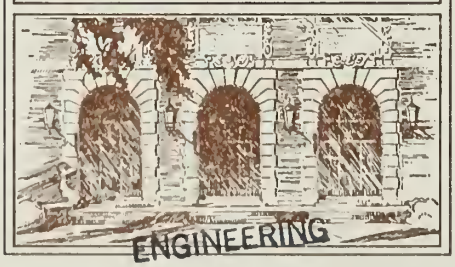

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CAC Document No. 8

ECONOMIC RESEARCH GROUP WORKING PAPER NO. 2

# Occupational Manpower Impacts of Shifting National Priorities

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This work was supported in part by the Advanced Research Projects Agency of the Department of Defense and was monitored by the U.S. Army Research Office-Durham under Contract No. DAHC04 72-C-0001.

ABSTRACT

This paper presents the development of an economic model capable of generating occupational manpower requirements from alternate specified distributions of national expenditures reflecting different goals and priorities. This model is used to simulate the effects of several specified shifts in national priorities upon manpower requirements of the United States in the early 1960's. The employment effects of these simulated priority shifts are indicated and 150 occupations are classified and ranked according to their sensitivity to changing patterns of resource allocation. The implications of these results for economic and manpower forecasting and planning are discussed.

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# INTRODUCTION

There continues to be a large amount of discussion in the United States concerning the desirability and possibility of reallocating national expenditures to emphasize different goals and priorities. Unfortunately this dialogue rarely progresses beyond the point of highly subjective and superficial discussion to the point of rigorous theoretical and empirical analysis. This is especially true when it comes to determining the effects on the labor market which shifting national goals and expenditure programs may generate. A recent and notable example of this was nationwide debate over funding of the Supersonic Transport Airplane. Although a large number of widely varying and conflicting estimates of the employment impacts which would result from cancellation of the SST were advanced by proponents and opponents of the project it was obvious that the precise manpower effects of programs such as the SST were unclear. More importantly, reliable estimates of the detailed employment effects which would be generated by allocating the resources freed by cancellation of the SST to other competing programs and activities were not available--nor were they readily obtainable. The substance of this argument could be repeated in relation to contemplated shifts in expenditures among a large number of different types of public and private economic activities. At present a comprehensive integrated economic model capable of translating functional distributions of national expenditures among a wide range of economic activities into requirements for detailed categories of manpower resources is lacking. In this paper a straightforward theoretical model for the generation of detailed manpower demands from alternate functional distributions of national expenditures corres-

ponding to different goals and priorities will be developed. Significant results derived by simulating the effects upon the labor market of specified reorderings of national priorities will be presented, and implications of these findings for manpower forecasting and planning will be indicated.

## I. THE THEORETICAL MODEL

The theoretical basis for the priority-expenditure manpower demand generating model developed here is the static open input-output model. Analytically let: y denote an n-by-1 vector specifying the industrial composition of final demand, z denote an n-by-n intermediate product flow matrix, w denote a 1-by-n vector showing the value added in each sector, and L denote a (partitioned) Leontief matrix. An interindustry model which represents a complete economic system is referred to as a Leontief model and a convenient way of representing an interindustry transaction table is by a partitioned Leontief matrix:

$$L = \begin{bmatrix} Z & y \\ \hline w & 0 \end{bmatrix} \tag{1}$$

The nonproduction accounts of the system are assumed to have been consolidated, and all output is accounted for by either intermediate demand or final demand. Letting x represent an n-by-1 total output vector and d denote an n-by-1 vector of ones:

$$x = Zd + y \tag{2}$$

Assuming that inputs vary proportionately with outputs the technical coefficient matrix may be obtained from equation (2) by dividing the elements in each column of Z by the adjusted output total in the corresponding row of the Leontief matrix. Letting A denote an n-by-n matrix of technical coefficients and X denote an n-by-n diagonal output matrix:

$$A = ZX^{-1} \tag{3}$$

The elements $a_{ij}$ of A show the direct purchases made by the $j^{th}$ sector from the $i^{th}$ sector per dollar of output. Solving (3) for Z and substituting the result into (2) yields:

$$x = AXd + y = Ax + y \tag{4}$$

With input-output coefficient matrix A and total output vector x, AX represents the vector of input requirements corresponding to these outputs. The final demand vector y is the vector of outputs available for disposal outside of the processing sector and, letting I denote an identity matrix of order n, using (4) the following equation may be derived:

$$x - AX = (I-A)x = y \tag{5}$$

Assuming (I-A) to be nonsingular the above may be solved for x:

$$x = (I-A)^{-1}y \tag{6}$$

$(I-A)^{-1}$ is the familiar Leontief inverse matrix and the elements of it indicate the output requirements generated directly and indirectly from industry i by industry j per delivery of a dollar's worth of output to final demand.

The fundamental problem of open model analysis is that of determining the interindustry transactions necessary to supply a specified bill of goods, and to determine the levels at which all industries must operate to produce a certain bill of goods y, equation (6) is solved for x.

The manpower demand generating model developed here may in its simplest form be considered to be a straightforward extension of the Leontief open input-output model in several directions.[1] To begin with, the final demand vector y, itself can be derived as the sum of a number of n-by-1 vectors each of which give the industrial input requirements of a distinct economic activity component of final demand. Letting u denote the number of sectoral components of final demand, $g_j$ denote an n-by-1 vector specifying the input requirements of exogenous activity j, and $\varepsilon_j$ denote a vector indicating the portion of final demand consumed by activity j:

$$(7) \qquad y = g_1 + g_2 + \ldots\ldots + g_u; \sum_i^n y_i = \sum_j^u \varepsilon_j \left(\sum_i^n y_i\right); \sum_j^u \varepsilon_j = 1$$

Dividing each of the bills of goods vectors $g_j$ by the total direct output requirements of the $j^{th}$ activity yields the percent distribution of direct output requirements generated by expenditures on that activity. These percent bills of goods vectors may be arranged into an n-by-u activity-industry matrix denoted by P: each $p_{ij}$ element of P indicates the direct requirements generated for the output of industry i per dollar of expenditure in final demand activity sector j. The distribution of

national expenditures among activities may be represented by a u-by-1 activity-expenditure vector denoted by q: each $q_j$ element of q shows the total expenditures devoted to activity j. Thus the final demand vector may be expressed as the product of the activity-industry matrix and the activity-expenditure vector:

$$(8) \qquad y = Pq$$

In an economic sense changing national priorities implies shifting national expenditures among competing public and private economic programs and activities to emphasize particular goals and objectives. The expenditure elements of the q vector can be reordered within limits to reflect a wide range of different priority commitments, and this is the manner in which specified shifts in national goals and priorities enter the model.

Proceeding, the Leontief inverse matrix may be transformed into labor units by having each of its rows multiplied by the appropriate employment-output ratio indicating the employment requirements per unit of output in the particular industry. This results in the creation of an interindustry-employment matrix showing the total employment generated by and within every industry in the economy.[2] This matrix may be represented by the following array:

(9)

| Industry Employment Generated By | Industry Employment Generated In: 1 | 2 | ... | j | ... | n |
|---|---|---|---|---|---|---|
| 1 | $m_{11}$ | $m_{12}$ | ... | $m_{1j}$ | ... | $m_{1n}$ |
| 2 | $m_{21}$ | $m_{22}$ | ... | $m_{2j}$ | ... | $m_{2n}$ |
| . . . | . . . | . . . | . . . | . . . | . . . | . . . |
| i | $m_{i1}$ | $m_{i2}$ | ... | $m_{ij}$ | ... | $m_{in}$ |
| . . . | . . . | . . . | . . . | . . . | . . . | . . . |
| n | $m_{n1}$ | $m_{n2}$ | ... | $m_{nj}$ | ... | $m_{nn}$ |

Each row of (9) indicates the manner in which employment is generated within industry i by required activity in industries 1, 2, ....., n and each column of (9) illustrates how the employment demands generated by activity in industry j are distributed among all industries in the economy. Postmultiplication of the interindustry-employment matrix, M, by a diagonal final demand matrix, $\hat{Y}$, yields the "total" interindustry employment matrix $M^T$:

$$M^T = M\hat{Y} \tag{10}$$

The column sums of $M^T$ show the total employment generated by a specific industry and the row sums of $M^T$ show the total employment generated within a specific industry. The interindustry-employment matrix thus makes it possible to generate total interindustry manpower requirements from

alternate specified distributions of national expenditures among economic activities.

The final step in the construction of the theoretical model involves the relation of interindustry-employment requirements to occupational employment demands. This transformation is accomplished by using an industry-occupation matrix showing in percentage terms the occupational distribution of industry employment for the time period under consideration. Denote this matrix by B: the rows of B represent industries, the columns of B represent occupations, and any element $b_{ik}$ of B shows the percent of total employment in industry i composed of persons classified within occupation k. Letting R denote a diagonal matrix whose diagonal elements are the corresponding row sums of $M^T$ an interindustry-occupation matrix is obtained by premultiplying B by R:

$$RB = S \tag{11}$$

S is one type of interindustry-occupation matrix, and the elements of it show the occupational employment requirements generated within each industry by a specified distribution of national expenditures. The column sums of S show the total manpower demands generated for an individual occupation, and it is thus possible to generate occupational manpower requirements from different distributions of national expenditures among economic activity categories reflecting alternate national priorities.[3]

## II. EMPIRICAL IMPLEMENTATION OF THE THEORETICAL MODEL

Conceptually it is possible to identify gross national product or national expenditures with final demand, and in the recent interindustry studies of the U. S. economy conducted by the Office of Business Economics input-output data were integrated with national income and product account data.[4] Thus the correspondence between the concepts of gross national product, national expenditures, and final demand used here is complete, and gross national product for the time period in question is totally distributed by the activity-industry matrix among every industry in the economy as either purchases, transfers, or compensation.

The empirical model pertains to the early 1960's and 1960 was the initial base year chosen for analysis. Input vectors were developed for 55 distinct categories of economic activity and these categories together with the estimated expenditures on these in 1960 are given in Table 1. Expenditures on each of these categories, expressed in terms of (constant) 1958 dollars, are distributed as required output from the 86 industries used by the Office of Business Economics in the 1958 input-output study. The 80-order 1958 Leontief inverse matrix expressed in labor units and modified to reflect 1960 interindustry and productivity relationships is used to generate total interindustry employment requirements. These industrial employment demands are disaggregated into requirements for 185 occupational categories of manpower resources by using a modified version of

the industry-employment-by-occupation matrix developed by the Bureau of Labor Statistics from the 1960 decennial census of population.[5]

The resulting model is a general, comprehensive, empirical one capable of translating alternate distributions of national expenditures reflecting different priorities into requirements for detailed categories of manpower resources. The model is empirical and yields a large quantity of useful information relating to the manner in which employment requirements are generated throughout the economy. Expenditures upon 55 categories of economic activity generate direct output requirements within 86 industries and generate employment demands within 85 industries and 185 occupational categories. The model is comprehensive and it accounts consistently for total gross national product, total direct and indirect output requirements, total interindustry employment, and total occupational employment. The model contains no double counting or overlapping within activity categories, output categories, or employment categories. Further, the model is general and allows, subject to a number of restrictions, the analysis of the manpower impacts of a number of different types of priority reorderings.

## III. SIMULATING SHIFTS IN NATIONAL PRIORITIES

As indicated, changes in national priorities enter the system as shifts in the distribution of expenditures among the 55 activity categories. In reallocating expenditures to reflect concentration on alternate national objectives, several constraints were adhered to in the simulations conducted. First of all, the total size of gross national product

was neither increased nor reduced, for interest centered upon analyzing the manpower consequences of reallocating a given gross national product among competing resource uses according to several different specified patterns.[6] Further, the expenditures devoted to any single activity category were not altered by more than thirty percent in either direction. This latter convention at the very least was deemed necessary to preserve the validity of the assumption of constant activity input coefficients.

Initially the employment requirements generated by the empirical model for 1960 from the actual 1960 distribution of expenditures given in Table 1 were compared with those which existed in that year to test the overall accuracy of the manpower demand generating mechanism. For practically all the manpower categories for which this type of comparison was possible the two estimates agreed, and the discrepencies recorded were small enough to be negligible. Then using the actual 1960 expenditure distribution as a starting point expenditures were redistributed in order to reflect within the confines of the model four different hypothetical types of priority reorientation on the part of the United States.

The first priority alternative derived, disarmament-control, was a type of control reallocation of expenditures which had been suggested to the author by Wassily Leontief. In this redistribution expenditures for defense and defense related activities were reduced 30 percent and the funds released by this cutback were reallocated proportionately among all the other final demand categories. Aside from acting as a general control type of redistribution this first reallocation pattern also permitted the employment effects generated by the model to be compared with

those obtained by Leontief and others using this type of alternative to study the economic and employment effects of disarmament.[7]

The second set of expenditure alternatives analyzed, disarmament-welfare, was one corresponding to a shift in national priorities away from defense in favor of domestic welfare programs. In this case expenditures for defense oriented activities were again reduced by 30 percent. However, rather than being allocated pro rata to every other activity category, the funds released were distributed to social welfare and public service activities. Thus this second alternative represents a shift of defense and defense related expenditures to social welfare payments, public housing programs, health and sanitation activities, educational programs, and so forth.

The third alternative experimented with, disarmament-tax cut, was meant to reflect a national consensus markedly different from that hypothesized above. It assumes that the political mood of the nation dictates that the expenditures released by a 30 percent cut in military expenditures be given back to the private sector--say, in the form of tax relief--rather than being allocated to domestic welfare activities. Accordingly, here the funds freed by the 30 percent reduction in defense expenditures are distributed among the categories of personal consumption expenditures, private investment, industrial and commercial construction, and so forth.

Finally, the fourth expenditure redistribution simulated, butter and guns, is one which differs considerably from any of the first three and represents a type of "butter and guns" choice by the nation. Here defense oriented activities received an expenditure increase amounting to 20 percent and all other public service categories received an increase in

expenditures amounting to 10 percent--the necessary funds being transferred from all the other final demand activity categories.

The hypothetical priority reorderings discussed above are meant to have no subjective significance attached to them, and they do not come close to exhausting the analytic capabilities of the model. Further, the expenditure shifts simulated here correspond to the priorities indicated only to the degree that the 55 activity categories contained in the empirical model can be validly used to represent different social and economic choices on the part of the nation. Nevertheless, the resource reallocations hypothesized here are believed to plausibly reflect broad types of shifts in national goals and priority commitments which are not at all unrealistic. With these points in mind it is interesting and important to analyze the overall, structural manpower impacts which these types of priority shifts tend to generate.

## IV. RESULTS

This section shall be confined to an analysis of the occupational manpower impacts generated by the priority reorderings hypothesized.[8] In general the occupational manpower requirements of the United States appeared to be highly sensitive to even the limited shifts in national priorities and expenditure programs specified here. Overall, the three alternate types of disarmament priorities specified generated a total increase in manpower demands of approximately one half of one percent of the 1960 labor force,

while the priority alternative emphasizing defense and nondefense government programs generated a net decrease in national employment requirements slightly larger than one half of one percent. The effects of the simulated shifts in national priorities on the requirements for individual occupations, however, were much more varied and pronounced. Some occupations appeared to be virtually insensitive to any type of expenditure redistributions, some occupations were consistently sensitive in one direction to the disarmament and "peace" priorities simulated, and sensitive in an opposite direction to the hypothesized "butter and guns" priority alternative. Still other occupations defied classification, for the demands for manpower within these changed to a different degree and often in a different direction depending on the distinct priority shift considered. But despite the wide range of variability in degree and direction it was possible to classify a large portion of the occupations contained in the model on the basis of the percentage change in demand for them corresponding to each alternate specified priority alternative. These classifications are presented in Tables 2 through 5.

Table 2 lists selected occupations which appeared to be relatively insensitive to redistributions of expenditures among economic activities reflecting any of the alternate priority commitments hypothesized here. That is, for the manpower categories given in Table 2 the percentage change in employment requirements generated by any of the priority reorderings simulated in the empirical model was either negligible, or, at most, approached the vicinity of one percent. Thus these occupations would tend to be unaffected by either a cut in military expenditures distributed several different ways among competing civilian resource uses or, conversely,

by an increase in defense and nondefense government programs. Another way of viewing the manpower categories listed in Table 2 is that the demand for employment within them is generated in such a widespread, diverse and interdependent manner by many factors throughout the economy that they are to a very considerable degree insulated from any favorable or unfavorable repercussions resulting from changing national goals and priorities.

The occupations listed in Table 3 share a considerably different characteristic. The employment demands for these occupations are generated in a manner such that they all showed a marked increase for the priority simulations emphasizing increases in defense and other public expenditures and a marked decrease for any of the alternate hypothesized nondefense priority reorderings. Thus these manpower categories are among the ones which would probably be the most adversely affected by cuts in defense oriented programs, and are labeled as "negative disarmament sensitive" occupations.

However, employment requirements for the occupations listed in Table 3 did not respond uniformly to shifts in the distribution of expenditures and for this reason a simple sensitivity ranking was devised to indicate the degree to which the individual occupations were found to be sensitive to the various disarmament alternatives. The demands for occupations indexed by the letter "C" were the least sensitive and decreased about two or three percent in shifts from military to nonmilitary priorities. The requirements for occupations indexed by the letter "B" exhibited a net decrease of about four or five percent in response to changes to nondefense priorities, while the employment demands for the occupations indexed by the letter "A" fell by more than five percent in response to the same types of priority changes. Thus Table 3 should

be interpreted in the following manner: the demands for all the occupations listed there are likely to show a non-negligible net decrease in response to a cutback in defense and related expenditures, and the alternate uses to which the released funds are put will do little to offset this. Those occupations indexed by "A" will be affected the most adversely by these cutbacks, those denoted by "B" may not be hurt quite so badly, and those indexed by "C", while still likely to suffer from a switch to a more civilian oriented economy, will be less adversely affected than the other two classes.

The occupations listed in Table 4 reacted in a manner completely opposite to those given in Table 3, for the employment demands for these manpower categories all increased in response to shifts from defense related priorities to <u>any</u> type of specified nondefense alternative. These occupations are indexed in the same manner as those in Table 3, only here the demand response indicated in a shift away from military spending programs is positive, and accordingly, these occupations are referred to as "positive disarmament sensitive." Thus in Table 4: occupations indexed by "A" increased by more than five percent in simulated shifts in favor of disarmament, the demands for those denoted by "B" increased about four or five percent, and the demands for those indexed by "C" increased about two or three percent. In other words, the transfer of military expenditures to civilian uses would be likely to increase employment requirements to varying degrees in the occupations listed in Table 4, and this is likely to be true for the transfer of defense expenditures to a wide range of nonmilitary activities.

Finally, the occupations listed in Table 5 shared a characteristic which is in one sense the most interesting, for the responses in demand

for employment within these occupations followed no set pattern but, rather, varied uniquely according to the specific priority alternative specified. While the demands for most of these occupations were sensitive to shifting priorities and expenditure distributions, the demand responses generated for these occupations fell into no easily classifiable patterns. Demands for some of these categories increased for some types of nondefense priorities and decreased for other patterns of reallocation of military expenditures. Thus, whether or not the requirements for manpower within these occupations would increase or decrease with a cut in military expenditures depends upon the specific alternate civilian uses to which the freed resources are devoted.

There is thus an interesting and potentially very significant distinction between the occupations given in this table and those listed in Tables 2, 3, and 4. The effect of disarmament on the demand for the occupations listed in the first three tables is generally easy to predict: the occupations in Table 2 would be relatively unaffected, the occupations in Table 3 are likely to be adversely affected, and the occupations given in Table 4 are likely to be favorably affected. But the net employment effect of disarmament--or of the other types of priority shifts hypothesized here--on the categories listed in Table 5 is indeterminate and will depend critically upon the specific type of alternate priority receiving increased emphasis. Viewed slightly differently, for those occupations given in Table 5 it may be possible to offset the unfavorable effects of disarmament by emphasis on selected types of nondefense programs; these occupations are labeled "countervailing sensitive."

## V. CONCLUSIONS AND POLICY IMPLICATIONS

In interpreting the findings reported here several limiting factors must be kept in mind: the model involved utilizes a number of very restrictive assumptions concerning the nature of economic phenomena, due to gaps and inconsistencies in the data available a large number of modifications of this data were necessary, and the relationships in the empirical system pertained to the early 1960's. Most of the restrictive assumptions involved were required to permit the empirical implementation of the theoretical model, and while research recently conducted with an updated version of this model does in general support the results presented here, the entire system itself must still be considered to be in a preliminary stage of development.[9] Nevertheless, to the degree that the simplifying assumptions made represent a plausible approximation to reality, that the methodology employed is valid, and that the economic relationships of the early 1960's are capable of generating results presently of interest, from the findings reported here the following conclusions do appear to be warranted:

1) The occupational manpower requirements of the United States are, in general, sensitive to shifts in the allocation of resources reflecting different national goals and priorities. While this is by no means uniformly true for all occupations and while changes in employment requirements for even the sensitive occupations often vary in degree and direction according to the expenditure reallocation hypothesized, there appears to be little doubt that this hypothesis must be accepted.

2) Accurate and reliable manpower forecasting is currently impossible. Given that national manpower demands are sensitive often to even slight shifts in expenditure distributions reflecting different priorities and granted that future national goals and priorities cannot be foretold with any degree of accuracy, it follows that there is no way to validly forecast the future requirements for many important occupational manpower categories. On the other hand, for certain types of occupations, such as those listed in Table 2, which do not appear to be sensitive to changing patterns of national expenditures it may be possible to forecast employment requirements with a passable degree of accuracy. By beginning to distinguish the sensitive occupations from the insensitive ones and by classifying these accordingly it is hoped that the research reported here has taken the first step toward the development of a more rational manpower forecasting methodology.

3) From the above it follows that most if not all of the manpower forecasts presently available may be seriously suspect and that policies implemented on the basis of them may as likely as not turn out to be mistake Conditional manpower demand projections varying widely may not be very satisfying to administrators and policy makers who wish to have a single set of estimates to base their decisions on, but this does appear to be the most advisable approach.[10]

4) The manner in which employment requirements are generated differs considerably among dissimilar classes of occupations. Demands for some occupations, such as those identified in Table 2, seem to be generated by a variety of factors throughout the economy in a manner widespread and interdependent enough to make them relatively insensitive to

shifts in the pattern of national expenditures and priority commitments. The demand structures for other occupations, such as some of those listed in Tables 3 and 4, is such that they are tied very strongly to specific types of economic activities and expenditure programs, and it may be difficult to generate employment within these types of occupations except by emphasizing the appropriate types of programs and activities. Finally, the manner in which employment requirements are determined for other occupations, such as those listed in Table 5, is even more complex and indeterminate, with the adverse employment effects of certain expenditure cutbacks appearing to be partially or entirely offset by expenditure increases reflecting different types of priorities. Thus those occupations listed in Table 5 may be the only type for which it is reasonable to hope that reductions in defense and defense related programs may be successfully compensated for by concentration on select types of "alternate domestic priorities."

Table 1

Economic Activity Categories and
1960 Expenditure Distribution

| Activity Category Number and Title[a] | | 1960 Expenditures (in millions of 1958 dollars) |
|---|---|---|
| I. | Personal Consumption Expenditures, Total | 287,674 |
| 1. | Food and tobacco | 79,047 |
| 2. | Clothing, accessories, and jewelry | 29,756 |
| 3. | Personal care | 4,270 |
| 4. | Housing | 40,845 |
| 5. | Household operation | 40,993 |
| 6. | Medical care and death expenses | 15,496 |
| 7. | Personal business | 14,390 |
| 8. | Transportation | 37,528 |
| 9. | Recreation | 16,440 |
| 10. | Private education and research | 3,434 |
| 11. | Religious and welfare activities | 3,381 |
| 12. | Foreign travel and remittances, net | 2,094 |
| II. | Gross Private Domestic Investment | 33,522 |
| 13. | Private fixed capital investment | 30,032 |
| 14. | Net inventory change | 3,490 |

(Table 1, cont.)

| | | |
|---|---|---|
| III. | New Construction, Total | 53,739 |
| A. | Residential buildings (nonfarm), total | 21,435 |
| | 15. one-to-four family apartments | 13,422 |
| | 16. Five-or-more family apartments | 2,237 |
| | 17. Additions and alterations | 4,265 |
| | 18. Public dwelling units | 684 |
| | 19. Other residential construction | 827 |
| B. | Nonresidential buildings, total | 14,347 |
| | 20. Offices | 2,102 |
| | 21. Industrial | 3,128 |
| | 22. Educational | 3,249 |
| | 23. Hospital and institutional | 966 |
| | 24. Other residential | 4,902 |
| C. | Public utilities | 4,479 |
| | 25. Railroads and local transit | 266 |
| | 26. Gas and petroleum | 1,174 |
| | 27. Electric light and power | 1,980 |
| | 28. Telephone and telegraph | 1,059 |
| D. | 29. Highways | 5,758 |
| E. | 30. Military facilities | 1,366 |
| F. | 31. Oil and gas well drilling and exploration | 2,122 |

(Table 1, cont.)

| | | | |
|---|---|---|---|
| G. | 32. | Water Systems | 563 |
| H. | 33. | Sewer Systems | 817 |
| I. | 34. | Conservation and Development | 476 |
| J. | 35. | All other public and private new construction | 2,406 |
| IV. | | Maintenance and Repair Construction, Total | 17,933 |
| | 36. | Residential buildings (nonfarm), total | 6,191 |
| | 37. | Nonresidential buildings, total | 4,175 |
| | 38. | Railroads and local transit | 994 |
| | 39. | Highways | 2,776 |
| | 40. | Military facilities | 782 |
| | 41. | Water systems and sewer systems | 901 |
| | 42. | All other public and private maintenance and repair construction | 2,114 |
| V. | 43. | Net exports | 4,067 |
| VI. | | Federal Government Expenditures, total | 49,600 |
| | 44. | National defense | 40,500 |
| | 45. | Other | 9,100 |
| VII. | | State and Local Government Expenditures, Total | 28,000 |
| | 46. | Education | 13,900 |
| | 47. | Health, welfare, and sanitation | 4,700 |
| | 48. | Safety | 3,000 |
| | 49. | Other | 6,400 |

(Table 1, cont.)

| | | |
|---|---|---|
| VIII. | Social Welfare Benefit Expenditures | 30,826 |
| IX. | Water Resource Civil Works Project Expenditures, Total | 613 |
| | 51. Large multiple-purpose water resource development projects | 208 |
| | 52. Locks, dams, and reservoirs | 198 |
| | 53. Local flood protection | 75 |
| | 54. Dredging and navigation projects | 119 |
| | 55. Miscellaneous water resource development projects | 13 |
| Total National Expenditures[b] | | 505,975 |

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[a]In order to develop a consistent framework for disaggregating national expenditures it was necessary to modify most of the individual activity categories in a unique manner. For convenience the original activity and program titles were retained; however, neither in concept nor expenditure magnitude should these categories be interpreted as corresponding to those bearing the same title appearing in the national income and product accounts, the Office of Business Economics input-output studies, and other U. S. Government statistical sources.

[b]For a number of reasons pertaining to the manner in which the individual activity categories and activity category expenditure levels were derived this figure is not equal to 1960 gross national product, but, rather, is approximately three percent larger than 1960 GNP. Adjustments made in other parts of the empirical system insure that this convention does not generate excess employment requirements.

Table 2

Selected Occupations Insensitive
to Shifting Priorities[a]

---

Professional and Technical

- Chemical engineers
- Mining engineers
- Chemists
- Accountants and auditors
- Airplane pilots and navigators
- Editors and reporters
- Photographers
- Workers in the arts and entertainment

Managerial and Clerical

- Railroad conductors
- Purchasing agents
- Office machine operators
- Accounting clerks
- Telephone operators
- Miscellaneous clerical workers

Craftsmen and Foremen

- Blacksmiths, forgemen, and hammermen
- Millwrights
- Radio and television mechanics

(Table 2, cont.)

Radio and car shop mechanics

Air-conditioning, heating, refrigeration, and other mechanics

Compositors and typesetters

Electrotypers and Stereotypers

Engravers, except photoengravers

Pressmen and plate printers

Cranemen, derrickmen, and hoistmen

Telephone and power linemen and servicemen

Locomotive engineers and firemen

Inspectors, except log and lumber

Unclassified craftsmen and kindred workers

Operatives, Service, and Other Workers

Furnacemen, smeltermen, and pourers

Railroad brakemen and switchmen

Power station operators

Sailors and deckhands

Blasters and powdermen

Mine operatives and laborers

Airline stewards and stewardesses

Janitors and sextons

Charwomen and cleaners

Laborers, except farm and mine

---

[a]Selected occupations for which employment requirements changed one percent or less in response to simulated shifts in national priorities.

Table 3

Selected Occupations Negative
Disarmament Sensitive[a]

| Occupation | Sensitivity Index[b] |
|---|---|
| Professional and Technical | |
| Aeronautical engineers | A |
| Electrical engineers | A |
| Industrial engineers | B |
| Mechanical engineers | A |
| Metallurgical engineers | B |
| Sales engineers and engineering technicians | C |
| Mathematicians | A |
| Physicists | A |
| Unclassified natural scientists | C |
| Economists | C |
| Statisticians and actuaries | C |
| Miscellaneous social scientists | B |
| Draftsmen | C |
| Radio operators and air traffic controllers | A |
| Electrical, electronic, and physical science technicians | B |
| Personnel and labor relations workers | B |

(Table 3, cont.)

| | |
|---|---|
| Craftsmen, Foremen, and Operatives | |
| Structural metal workers | C |
| Machinists and job setters | B |
| Boilermakers | C |
| Heat treaters, annealers, and temperers | B |
| Metal molders, except coremakers | C |
| Metal and wood patternmakers | B |
| Tinsmiths, coppersmiths, and sheet metal workers | B |
| Toolmakers, diemakers, and setters | A |
| Airplane mechanics and repairmen | A |
| Metalworking assemblers, all classes | A |
| Metalworking inspectors, examiners, and checkers | A |
| Machine tool operators | A |
| Electroplaters and electroplaters helpers | A |
| Metal heaters | C |
| Welders and flame cutters | C |

[a]Selected occupations for which employment requirements decreased substantially for all types of simulated shifts from defense to nondefense priorities.

[b]Occupations indexed by "C" showed a decrease in employment requirements of approximately two or three percent; occupations indexed by "B" showed a decrease in employment requirements of approximately four or five percent; occupations indexed by "A" showed a decrease in employment requirements of greater than five percent.

Table 4

Selected Occupations Positive
Disarmament Sensitive[a]

| Occupation | Sensitivity Index[b] |
|---|---|
| Professional, Technical, Managerial, and Clerical | |
| Dentists | C |
| Dietitians and nutricianists | C |
| Professional nurses | C |
| Optometrists and Osteopaths | B |
| Pharmacists | B |
| Physicians and Surgeons | C |
| Medical and dental technicians | C |
| Veterinarians | C |
| Teachers: elementary, secondary, and college | C |
| Ship officers, pilots, and engineers | B |
| Bookkeepers | B |
| Cashiers and bank tellers | A |
| Sales workers | A |
| Craftsmen, Foremen, and Operatives | |
| Brickmasons, stonemasons, and tilesetters | C |
| Carpenters | C |
| Cement and concrete finishers | C |

(Table 4, cont.)

| | |
|---|---|
| Plasterers | C |
| Roofers and slaters | C |
| Motor vehicle mechanics | B |
| Office machine mechanics | B |
| Bakers | A |
| Cabinetmakers | C |
| Glaziers | C |
| Jewelers and watchmakers | B |
| Loom fixers | B |
| Log and lumber inspectors | A |
| Deliverymen and routemen | B |
| Bus, truck, and tractor drivers | C |
| Knitters, loopers, and toppers | A |
| Textile spinners and weavers | A |
| Manufacturing sewers and stitchers | A |
| Automobile service and parking attendants | A |
| Laundry and dry cleaning operators | B |
| Meat cutters, except meatpacking | B |
| **Service and Other Workers** | |
| Private household workers | A |
| Bartenders and cooks | B |
| Counter and fountain workers | C |
| Waiters and waitresses | A |

(Table 4, cont.)

| | |
|---|---|
| Hospital and institutional attendants | C |
| Practical Nurses | C |
| Miscellaneous service workers | C |

---

[a]Selected occupations for which employment requirements increased substantially for all types of simulated shifts from defense to nondefense priorities.

[b]Occupations indexed by "C" showed an increase in employment requirements of approximately two or three percent; occupations indexed by "B" showed an increase in employment requirements of approximately four or five percent; occupations indexed by "A" showed an increase in employment requirements of greater than five percent.

Table 5

Selected Occupations Countervailing Sensitive[a]

---

Professional and Technical

- Civil engineers
- Psychologists
- Unclassified teachers
- Foresters, conservationists, and agricultural scientists
- Biological scientists
- Geologists and geophysicists
- Surveyors
- Architects
- Designers, except design draftsmen
- Lawyers and judges
- Librarians
- Social service and welfare workers

Managerial, Clerical, and Craftsmen

- Creditmen
- Postmasters and assistants
- Stenographers, typists, and secretaries
- Mail carriers, postal clerks, and other postal employees
- Shipping and receiving clerks

(Table 5, cont.)

Electricians

Excavating, grading, and road machinery operators

Plumbers and pipefitters

Painters, construction and maintenance, and paperhangers

Structural metal workers

Rollers and roll hands

Miscellaneous foremen

Photoengravers and lithographers

Opticians, lens grinders, and lens polishers

Upholsters

Operatives, Service, and Other Workers

Asbestos and insulation workers

Miscellaneous operatives

Firemen

Policemen and other law enforcement officials

Guards, watchmen, and doorkeepers

---

[a]Selected occupations for which the employment requirements increased or decreased depending upon the precise type of defense or non defense priority simulated.

## FOOTNOTES

[1] A more rigorous and comprehensive development of the model involved here is contained in Bezdek [3].

[2] The development of an interindustry-employment table is discussed in Alterman [1].

[3] See chapters 3 and 7 of Bezdek [2].

[4] The 1958 interindustry study is discussed in [6] and the 1963 study is discussed in [11].

[5] The 1960 Bureau of Labor Statistics industry-employment-by-occupation matrix is contained in [13].

[6] This assumption is not necessary to maintain the validity of the model and has been relaxed in additional research conducted with this type of model; see Bezdek and Scoville [4].

[7] See Leonteif [8], [9], and [10].

[8] The effects upon the demand for output and interindustry employment generated by these priority simulations are given in Bezdek [2].

[9] Recent results derived from research conducted with an updated and projected version of this model are given in Bezdek and Scoville [4].

[10] It is encouraging to note that in recent years manpower forecasting under alternate assumptions as to the composition of gross national product has begun to be undertaken--see, for instance, [12] and [14].

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UNCLASSIFIED

Security Classification

## DOCUMENT CONTROL DATA - R & D

*(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

| ORIGINATING ACTIVITY (Corporate author) | 2a. REPORT SECURITY CLASSIFICATION |
|---|---|
| Center for Advanced Computation<br>University of Illinois at Urbana-Champaign<br>Urbana, Illinois 61801 | UNCLASSIFIED |
| | 2b. GROUP |

REPORT TITLE

ECONOMIC RESEARCH GROUP WORKING PAPER NO. 2
Occupational Manpower Impacts of Shifting National Priorities

DESCRIPTIVE NOTES (Type of report and inclusive dates)

Research Report

AUTHOR(S) (First name, middle initial, last name)

Roger H. Bezdek

| REPORT DATE | 7a. TOTAL NO. OF PAGES | 7b. NO. OF REFS |
|---|---|---|
| July 27, 1971 | 40 | 10 |

| . CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) |
|---|---|
| DAHC04 72-C-0001<br>. PROJECT NO.<br>ARPA Order 1899 | CAC Document No. 8 |
| | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |

. DISTRIBUTION STATEMENT

Copies may be requested from the address given in (1) above.

| . SUPPLEMENTARY NOTES | 12. SPONSORING MILITARY ACTIVITY |
|---|---|
| None | U.S. Army Research Office-Durham<br>Duke Station, Durham, North Carolina |


ABSTRACT

This paper presents the development of an economic model capable of generating occupational manpower requirements from alternate specified distributions of national expenditures reflecting different goals and priorities. This model is used to simulate the effects of several specified shifts in national priorities upon manpower requirements of the United States in the early 1960's. The employment effects of these simulated priority shifts are indicated and 150 occupations are classified and ranked according to their sensitivity to changing patterns of resource allocation. The implications of these results for economic and manpower forecasting and planning are discussed.


D FORM 1 NOV 68 1473

UNCLASSIFIED

Security Classification

| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Social and Behavorial Sciences (Economics) | | | | | | |