transportation to and access to financial centers' cash reserves will be impossible.

(5) High probability of robbery of trucks moving cash either within host areas or into host area from outside areas.

E. Require central administration of all host area banks' activities, including rules for and limitations on service.

1. Effect would be to:

a. assure equable administration of services to public.

b. prevent unnecessary dilution of cash reserves.

c. provide centralization of a pool of experienced banking personnel for use by host area banks when and where needed.

VI. E. 1. d. permit a central clearinghouse for checks among host area banks so that some check activity will be possible to supplement other cash needs.

e. permit equable allocation of relocated individuals' accounts from crisis area banks to host area banks.

Appendix B

METHODOLOGY FOR THE NATIONAL AND COLORADO STATE FOOD PRODUCTION STUDY

Appendix B

B.1 Input-Output Analysis For National Food Production Study

1. Introduction

Eight variables related to the production of food and kindred products in both risk and non-risk areas during Crisis Relocation (CR) are discussed in the text. Values of seven of these variables are computed by use of the 12 matrix equations that constitute the Input-Output (I-O) model developed for this study. The value of the eighth variable, Percentage Reduction from Normal Consumption or Final Demand, (listed in the first column of each of Tables 7 to 10 in the text), is derived directly from values in the published basic data sources listed in Table B.1.

Of the 12 equations, the solution of each equation from 1 to 11 is a column matrix of 32 terms, corresponding to the 32 food products considered. Capital letters are used to denote matrices, and lower-case letters that correspond to the capitals represent the elements within those matrices. Four sets of I-O computations were carried out for this study. Differences are noted in the sub-section presenting the model equations. Equations (1) through (5) constitute the preliminary calculations needed to formulate equations (6) through (12). Solutions of equations (6) through (11) are the values listed, for each product (by number), in Tables 7 through 10 in the text. The solutions of equation (12), the quotient of two summations, provide values for that percent of food production employees who continue to work in risk areas, a variable discussed in the text.

The mathematical format of the 12 model equations is presented in the following sub-section.

Table B.1

FOOD AND KINDRED PRODUCTS--BASIC DATA SOURCES USED IN NATIONAL CR PRODUCTION STUDY

Variable Symbol	Matrix Shape	Description	Source
V	32 X 50	Percent of Production of Each Product in Each State Under Normal Conditions	1972 Census of Manufacturers
S	1 X 50	Percent of MVA Produced in SMSAs Under Normal Conditions	1972 Census of Manufacturers
E	32 X 1	Number of Employees per $\$10^6$ of Output for Each Product	1972 Census of Manufacturers
P, P1	32 X 1	National Emergency Food Consumption Expressed as Percentage of Normal Consumption	Based on National Emergency Food Consumption Standard (USDA Defense Food Order #2)
D	32 X 1	Final Demand for Each Product Under Normal Conditions	Input-Output Structure of the U.S. Economy: 1967 Bureau of Economic Analysis, Dept. of Commerce, Government Printing Office, 1974
O	32 X 1	Total Output for Each Product Under Normal Conditions	Same as above
A	32 X 32	Input Coefficients Between Individual Food and Kindred Products	Same as above
C	32 X 1	Rough Estimate in Percent, Emergency Production Capacity for each Product	Reported and Estimated Capacity, U.S. Mining and Manufacturing Industries 1957, 1962, Part II, by J.D. Norton, National Planning Association, October 1963.

2. Calculations

Eq. (1) CRD = CR Final Demand

where $(crd)_i = p_i d_i$; elements of matrix P were used in the calculations for Tables 7 and 9, and elements of matrix P1 were used in calculations for Tables 8 and 10

Eq. (2) M = Estimated Percent of Production Done in Risk Areas Under Normal Conditions (a 32 x 1 column matrix)

$$\text{where } m_i = \sum_{j=1}^{50} v_{ij} s_j$$

Eq. (3) CRO = A x CRD = CR Total Output Needed

Eq. (4) NP = Estimated Production Capacity in Non-Risk Areas

where $(np)_i = (1-m_i)o_i$ for Tables 7 and 8 (under normal conditions)

$(np)_i = (1-m_i)o_i c_i$ for Tables 9 and 10 (emergency capacity conditions)

Eq. (5) RP = Estimated Necessary Risk Area Production During CR

$$\text{where } (rp)_i = \begin{cases} 0.0 & , (np)_i \geq (cro)_i \\ (cro)_i - (np)_i & , (np)_i < (cro)_i \end{cases}$$

3. I-O Analytical Results

Eq. (6) SPC = Percentage of Risk Area Normal Production Continued During CR

$$\text{where } (spc)_i = \frac{(rp)_i}{m_i o_i}$$

Eq. (7) CPR = Percentage of Total CR Production Done in Risk Areas

$$\text{where } (cpr)_i = \frac{(rp)_i}{(cro)_i}$$

Eq. (8) INR = Percent Increase in Non-Risk Production Required to End Risk Production During CR

$$\text{where } (inr)_i = \frac{(rp)_i}{(np)_i}$$

Eq. (9) DRP = Percent Decrease in Risk Area Production Possible with a 1% Increase in Non-Risk Production During CR

$$\text{where } (drp)_i = \begin{cases} \dfrac{.01\ (np)_i}{(rp)_i} & (np)_i \neq 0 \\ 0.0 & (rp)_i = 0 \end{cases}$$

Eq. (10) SURPLUS = Percentage Surplus Over Needs Produced in Non-Risk Areas During CR

$$\text{where } (surplus)_i = \begin{cases} 0.0 & (rp)_i \neq 0 \\ \dfrac{(np)_i - (cro)_i}{(cro)_i} & (rp)_i = 0 \end{cases}$$

Eq. (11) EP = Percent of Necessary Risk Area Food Employment Used for Each Product During CR

$$\text{where } (ep)_i \quad \frac{e_i (rp)_i}{\sum_{i=1}^{32} e(rp)_i}$$

Eq. (12) RE = Percent of Risk Area Employees in the Food Industry Who Continue to Work in the Risk Areas During CR

$$RE = \frac{\sum_{i=1}^{32} e_i (rp)_i}{\sum_{i=1}^{32} e_i o_i m_i}$$

B.2 Input-Output Analysis for Colorado Food Production Study

1. Introduction

Eight variables related to the production of food and kindred products in both risk and non-risk areas during CR in the State of Colorado are discussed in the text. These variables are the same as those considered in the national study. Values of seven of these variables are computed by use of the 15 matrix equations that comprise the I-O model for this study. The values of the eighth variable, Percentage of Normal Consumption for each Food Product (listed in the first column of Tables 11 and 12 in the text) are those of the second set of consumption levels developed in the national study.

Of the 15 equations, the solution of each equation from 1 to 14 is a column matrix of 32 terms, corresponding to the 32 food products considered. Capital letters denote metrices, and lower-case letters that correpond to the capitals represent the elements within those matrices. Equations (1) through (8) constitute the preliminary calculations needed to formulate equations (9) through (15). Solutions of equations (9) through (14) are the values listed, by product numbers, in Tables 11 and 12 of the text. The solutions of Eq. (15), the quotient of two summations, provide values for that percent of Food Production employees who continue to work in risk areas, a variable discussed in the text.

Table B.2 lists the basic data sources used in the model equations. Following the table, the mathematical format of the 15 model equations is presented.

Table B.2

FOOD AND KINDRED PRODUCTS--BASIC DATA SOURCES USED IN COLORADO CR PRODUCTION STUDY

Variable Symbol	Matrix Shape	Description	Source
M	32 X 1	Percent of Production in Risk MCDs for Each Product Under Normal Conditions	Dun and Bradstreet Business Tape
E	32 X 1	Number of Employees per $\$10^6$ of Output for Each Product, Under Normal Conditions	Dun and Bradstreet Business Tape
P-1	32 X 1	Percentage of Normal Consumption	Based on National Emergency Food Consumption Standard (USDA Defense Food Order #2)
D	32 X 1	National Final Demand for Each Product Under Normal Conditions	Input-Output Structure of the U.S. Economy, 1967, Bureau of Economic Analysis, Dept. of Commerce, Government Printing Office, 1974
A	32 X 32	Input Coefficients Between Individual Food and Kindred Products	Same as above
C	32 X 1	Rough Estimate in Percent, of Emergency Production Capacity for each Product	Reported and Estimated Capacity, U.S. Mining and Manufacturing Industries 1957, 1962, Part II, by J.D. Norton, National Planning Association, October 1963
CP	32 X 1	Colorado Production of Each Product Under Normal Conditions	Dun and Bradstreet Business Tape
R	32 X 1	National CR Total Output as a Percent of Normal Total Output	Second Calculation of the National CR Production Study
O	32 X 1	National Total Output for Each Product, Under Normal Conditions	Input-Output Structure of the U.S. Economy: 1967, Bureau of Economic Analysis, Dept. of Commerce, Government Printing Office, 1974.

2. Calculations

Eq. (1) DC = Estimated Final Demand for Colorado Under Normal Conditions

where $(dc)_i = d_i$ x (Ratio of Colorado Population to National Population [1967])

$= d_i$ x (.0105139)

Eq. (2) OC = Estimated Total Output Needed for Colorado Plus Imports from Other States Minus Exports to Other States, Under Normal Conditions

where $(oc)_i = o_i$ (.0105139)

$$XI = \begin{cases} \text{Normal Export to Other States} & (xi)_i > 0 \\ \text{Normal Imports from Other States} & (xi)_i < 0 \end{cases}$$

where $(xi)_i = (cp)_i - (oc)_i$

Eq. (4) CRD = CR Final Demand

where $(crd)_i = (p-1)_i (dc)_i$

Eq. (5) CRO = A x CRD = CR Total Output

Eq. (6) CRCP = Necessary Colorado Production for Domestic Needs and Exports to Other States During CR

where $(crcp)_i = (cro)_i + (r_i (xi)_i)$

Eq. (7) NP = Estimated Production Capacity in Non-Risk Areas

where $(np)_i = (1-m_i)(cp)_i$ for first computation, under normal conditions

and $(np)_i = (1-m_i)(cp)_i C_i$ for second computation, applying emergency capacity factors

Eq. (8) RP = Estimated Necessary Risk Area Production During CR

$$\text{where } (rp)_i = \begin{cases} 0.0 & (np)_i \geq (crcp)_i \\ (crcp)_i - (np)_i & < (crcp)_i \end{cases}$$

3. I-O Analytical Results

Eq. (9) SPC = Percentage of Normal Risk Area Production Continued During CR

$$\text{where } (spc)_i = \frac{(rp)_i}{m_i(cp)_i}$$

Eq. (10) CPR = Percentage of Total CR Production Done in Risk Areas

$$\text{where } (cpr)_i = \begin{cases} \dfrac{(rp)_i}{(crcp)_i} & , (crcp)_i > 0.0 \\ 0.0 & , (crcp)_i \leq 0.0 \end{cases}$$

Eq. (11) INR = Percent Increase in Non-Risk Area Production Required to End Risk Area Production During CR

$$\text{where } (inr)_i = \frac{(rp)_i}{(np)_i}$$

Eq. (12) DRP = Percent Decrease in Risk Area Production Possible with a 1% increase in Non-Risk Production

$$\text{where } (drp)_i = \begin{cases} \dfrac{.01\ (np)_i}{(rp)_i} & (rp)_i \neq 0 \\ 0.0 & (rp)_i = 0 \end{cases}$$

Eq. (13) SURPLUS = Percentage Surplus Over Needs Produced in Non-Risk Areas During CR

$$\text{where } (surplus)_i = \begin{cases} 0.0 & (rp)_i \neq 0 \\ \dfrac{(np_i - (crcp)_i}{(crcp)_i} & (rp)_i = 0 \end{cases}$$

Eq. (14) EP = Percent of Necessary Risk Area Food Employment Used for Each Product During CR

$$\text{where } (ep)_i = \frac{e_i(rp)_i}{\sum_{i=1}^{32} e_i(rp)_i}$$

Eq. (15) RE = Percent of Risk Area Employees in the Food Industry Who Continue to Work in the Risk Areas

$$RE = \frac{\sum_{i=1}^{32} e_i(rp)_i}{\sum_{i=1}^{32} e_i m_i(cp)_i}$$

Appendix C

STRUCTURE OF TEMCRIS II

This appendix summarizes the structure of TEMCRIS II and includes:

- o List of endogenous and exogenous variables used in the model.
- o Data sources for the variables appearing in the model.
- o Model equations
- o Method for estimating the paramenters and determined time-dependent multipliers.

LIST OF VARIABLES

Endogenous Variables

Symbol	Description	Billions of Dollars*	Ratio or Percent	Lagged Endogenous	Occurs in Equation
CEEG	Consumption Expenditures, Non-Durable Goods and Services	x		x	1, 2, 17
CEDG	Consumption Expenditures, Durable Goods	x		x	2, 17
GIRS	Gross Investment Residential Structures, Household	x		x	3, 17
GISE	Gross Investment, Other Structures and Equipment	x		x	4, 7, 17
PCHP	Percent Change in Prices (GNP Price Index 1972=100)		x	x	1, 2, 5, 12, 13, 14
DCFH	Demand Credit Funds, Household	x		x	6, 12, 15
DCFB	Demand Credit Funds, Business	x		x	6, 7, 13, 15
DCFG	Demand Credit Funds, Governments	x		x	7, 8, 14, 15
ACFH	Availability of Credit Funds, Household	x		x	3, 6, 9, 12, 16
ACFB	Availability of Credit Funds, Business	x		x	4, 7, 10, 13, 16
ACFG	Availability of Credit Funds, Governments	x		x	8, 11, 14, 16
INTH	Interest Rate, Households		x	x	3, 6, 9, 12, 13, 14
INTB	Interest Rate, Business		x	x	4, 7, 10, 12, 13, 14
INTG	Interest Rate, Governments		x	x	8, 11, 12, 13, 14
DCF-ACF	Total Excess Demand for Credit Funds	x			15
ACF	Total Availability of Credit Funds	x			16
GNPG	Gross National Product Gap	x		x	4, 5, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19
DINC	Disposable Income	x		x	1, 2, 3, 6, 18
GBS	Governments Budget Surplus	x		x	5, 8, 19

*Constant 1972 Dollars

LIST OF VARIABLES (Concluded)

Symbol	Description	Billions of Dollars*	Ratio or Percent	Lagged Exogenous	Occurs in Equations
	Exogenous Variables				
PSM	Personal Savings Measure		x		2, 3, 6
BSM	Business Savings Measure		x		7, 18
CPM	Corporate Profitability Measure		x	x	4, 7, 10
LFTL	Labor Force Time Lost		x	x	1, 2, 5, 9
TTM	Total Tax Measure		x		4, 8, 11, 18, 19
GEGS	Governments Expenditures, Goods, and Services	x			17, 19
TMBR	Total Member Bank Reserves	x			9, 10, 11
DCFF	Demand Credit Funds, Foreigners	x			7, 15
ACFF	Availability of Credit Funds, Foreigners	x			16
DDTS	Demand Deposit and Time Savings	x			9, 10, 15
CMI	Credit Market Instruments	x			10, 15
OSCF	Other Sources of Credit Market Funds	x			9, 15
GNPC	Gross National Product Capacity	x			17, 18, 19
GTP	Government Transfers to Persons	x			1, 18, 19
NEX	Exports Less Imports	x			17
OSDI	Other (Net) Wealth Sources of Disposable Income	x			18
OGEX	Other (Net) Government Expenditures	x			19

*Constant 1972 Dollars

Data Sources for Variables in TEMCRIS II

Endogenous Variables

1. The Survey of Current Business, January 1976, Parts I and II, and August 1976 as well as the Economic Report of the President, February 1976 and February 1977, were used as the data source (expressed in constant dollars) for:
   - Consumption Expenditure, Non-Durable Goods and Services (CEEG)
   - Consumption Expenditure, Durable Goods (CEDG)
   - Gross Investment Residential Structure (GIRS)
     (The residential component of fixed investment, gross private domestic investment)
   - Gross Investment, Other Structures and Equipment (GISE)
     (The non-residential component of fixed investment, gross private domestic investment plus change in business inventories)
   - Percent Change in Prices (GNP Price Index 1972 = 100) (PCHP)
     (Calculated percent change in implicit price deflation for gross national product)
   - Disposable Income (DINC)
     (National income element personal income less personal tax and non-tax payments)
   - Government Budget Surplus
     (Total government surplus or deficit -- receipts less expenditures: national income and product accounts divided by GNP deflator)
2. The Federal Reserve Bulletin, various issues, were used as data sources for:
   - Demand for Credit Funds, Households (DCFH)
     (Total funds raised, private domestic non-financial sectors, by borrowing sector: households divided by GNP deflator)

- Demand for Credit Funds, Business (DCFB)

  (Total funds raised, private domestic non-financial sectors, by borrowing sector: non-financial business divided by GNP deflator)

- Demand for Credit Funds, Government (DCFG)

  (Total funds raised, private domestic non-financial sectors, by borrowing sector: State and local governments plus U.S. government divided by GNP deflator)

- Availability of Credit Funds, Households (ACFH)

  (Observationally equivalent to Demand for Credit Funds, Households)

- Availability of Credit Funds, Business (ACFB)

  (Observationally equivalent to Demand for Credit Funds, Business)

- Availability of Credit Funds, Government (ACFG)

  (Observationally equivalent to Demand for Credit Funds, Government)

3. The Economic Report of the President, various years, was the source of the data for:

   - Interest Rate, Households (INTH)

     (Bond yields and interest rates, FHA new home mortgage yields, median month in each quarter, divided by GNP deflator)

   - Interest Rate, Business (INTB)

     (Bond yield and interest rates, average rate on short-term bank loans to business, selected cities, median month in each quarter, divided by GNP deflator)

   - Interest Rate, Government (INTG)

     (Bond yields and interest rates, geometric mean of 3 month Treasury bill yields and 3-5 years U.S. government securities yields, median month in each quarter, divided by GNP deflator)

4. Variables Derived from Other Variables

   - Total Excess Demand for Credit Funds (DCF-ACF)

     (Identity relationship. See equation 15.)

   - Total Availability of Credit Funds (ACF)

     (Identity relationship. See equation 16.)

   - Gross National Product Gap (GNPG)

     (Identity relationship. See equation 17.)

Exogenous Variables

1. The Survey of Current Business, January 1976 Parts I and II and August 1976 as well as the Economic Report of the President, various years were used as the data source (expressed in constant dollars) for:

   - Personal Savings Measure (PSM)

     (Personal savings as a percent of disposable personal income)

   - Business Savings Measure (BSM)

     (Capitol consumption allowances with capitol consumption adjustment current dollars plus undistributed profits current dollars divided by GNP deflator)

   - Total Tax Measure (TTM)

     (Federal government receipts plus State and local government receipts less federal grants-in-aid divided by Gross National Product)

   - Government Expenditures Goods and Services (GEGS)

     (Federal government constant dollar purchases of goods and services plus State and local government constant dollar purchases of goods and services)

- Government Transfers to Persons (GTP)

  (Federal, State, and local government transfers to persons plus net interest paid to persons and business divided by GNP deflator)

- Export less Import (NEX)

  (Net exports of goods and services in constant dollars)

2. The Economic Report of the President, various years, was used as the data source for:

   - Labor Force Time Lost (LFTL)

     (Selected unemployment rates, aggregate hours lost by unemployed and persons on part-time for economic reasons as a percent of potentially available labor force hours, median month for each quarter)

   - Corporate Profitability Measure (CPM)

     (Relationship of profits after taxes to stockholders equity, ratio of profits after income taxes (annual rate) to stockholders equity, all manufacturing corporations)

3. The Federal Reserve Bulletin, various issues, was used as the data source for:

   - Total Member Bank Reserves (TMBR)

     (Median month in each quarter divided by GNP deflator)

   - Demand for Credit Funds, Foreigners (DCFF)

     (Equivalent to Availability of Credit Funds, Foreigners (ACFF)

     (Total funds raised, foreign, corporate equities plus debt instruments, divided by GNP deflator)

   - Demand Deposits and Time Savings (DDTS)

     (Total funds advanced to non-financial sectors, financed directly or indirectly by deposits, divided by GNP deflator)

- Credit Market Instrument (CMI)

  (Total funds advanced to non-financial sectors, financed directly or indirectly by U.S. government securities, private credit market instruments, corporate equity less security debt, divided by GNP deflator)

- Other Sources of Credit Market Funds (OSCF)

  (Total funds advanced to non-financial sectors, financed directly or indirectly by foreign funds, change in U.S. government cash balance, U.S. government loans, private insurance and pension reserves, and other, divided by GNP deflator)

4. Calculated Variable or Variables Derived from Other Variables

   - Gross National Product Capacity (GNPC)

     (For TEMCRIS II a simple proxy was used. Conceptually, capacity is equal to optimal output per worker (in real terms) times optional employment. The optional output was estimated at $12,500 for mid 1963. This figure was increased by 1.006 for each quarter. Optional employment is taken to be the civilian labor force in each quarter times .965. In the interactive TEMCRIS/Linear Programming Input-Output model, the change in capability is determined through the LP I-O model.)

   - Other (Net) Wealth Sources of Disposable Income (OSDI)

     (To balance accounts, the algebraic determination of this variable is as follows:

     $$OSDI = DINC - [(1-TTM-BSM)GNP] - GTP \quad)$$

   - Other (Net) Government Expenditures (OGEX)

     (The algebraic determination of this variable is as follows:

     $$OGEX = GBS - TTM \cdot GNP + GEGS + GTP \quad)$$

VARIABLES AND CORRESPONDING COEFFICIENTS

Endogenous		Lagged Endogenous[a]		Exogenous		Lagged Exogenous[a]	
Coefficient	Variable	Coefficient	Variable	Coefficient	Variable	Coefficient	Variable
β_1	CEEG	γ_1	LCEEG	δ_1	PSM		
β_2	CEDG	γ_2	LCEDG	δ_2	BSM		
β_3	GIRS	γ_3	LGIRS	δ_3	CPM	θ_3	LCPM
β_4	GISE	γ_4	LGISE	δ_4	LFTL	θ_4	LLFTL
β_5	PCHP	γ_5	LPCHP	δ_5	TTM		
β_6	DCFH			1	GEGS		
β_7	DCFB			δ_7	TMBR		
β_8	DCFG	γ_8	LDCFG	δ_8	DCFF		
β_9	ACFH	γ_9	LACFH	1	ACFF		
β_{10}	ACFB	γ_{10}	LACFB	δ_9	DDTS		
β_{11}	ACFG	γ_{11}	LACFG	δ_{10}	CMI		
β_{12}	INTH	γ_{12}	LINTH	δ_{11}	*OSCF*		
β_{13}	INTB	γ_{13}	LINTB	1	GNPC		
β_{14}	INTG			δ_{13}	GTP		
β_{15}	DCF			1	NEX		
β_{16}	ACF			1	OSDI		
β_{17}	GNPG			1	OGEX		
β_{18}	DINC						
β_{19}	GBS						
β_1^*	$(\text{DCFH} - \text{ACFH})_{\text{calc}}$						
β_2^*	$(\text{DCFB} - \text{ACFB})_{\text{calc}}$						
β_3^*	$(\text{DCFG} - \text{ACFG})_{\text{calc}}$						

[a]The variables designated as lagged have values of the preceding period.

MODEL EQUATIONS

The following equations define the nineteen endogenous variables used in the econometric model:

1. $CEEG = \alpha_1 + \beta_{1,5}\ PCHP + \beta_{1,18}\ DINC + \gamma_{1,1}\ LCEEG + \delta_{1,4}\ LFTL + \delta_{1,13} GTP + \varepsilon_1$

2. $CEDG = \alpha_2 + \beta_{2,1}\ CEEG + \beta_{2,5}\ PCHP + \beta_{2,18}\ DINC + \gamma_{2,2}\ LCEDG + \delta_{2,1}\ PSM + \delta_{2,4}\ LFTL + \theta_{2,4}\ LLFTL + \varepsilon_2$

3. $GIRS = \alpha_3 + \beta_{3,9}\ ACFH + \beta_{3,12}\ INTH + \gamma_{3,3}\ LGIRS + \gamma_{3,18}\ LDINC + \delta_{3,1}\ PSM + \varepsilon_3$

4. $GISE = \alpha_4 + \beta_{4,10}\ ACFB + \beta_{4,13} INTB + \gamma_{4,4}\ LGISE + \gamma_{4,17}\ LGNPG + \theta_{4,3}\ LCPM + \delta_{4,5} TTM + \varepsilon_4$

5. $PCHP = \alpha_5 + \beta_{5,17}\ GNPG + \gamma_{5,5}\ LPCHP + \gamma_{5,19}\ LGBS + \theta_{5,4} LLFTL + \varepsilon_5$

6. $DCFH = \alpha_6 + \beta_{6,7}\ DCFB + \beta_{6,12}\ INTH + \beta_{6,18}\ DINC + \gamma_{6,6} LDCFH + \gamma_{6,12}\ LINTH + \delta_{6,1}\ PSM + \varepsilon_6.$

7. $DCFB = \alpha_7 + \beta_{7,8}\ DCFG + \beta_{7,13}\ INTB + \gamma_{7,4} LGISE + \gamma_{7,7}\ LDCFB + \gamma_{7,13}\ LINTB + \delta_{7,2}\ BSM + \delta_{7,8}\ DCFF + \theta_{7,3}\ LCPM + \varepsilon_7.$

8. $DCFG = \alpha_8 + \beta_{8,14}\ INTG + \beta_{8,19}\ GBS + \gamma_{8,8}\ LDCFG + \gamma_{8,17} LGNPG + \delta_{8,5}\ TTM + \varepsilon_8.$

9. $ACFH = \alpha_9 + \beta_{9,12}\ INTH + \beta_{9,17}\ GNPG + \gamma_{9,9}\ LACFH + \delta_{9,4}\ LFTL + \delta_{9,7}\ TMBR + + \delta_{9,9}\ DDTS + \delta_{9,11}\ OSCF + \varepsilon_9$

10. $ACFB = \alpha_{10} + \beta_{10,13}\ INTB + \beta_{10,17}\ GNPG + \gamma_{10,10}\ LACFB + \delta_{10,3}\ CPM + \delta_{10,7}\ TMBR + \delta_{10,9}\ DDTS + \delta_{10,10}\ CMI + \delta_{10,11}\ OSF.$

11. $ACFG = \alpha_{11} + \beta_{11,14}\ INTG + \beta_{11,17}\ GNPG + \gamma_{11,11}\ LACFG + \delta_{11,5}\ TTM + \delta_{11,7}\ TMBR + \varepsilon_{11}.$

12. $INTH = \alpha_{12} + \beta_{12,5}\ PCHP + \beta_{12,13}\ INTB + \beta_{12,14}\ INTG + \beta_1^{*}\ (ACFH - DCFH)_{calc} + \gamma_{12,12} LINTH + \gamma_{12,17}\ LGNPG + \varepsilon_{12}$

13. $INTB = \alpha_{13} + \beta_{13,5}\ PCHP + \beta_{13,12}\ INTH + \beta_{13,14}\ INTG + \beta_2^{*}\ (ACFB - DCFB)_{calc} + \gamma_{13,13}\ LINTB + \gamma_{13,17}\ LGNPG + \varepsilon_{13}$

14. $INTG = \alpha_{14} + \beta_{14,5}\ PCHP + \beta_{14,12}\ INTH + \beta_{14,13}\ INTB + \beta_3^{*}\ (ACFG - DCFG)_{calc} + \gamma_{14,13}\ LINTB + \gamma_{14,17}\ LGNPG + \varepsilon_{14}$

15. $DCF - ACF = DCFH + DCFB + DCFG + DCFF - DDTS - CMI - OSCF$

16. $ACF = ACFH + ACFB + ACFG + ACFF$

MODEL EQUATIONS (Continued)

17. GNPG = GNPC - CEEG - CEDG - GIRS - GISE - GEGS - NEX

18. DINC = (1 - TTM - BSM) (GNPC - GNPG) + GTP + OSDI

19. GBS = TTM (GNPC - GNPG) - GEGS - GTP - OGEX

β^* coefficients are used to correspond to the fitted functions, the differences between the respective calculated values of demand and availability of credit funds.

The last five relationships, identity equations, are necessary to complete the system. Although equations 18 and 19 are non-linear, they can be transferred into linear relationship by applying Taylor's expansion for finite differences.

DERIVATION OF ESTIMATES OF PARAMETERS AND MULTIPLIERS

The initial system of equations can be expressed in matrix terminology. Let:

Y_t = vector of endogenous variables

Y_{t-1} = vector of lagged endogenous variables

X_t = vector of exogenous variables (including the constants)

X_{t-1} = vector of lagged exogenous variables

B = matrix of β coefficients associated with the (right-hand) endogenous variables

Γ = matrix of γ coefficients associated with the lagged endogenous variables

Δ = matrix of δ coefficients associated with the exogenous variables

Θ = matrix of θ coefficients associated with the lagged exogenous variables

Ψ_t = vector of normally distributed uncorrelated error terms

The system of equations is written as:

$$Y_t = BY_t + \Gamma Y_{t-1} + \Delta X_t + \Theta X_{t-1} + \Psi_t$$

Rearranging terms (all current endogenous variables appearing on the left-hand side) gives:

$$Y_t = (I-B)^{-1}\Gamma Y_{t-1} + (I-B)^{-1}\Delta X_t + (I-B)^{-1}\Theta X_{t-1} + (I-B)^{-1}\Psi_t$$

A computer program utilizing the two-stage least squares (2SLS) method is used to estimate the various parameter elements of the matrices B, Γ, Δ, and Θ. If a system of equations exhibits first-order serially correlated errors (that is $\Psi_t = T\Psi_{t-1} + \xi_t$ where T is a matrix having values representing serially correlated errors only on the diagonal positions and Ξ_t is a vector of normally distributed uncorrelated errors), the system of equations becomes transformed. The system of equations becomes:

$$Y_t - TY_{t-1} = B(Y_t - TY_{t-1}) + \Gamma(Y_{t-1} - TY_{t-2}) + \Delta(X_t - TX_{t-1}) + \Theta(X_{t-1} - TX_{t-2}) + \Xi_t$$

An expanded computer program utilizing 2SLS correcting for first-order serially correlated errors is used to estimate the various parameter elements of the matrices B, Γ, Δ, Θ, and T.

Rearranging terms results in:

$$Y_t = (I-B)^{-1}(T\{I-B\} + \Gamma)Y_{t-1} - (I-B)^{-1}(T\Gamma)Y_{t-2} + (I-B)^{-1}\Delta X_t$$
$$- (I-B)^{-1}(T\Delta-\Theta)X_{t-1} + (I-B)^{-1}(T\Theta)X_{t-2} + (I-B)^{-1}\Xi_t$$

If the various matrices are redefined, the system of equations is simplified as:

$$Y_t = \Gamma^* Y_{t-1} + \Gamma^{**} Y_{t-2} + \Delta^* X_t + \Delta^{**} X_{t-1} + \Delta^{***} X_{t-2} + \nabla^* \Xi_t$$

Where:

$$\Gamma^* = (I-B)^{-1}(T\{I-B\} + \Gamma)$$

$$\Gamma^{**} = -(I-B)^{-1}(T\Gamma)$$

$$\Delta^* = (I-B)^{-1}\Delta$$

$$\Delta^{**} = -(I-B)^{-1}(T\Delta-\Theta)$$

$$\Delta^{***} = -(I-B)^{-1}T\Theta$$

$$\nabla^* = (I-B)^{-1}$$

The calculation of multipliers is obtained by successively substituting the system of equations represented by Y_{t-1}, Y_{t-2}... and tracking the matrices of X_t, X_{t-1},.... Two sets of multipliers are of interest. Impact multipliers indicate the direct consequences of a change in the exogenous variables on the endogenous variables recognizing the interdependencies specified by the system of equations. Interim multipliers trace the subsequent consequences of that change over time.

These multipliers can be expressed as:

$M(0) = \Delta^*$	Impact multipliers
$M(1) = G(1)J + G(0)K$	1st period interim multipliers
$M(2) = G(2)J + G(1)K$	2nd period interim multipliers
$M(3) = G(3)J + G(2)K$	3rd period interim multipliers
⋮	
$M(t) = G(t)J + G(t-1)K$	t^{th} period interim multipliers

Where $J = = \Gamma^*\Delta^* + \Delta^{**}$

$K = \Gamma^{**}\Delta^* + \Delta^{***}$

$G(t) = \Gamma^* G(t-1) + \Gamma^{**} G(t-2)$

$G(0)$ = null matrix

$G(1)$ = identity matrix

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As examples $G(2) = \Gamma^{*}I + \Gamma^{**}0 = \Gamma^{*}$

$$G(3) = \Gamma^{*}\Gamma^{*} + \Gamma^{**} = (\Gamma^{*})^{2} + \Gamma^{**}$$

Although <u>total</u> multipliers (showing the consequences of a <u>sustained</u> change in the exogenous variables on the endogenous variables) are not used in the analysis, their matrix structure is given by:

$$M = \sum_{t=1}^{t=\infty} M(t) + M(0)$$

$$= \sum_{t=1}^{t=\infty} G(t)J + \sum_{t=1}^{t=\infty} G(t-1)K + \Delta^{*}$$

ADDITIONAL MODEL EQUATIONS

The following equations define relationships among selected exogenous variables used in generation of scenarios and policies:

1. $$PSM = \alpha_1 + \omega_{1,1}\,LFTL + \omega_{1,2}\,DDTS + \omega_{1,3}\,GEGS + \omega_{1,4}\,TMBR + \omega_{1,5}\,CMI + \omega_{1,6}\,GTP + \omega_{1,7}\,OGEX + \omega_{1,8}\,NEX + \varepsilon_1$$

2. $$BSM = \alpha_2 + \omega_{2,1}\,LFTL + \omega_{2,2}\,DDTS + \omega_{2,3}\,GEGS + \omega_{2,4}\,TMBR + \omega_{2,5}\,CMI + \omega_{2,6}\,GTP + \omega_{2,7}\,OGEX + \omega_{2,8}\,NEX + \varepsilon_2$$

3. $$CPM = \alpha_3 + \omega_{3,1}\,LFTL + \omega_{3,2}\,DDTS + \omega_{3,3}\,GEGS + \omega_{3,4}\,TMBR + \omega_{3,5}\,CMI + \omega_{3,6}\,GTP + \omega_{3,7}\,OGEX + \omega_{3,8}\,NEX + \varepsilon_3$$

4. $$TTM = \alpha_4 + \omega_{4,1}\,LFTL + \omega_{4,2}\,DDTS + \omega_{4,3}\,GEGS + \omega_{4,4}\,TMBR + \omega_{4,5}\,CMI + \omega_{4,6}\,GTP + \omega_{4,7}\,OGEX + \omega_{4,8}\,NEX + \varepsilon_4$$

5. $$DCFF = \alpha_5 + \omega_{5,1}\,LFTL + \omega_{5,2}\,DDTS + \omega_{5,3}\,GEGS + \omega_{5,4}\,TMBR + \omega_{5,5}\,CMI + \omega_{5,6}\,GTP + \omega_{5,7}\,OGEX + \omega_{5,8}\,NEX + \varepsilon_5$$

Appendix D

CRISIS IMPACT UPON ELEMENTS OF THE ECONOMY (REPRODUCED FROM PHASE I REPORT)*

*"Economic and Industrial Aspects of Crisis Relocation: An Overview," Richard K. Laurino, et al., prepared by Center for Planning and Research, Inc. for Defense Civil Preparedness Agency, May 1977.

Table 6*

CRISIS IMPACT ON INDIVIDUAL/FAMILY ECONOMIC BEHAVIOR

Operation Phase	Income	Expenditures	Resources
Pre-CR Crisis	Selective unemployment Absenteeism Underemployment Slowdown in receivables	New demand patterns Excessive buying Increased prices Shortages Speculation	Restriction on use of liquid assets Rapid change in asset values Credit limitations
CR-Initiation	Stoppage of income Increased income (host area) Distress sales	Relocation costs Initial needs in host area	Cash shortages Unavailability of credit Unacceptability of checks
CR-Maintenance	Loss of employment income Disruption of payment of receivables Increased income (host area) Payment for emergency services Public assistance	CR maintenance costs Supply and price controls Competition (host area)	Cash shortage Restricted credit and check use Damage to assets (risk area) Overdue obligations
CR-Reconstitution	Slow reemployment Temporary underemployment Delayed payment of receivables	Demand for necessities Reduction in discretionary expenditures Slow payment of obligations Supply and price controls Asset repair and maintenance costs	Reduced liquid assets (evacuees) Changed asset values Overdue obligations Restrictions on credit Accrued benefits Government assistance

*Table numbers in this appendix are those in the Phase I report.

Table 11

POTENTIAL IMPACT OF CRISIS RELOCATION ON BUSINESS
BY TIME PHASES

Business Function	Business Response	Impact of Business Response
Pre-CR Crisis Phase		
Production and inventories	o Shutdown of production (risk areas) o Liquidation of inventories (risk areas)	o Loss of goods to economy o Disruption of distribution channels
Finance	o Deferred payment of current accounts and expenses o Cash withdrawals from banks o High sales of merchandise	o Disruption of money and capital markets o Large cash holdings o Revised price structure
Employment	o Increased absenteeism o Increased unemployment	o Loss of efficiency and production o Long term loss of purchasing power
CR-Initiation Phase	o General shutdown of all business o Freeze of assets and payments	o Loss of goods and services to economy o Distribution hiatus o Problems of security of assets
CR-Maintenance Phase		
Production and inventories	o High demands on essential and host area businesses o Shutdown of other risk area businesses	o Loss of goods and services to economy o Revised production and distribution subject to loss of controls and inefficiencies o Developing imbalances
Finance	o Suspended payments of risk area business accounts o Flow of cash and assets to host area businesses	o Disruption of current asset position of many businesses o Dissipation of liquid business assets
Employment	o Imbalanced skill requirements o High unemployment	o Loss of efficiency and production o Loss and imbalance of purchasing power

Table 11 (concluded)

Business Function	Business Response	Impact of Business Response
CR-Reconstitution Phase		
Production & inventories	o Need to rebuild work-in-process, distribution, and inventories	o Continued shortages of consumer goods o Imbalance of distribution
Finance	o Revision of asset values o Curtailed ability to meet current expenses o Curtailed ability to finance rebuilding of inventories	o Possible high bankruptcy rate o Inability to collect current accounts o Losses of asset value
Employment	o Slow pickup as pipelines refill o Permanent dislocations from business failures and worker relocations	o Loss of productivity and inefficiencies due to labor force imbalances o Permanent losses of purchasing power

Table 18

POTENTIAL IMPACT OF CRISIS RELOCATION ON FINANCIAL INSTITUTIONS

Financial Function	Institutions Problems	Impact of Problems
Pre-CR Crisis Phase		
Check Clearing	o Increase in employee absenteeism o Increase in time to clear checks	o Unplanned increase in money supply
Deposit Withdrawals	o Increased withdrawals from demand, time, and savings deposits o Possible curtailment of automatic deposits	o Curtailment of new loan commitments, especially long term commitments o Difficulties in finding liquid assets to meet withdrawals o Curtailed availability of funds for interbank borrowing o Adverse effect on earnings
Earning Assets Management	o Reduced willingness to make loans o Increased delay in loan repayments o Erosion in value of securities held o Reluctance to call loans and forced disposal of securities	o Increased reliance on interbank borrowing to meet reserve requirements o Increased costs of borrowed funds o Limit to borrowing from the federal government
Other Services	o Increased delays in carrying out payroll, billing, credit card, and other functions o Increased inability to underwrite financing transactions	o Disruption of users' operations o Disruption of financing of new securities
CR-Initiation Phase	o Availability of computer check processing system o Availability of duplicate bank records o Determination of functions to be performed in risk areas o Desirability of closing down securities, commodities, and options markets o Safety of securities and facilities	o Promulgation of principles of loss equalizations o Implementation of Agent Bank plans o Unavoidable disruption of financial activities

Table 18 (Continued)

Financial Function	Institutions Problems	Impact of Problems
CR Maintenance Phase		
Check Clearing	o Control of cashing of checks in host areas o Verification of checks o Increase in time to clear checks o Acceptability of checks in host areas	o Unlikely profitability of banks o Increase in net borrowed reserves
Deposit Withdrawals	o Increased requirement for cash in host areas o Limitation on withdrawals for essential purposes o Curtailment of withdrawals by foreigners	o Implementation of measures similar to EB Reg. No. 1 o Uncertainty as to how reserves are balanced o Rationing of cash
Earning Assets Management	o Criteria for making essential short term loans o Inability to satisfy reserves through loan repayments or restructuring o Uncertain value of securities held o Curtailed ability to call loans	o Uncertain extent to which U.S. government securities can be sold o Less likelihood of continuation of interbank borrowing
Other Services	o Inability to provide payroll, billing, and other services o Control of credit card purchases o Cessation of underwriting functions	o Delay in completing transactions o Solvency of businesses and financial institutions

Table 18 (Concluded)

Financial Function	Institutions Problems	Impact of Problems
CR-Reconstitution Phase		
Check Clearing	o Orderly removal of control on cashing of checks o Resolution of bad checks issued o Orderly transfer to centralized check clearing o Record reconciliation	o Orderly return to the usual pre-crisis level of float
Deposit Withdrawals	o Encouragement of depositors o Determination of return on new time and savings deposits	o Maintenance of bank liquidity
Earning Assets Management	o Valuation of earning assets o Orderly phase-in of purchases of governmental and other securities o Restructuring of loans o Establishment of criteria for making new loans	o Phased reconstruction of credit market o Return to profitability o Loss equalization resulting from insolvency o Phase-in of normal security operations
Other Services	o Sorting out of records o Reconstitution of system of providing essential business functions o Reconstitution of securities, commodities, and options markets o Transfer of Agent Bank functions back to Federal Reserve	o Orderly phase-in of established services

Table 22

LOCAL AND STATE GOVERNMENT

Phase	Revenue	Expenditures	Assets
Pre-CR Crisis	Reduced payments for services Reduced tax receipts Slowdown of intergovernmental payments	Crisis preparation and control costs Accelerated vendor payment demands Slowdown in payments Rise in unit cost of services	Redemption of short term securities Greater use of cash deposits Deferred loan programs
CR-Initiation	Tax revenue reduced or stopped Reduced earnings because of curtailment of services Intergovernmental payment for emergency services	Increased costs of emergency services Reduction in non-emergency expenditures Deferral of payments	Unavailability of liquid assets (risk) Loss and damage to equipment and facilities
CR-Maintenance	Reduced earnings (risk) Increased revenue (host) General delay in payments	Costs of evacuee maintenance Costs of protective measures Costs of key worker transportation Costs of host area control measures Ongoing salary and maintenance costs Continued cost of terminated operations Welfare institutional costs Debt service Other prior obligations Demands for early payment from vendors Cash flow problems (host area and state)	Controlled access to deposits Impaired market for securities Loss or damage to facilities and equipment

Table 22 (Concluded)

Phase	Revenue	Expenditures	Assets
CR-Reconstitution	Below normal tax revenue Lower service revenue Delayed payments Reduced interest income Increased intergovern-mental revenues	Increased welfare and unemployment costs Payment of accrued earnings Payment of obligations Increased maintenance costs Intergovernmental claims Deferral of new obligations	Depleted liquid assets Restrictive credit Reduced asset values Reduced tax base

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