MEASURING AND ANALYZING THE IMPACT OF EMPLOYMENT GENERATION BENEFITS OF A PUBLIC WATER RESOURCE DEVELOPMENT PROJECT IN APPALACHIA

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A Report

Prepared for

The Center for Economic Studies
Institute for Water Resources
Corps of Engineers
Department of the Army

by

Ungsoo Kim

1971

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FOREWORD

A. PURPOSE.

This research study was written as a doctorate dissertation by the author while being employed by the Corps of Engineers. The topic is one for which intense interest has been displayed by Congress and the Executive Branch. The existence of structural unemployment and depressed regions has led to a concern for expanding the analysis of public works projects to include the utilization of otherwise unemployed resources in construction or of inducing other economic activity.

The study seeks (1) to develop a method of measuring the employment generation benefits from a federal water resource investment in a depressed area, (2) to relate such benefits to the social cost and economic benefit-cost ratio, and (3) to analyze the sensitivity of employment generation benefits to various types and locations of water project investment within areas designated as depressed regions. The Upper Licking River project in the Appalachian portion of Kentucky was chosen as the study area.

B. FINDINGS.

The study carefully examines the sensitivity of a variety of assumptions about the character of the location in which projects are constructed, the composition of the demands for labor and materials in various types of engineering alternatives and various patterns of response by otherwise unemployed factors of production.

The study relies upon (1) the use of regression and relative share methods for projecting unemployment rates, (2) the use of static input-output inter-industry, labor and occupational coefficients, (3) the potential for economic development articulated in the Upper Licking survey report, and (4) a range of hypothetical resource response functions rather than empirical evidence.

The report concludes that conventional B/C analysis should encompass the utilization of otherwise unemployed resources, that those impacts should extend to the analysis of economic development induced by the project, that those benefits from utilization vary greatly with the type and location of the project with respect to the distribution of idle resources, with demand functions of production and the response pattern of idle resources to incremental demand. Finally and most importantly, the report concludes that public water resource investment decisions should be more discriminating to the type and location of investments. This requires investigation of the foregone benefits from alternative types and location of water projects and from competing public works projects.

C. ASSESSMENT.

The report completes a careful study of the procedures for estimating the benefits from the employment of otherwise unemployed resource by public works projects. A thorough sensitivity analysis reinforces the conclusions and empirical and theoretical limitations are documented.

This dissertation could be modified into an operational manual for project studies with some additional testing of the empirical procedures. Additional effort to this end appears warranted. The important policy conclusions, with respect to the significant differences of various types and location of projects on social benefits and costs should be urgently considered in the development of guidelines for project evaluation and selection.

D. STATUS.

This research represents the findings, conclusions and independent judgment of the researcher. In light of the potential use of the methodology for evaluating water resources projects, comments on the report are invited.

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MEASURING AND ANALYZING THE IMPACT OF EMPLOYMENT GENERATION BENEFITS OF A PUBLIC WATER RESOURCE DEVELOPMENT PROJECT IN APPALACHIA

A DISSERTATION

Submitted to the Faculty of the
Graduate School
Of The Catholic University of America
In Partial Fulfillment of the Requirements
For the Degree
Doctor of Philosophy

By

Ungsoo Kim

Washington, D. C.
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This research effort was performed while the author was working for the Army Corps of Engineers. It was due to the kind sponsorship of Lt. General William F. Cassidy and Mr. Robert M. Gidez that this endeavor was allowed. The opportunity granted is very much appreciated.

Special recognition must be given for the particularly constructive guidance and assistance provided by professors Henry W. Spiegel and Alexander Woroniak at Catholic University, Dr. Sang O. Park, Senior Economist at the Office of Business Economics, Department of Commerce, Mr. Robert M. Gidez, Assistant Chief, Planning Division, Office of the Chief of Engineers, and numerous Corps staff members in the Evaluation and Economics Branch and the Water Resources Institute. These include George Antle, William J. Donovan, Robert L. Fulton, David Hottenstein Jr. and Dr. Richard R. Howes.

The existing Appalachian input-output model was transferred to the Univac 1108 and a new computer model had to be constructed. Both of these tasks were carried out by Lt. John D. Black Jr., Corps of Engineers.

The presentation of rather abstract and involved concepts puts the foreign student at a tremendous disadvantage. Much assistance was provided by Mr. Hottenstein to minimize this problem. The typing staff that worked so diligently on this paper includes Mrs. Nancy W. Marsh and Miss Marilyn L. Werner.

The author is very grateful to all of the people listed above.

The views expressed in this study, along with all faults and mistakes, are those of the author and do not reflect the position of the Corps of Engineers.

Final mention is deserved by the author's wife and family, for their active support and understanding throughout this study.

SUMMARY OF DISSERTATION

MEASURING AND ANALYZING THE IMPACT OF EMPLOYMENT GENERATION BENEFITS OF A PUBLIC WATER RESOURCE DEVELOPMENT PROJECT IN APPALACHIA

The major criticism of the traditional benefit-cost analysis has been centered around the implicit assumption of full employment conditions. Since public investment programs undertaken under conditions of substantial unemployment anticipate a significant tapping of otherwise idle resources, it has often been suggested that Employment Generation Benefits should be properly reflected in the determination of the cost of such projects.

In this study an attempt is made (1) to develop a method of measuring Employment Generation Benefits resulting from a federal water resource investment in a depressed area, (2) to relate the Employment Generation Benefits to the social cost and benefit-cost ratio, and (3) to test the significance of the impacts of a public investment under unemployment conditions. To implement the empirical analysis of this study, the Upper Licking Project in the Appalachian portion of Kentucky was selected as the basis for estimating Employment Generation Benefits for the benefit-cost analysis.

The study begins with the evaluation of the availability of idle production factors in the three Appalachian subregions. The next step is the estimation of potential industrial output and the determination of demand schedules for production factors resulting from water resource projects. Applying the 1963 Input-Output transaction tables for the subregions studied, the industrial output, the occupational labor demand and the plant capacity utilization by each industry within Appalachia were estimated. These demand estimates were compared with the supply of production factors to determine whether idle resources are available to satisfy the incremental demand.

Following this analysis, the response functions of labor and capital to incremental factor demand from the pool of idle resources were hypothesized and estimated. Employment Generation Benefits were then calculated. On the basis of these estimates, a revision was undertaken of the previous benefit-cost indices of the Upper Licking Project to reflect additional social benefits and/or a reduction in social costs of the project. The potential impact of Employment Generation Benefits on the benefit-cost ratio was also tested by changing the location of the project to other subregions and by substituting alternative types of projects.

This research ends with the conclusion that Employment Generation Benefits resulting either from the construction phase of the Upper Licking Project or from the economic expansion induced by the project are very significant. However, changing either the location or the type of a project might affect considerably the significance of the utilization of idle resources, and might result in a great variation in Employment Generation Benefits. Compared to the industrial output, the impact on Employment Generation Benefits seems to be larger from a change in the project location than from a change in the project type. Consequently, Employment Generation Benefits are the function of (1) location and type of the public investment project, (2) demand pattern for the factore of production, (3) distribution pattern of idle resources, and finally (4) response pattern of idle factors to incremental demand for resources.

TABLE OF CONTENTS

	Page
INTRODUCTION	
Statement of the Problem	1
Previous Studies	5
Purpose and Objectives of this Study	7
Methodology	7
Significance of this Study	13
Chapter	
I. ESTIMATES OF UNEMPLOYMENT AND OF EXCESS INDUSTRIAL CAPACITY	14
National Unemployment and Evaluation of Federal Water Resource Investments	14
Appalachian Unemployment and Evaluation of Federal Water Resource Investments in Appalachia	21
Estimate of the U.S. Total Unemployment	25
Estimates of Total Unemployment in Appalachia and its Subregions	26
Estimates of Occupational Unemployment in Appalachian Regions and the Upper Licking Area	34
Estimates of Unemployment in Appalachian Regions Based on 5.6 Percent National Unemployment Rate	42
Estimates of Underemployment and Potential Unemployment	44
Estimate of Excess Industrial Capacity Rate	48
II. ESTIMATES OF DEMAND FOR INDUSTRIAL OUTPUT AND FACTORS OF PRODUCTION INDUCED BY THE UPPER LICKING PROJECT	57
Description of the Upper Licking Project	57
The Model Used to Estimate Sectoral Demand	64
Estimate of Industrial Demand	76
Estimate of Demand for the Factors of Production	88
Summary	99
III. EMPLOYMENT GENERATION BENEFITS FROM THE UPPER LICKING PROJECT AND THEIR IMPACT ON THE BENEFIT-COST ANALYSIS	103
Comparison of Demand for and Supply of the Factors of Production Associated with the Upper Licking Project	103
The Nature of Employment Generation Benefits	104
Model Used to Estimate Employment Generation Benefits .	106
Estimate of Employment Generation Benefits Resulting from the Upper Licking Project	114
Social Costs of the Upper Licking Project	117
Evaluation of the Impact of Employment Generation Benefits on the B/C Analysis of the Upper Licking Project ...	122
Employment Generation Benefits and B/C Ratio Based on 5.6 Percent National Unemployment Rate	126
Summary	127

TABLE OF CONTENTS (continued)

	Page
Chapter	
IV. SENSITIVITY OF OUTPUT TO CHANGES IN THE LOCATION AND TYPE OF EXPENDITURES	130
Sensitivity of Final Demand	131
Sensitivity of Gross Output..........................	136
Sensitivity of Employment Generation Benefits	139
Sensitivity of B/C Ratio and Social Costs under Various Investment Conditions	148
Summary	150
CONCLUSIONS	153
APPENDIXES	161
A. National Final Demand Vector per $1,000 Project Costs for a Closed Input-Output Model	160
B. Percentage Distribution of the National Final Demand Vector within, and outside of Appalachia	164
C. Proportion of Gross Output by Industry Accounted for by Total Value Added and Those Proportions of Total Value Added Accounted for by Each Value Added Component	168
D. Labor and Occupational Coefficients	172
E. Estimated U.S. Mean Earnings (Wages and Salaries and Self-Employed in 1970 and Annual Compound Growth Rate	178
F. Estimate of Increase by 2020 in Appalachian Export Capacity, by Industry, Induced by Upper Licking Water Resource Investments	181
G. Industrial Demand Resulting from the Upper Licking Project by Region and Industry	187
H. Percentage Distribution of Gross Domestic Investment and Personal Consumption Expenditures by Industry Sector	191
I. Computer Program for Deriving Employment Generation Benefits	193
SELECTED BIBLIOGRAPHY	203

LIST OF TABLES

Page

1. U.S. Unemployment Rate of Persons 16 Years Old and Over by Occupation Group 1947-1970 17
2. Unemployment Rate of U.S., Appalachia and The Upper Licking Area 1960-1969 22
3. Estimate of Labor Force, Employment and Unemployment in Appalachia 1970-2020 31
4. Estimate of Labor Force and Unemployment in Subregions of Appalachia 1960, 1970 & 1980 33
5. Unemployment Rates; Percent Distribution of Labor Force and Unemployment, by Major Occupation for U.S., Appalachia and Appalachian Regions in 1960 36
6. Estimated Labor Force, Unemployed and Unemployment Rate by Major Occupation for Appalachian Regions in 1970 39
7. Estimated Labor Force, Unemployed and Unemployment Rate by Major Occupation for Appalachian Regions in 1980 40
8. Estimated Labor Force, Unemployed and Unemployment Rates by Major Occupation in The Upper Licking Area, 1970 & 1980 41
9. Estimated Unemployed and Unemployment Rate by Major Occupation for Appalachian Regions and Upper Licking Area for 1970 (Based on 5.6% National Unemployment Rate) 43
10. Labor Participation Rate of the U.S., Appalachia and The Upper Licking Area 1960, 1970 & 1980 46
11. Estimates of Potential Labor Force and Unemployment in The Upper Licking Area 1960, 1970 & 1980 47
12. Total Excess Industrial Capacity Rates of the United States 1947-1970 51
13. Average Rates of Excess Industrial Capacity by Industry for the Years 1947, 1958, 1969 and the Period 1947-1969 53
14. Industry Numbering for the 1958 Input-Output Analysis 55
15. Summary of Estimated Costs for Selected Plans of the Upper Licking Project 59
16. Estimated Annual Costs for The Upper Licking Project 61

LIST OF TABLES (continued)

Page

17. Potential Share of Incremental Increases in Manufacturing Output Salyesville-Royalton Area.................................. 63

18. Distribution of On-Site Demand by Occupation, Off-Site Demand and Unallocated Costs by Type of Water Project.......... 72

19. Final Demand for Inputs to Construct The Upper Licking Project by Region and Industry.................................. 78

20. Final Demand for Annual Inputs to O & M of The Upper Licking Project by Region and Industry.......................... 80

21. Increased Export Capacity by 2020 Resulting from The Upper Licking Project by Region and Industry.................. 82

22. Industrial Demand Resulting from the Construction of The Upper Licking Project by Region and Major Industry............ 84

23. Annual Industrial Demand Resulting from the O & M of The Upper Licking Project by Region and Major Industry............ 85

24. Industrial Demand in 2020 Induced Through Increased Export Capacity Resulting from The Upper Licking Project by Region and Major Industry.. 86

25. On-Site Demand for Labor and Wage Bill by Occupation Resulting from Project Construction and Annual O & M.................. 89

26. National and Regional Final Demand, Gross Output and Value Added Components by Expenditure Category........................ 90

27. National and Regional Final Demand, Gross Output and Value Added Components by Expenditure Category (per $1,000 Total Final Demand and Export Capacity).............................. 92

28. Off-Site Demand for Labor and Wage Bill by Occupation and Region Resulting from Project Construction.................. 94

29. Off-Site Demand for Labor and Wage Bill by Occupation and Region Resulting from The Upper Licking Project Construction (Adjusted to Value Added Approach)................ 96

30. Off-Site Demand for Labor and Wage Bill by Occupation and Region Resulting from O & M (Adjusted to Value Added Approach).. 97

31. Off-Site Demand for Labor and Wage Bill by Occupation and Region Induced by Increase in Export Capacity (Adjusted to Value Added Approach)................................... 98

LIST OF TABLES (continued)

Page

32. Total Demand (Off-Site and On-Site) for Labor and Wage Resulting from Project Construction and O & M (Adjusted to Value Added Approach)........................... 100

33. Estimate of Employment Generation Benefits Resulting from the Upper Licking Project................................ 115

34. Average Annual Employment Generation Benefits from The Upper Licking Project..................................... 118

35. Average Annual Employment Generation Benefits per $1,000 Cost of the Upper Licking Project...................... 123

36. Appalachian Demand and Leakage per $1,000 Expenditure with Changes in the Location and Measure Used................. 133

37. Distribution of Gross Output by Major Industry per $1,000 Expenditures with Changes in the Location and the Measure Used.. 138

38. Employment Generation Benefits from On-Site Wage Demand Resulting from Project Construction and its Distribution Per $1,000 Project Cost, by Occupation and Type of Project Based on Linear Response Function..................... 141

39. Employment Generation Benefits Resulting from Off-Site Demand for Labor and its Distribution per $1,000 Project Cost, by Occupation and Type of Project Based on Linear Response Function.. 144

40. Employment Generation Benefits Per $1,000 Expenditures by Sources, Location and Measure Used......................... 146

LIST OF FIGURES

1. Computer Model for Deriving Employment Generation Benefits..... 11

2. Unemployment Rate by Occupation 1953-1970...................... 18

3. Labor Response Functions....................................... 110

4. Capital Response Functions..................................... 110

PLATE

1. Appalachian Region and Upper Licking Area 27

INTRODUCTION

Statement of the Problem

Benefit-cost analysis based on full-employment assumptions and national income maximization has long been the major tool for the evaluation of public expenditures. Because of the full-employment assumption, market prices of the factors of production are assumed to represent the opportunity cost to society, i.e., social cost,[1] while benefits are limited to those from direct project output i.e., primary benefits.

As the magnitude of public expenditures to counteract depressed economic conditions has increased the adequacy of the traditional benefit-cost analysis has been challenged,[2] particularly in recent decades. Since idle resources incur negligible opportunity costs to society,[3] market prices of resources for public use under conditions of substantially less than full-employment may overstate associated

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[1]Social costs of a project may also refer to undesirable things to society such as overcrowding, noise, pollution or inequal distribution of income, etc. In this study, however, the term of "social cost" is strictly limited to opportunity cost of factors of production directly and indirectly utilized for the project.

[2]See A.R. Prest and Turvey, "Cost-Benefit Analysis: A Survey," Economic Journal, Vol. 75, Dec. 1965, pp. 683-735, for a review of the literature and an extensive bibliography on the subject. See also U.S. Congress, Guidelines for Estimating the Benefit of Public Expenditures, Hearings before the SubCommittee on Economy in Government of the Joint Economic Committee, 91st Cong., 1st Sess., May 12 and 14, 1969.

[3]The utility of using leisure time depends on whether leisure is voluntary or involuntary. To the extent that there is utility in using leisure time, it is difficult to say without reservation that there is no opportunity cost for idle labor. However, capital goods may become obsolete if not used. Thus, to the extent that durable capital assets can defer their effective production capacity, it is difficult to say that there is no opportunity cost associated with idle capital.

opportunity costs to society to the extent that resources are actually drawn from their idle status. Thus, the traditional benefit-cost (referred to henceforth as B/C) analysis may not always be the proper technique to use for an accurate comparison of social costs and benefits in the evaluation of public expenditure alternatives.

Although economists do recognize some theoretical inconsistencies in applying the traditional B/C analysis under less than full employment conditions, some economists are reluctant to adjust the traditional B/C analysis to enable evaluation of public expenditures under moderate and cyclical unemployment conditions. Eckstein[4] argues that many public investments such as those in water resource development projects involve a planning period so lengthy that actual construction might take place after prosperity has returned. McKean[5] argues that the uncertainty associated with future unemployment conditions may add larger measurement errors than those resulting from established procedure. However, most economists appear to agree that the traditional B/C analysis should be adjusted to reflect the differences between market cost price data and their social cost counterparts under severely depressed conditions.

To correct this situation, some economists have advocated that employment generation benefits (hereafter referred to as EGB) from the project should be credited in addition to primary benefits, and conversely, others have advocated that actual project costs (money costs) should be discounted by the amount of overstated social costs of the project in

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[4]Otto Eckstein, Water Resource Development, The Economics of Project Evaluation (Cambridge: Harvard University Press, 1958), pp. 32-33.

[5]Ronald McKean, Efficiency in Government Through Systems Analysis (New York: John Wiley and Sons, 1958), pp. 157-58.

the B/C analysis. These two approaches result basically in the same B/C ratio,[6] although arrived at from different directions. EGB are created by otherwise idle resources which are equal to overstated social costs.

Public investments under depressed conditions are often defended on the basis that they anticipated a favorable B/C ratio if the discrepancy between market and social costs is reconciled. These decisions are based more on speculation than on any standard measurement. If the EGB are to be useful for the evaluation of public expenditure alternatives, the benefits should be of a significant magnitude and should be measurable under various investment conditions. Some public projects are intended to stimulate the potential for the long-term development of a depressed region, as indicated in the Appalachian Development Act,[7] among others, rather than to remedy a short-term recession. If this is the case, the investigation of investment impact on EGB should be extended beyond the initial phase of investment to the ultimate phase of economic development. These investments anticipate large future gains will compensate for any temporary loss immediately after investment.

Because of the technical difficulties, methodology used to measure adjusted benefits and costs under various unemployment conditions has thus far not been developed. The existence of unemployed resources does not

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[6]Although the same values will either be discounted from the actual project cost or added to the primary benefits, the B/C ratios arrived at from different approaches are not exactly the same in a mathematical sense. The cost discounting approach tends to be biased upward. However, these differences are not significant. Therefore the two ratios are treated as the same.

[7]The Appalachian Development Act of 1965 states:

Sec. 2... The Congress...concludes that regionwide development is feasible, desirable, and urgently needed. It is, therefore, the purpose of this Act to assist the regic in meeting its special problems, to promote its economic development...meeting its common needs on a coordinated and concerted regional basis. The public investments made in the region under this Act shall be concentrated in areas where there is a significant potential for future growth, and where the expected return on public dollars invested will be the greatest.

guarantee EGB from a public investment, unless it generates a direct or significantly large indirect demand for these particular idle resources. EGB resulting from public investments might vary in accordance with various investment conditions.

Different types of investment are usually associated with different demands for inputs (e.g., national demand).[8] Project location may be associated with some unique production function and resource distribution pattern. Therefore, the structure and composition of regional demand for resources (direct or indirect) generated by a given investment project may vary in accordance with the project location selected. Differential mobility of resources among geographical locations and among resource categories suggests that any effective utilization of idle resources requires close scrutiny of the location and type of investment in terms of the potential to generate demand for readily available idle resources.

The level of unemployment alone is not an adequate guide for the sound evaluation of public expenditures under less than full employment conditions. Public investment decisions should discriminate in selecting the type and location of the expenditure and the distribution pattern of idle resources. The development of a model and methodology to measure both short- and long-term[9] EGB under various investment conditions is vital for this end.

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[8] National demand signifies a total demand for inputs for a project imposed on the national economy as contrasted with regional demand imposed on a local economy.

[9] Definitions of these terms vary according to type of project data available and objective of the research. For the purpose of this study the short-term refers to the construction phase of a project in the case of benefits determination, and duration of business cycle in the case of mentioning unemployment rate.

Previous Studies

The methodology to measure the economic impact of a public investment on otherwise idle resources is just being developed. Haveman and Krutilla[10] have recently completed a study which shows how to measure the rate of divergence of actual public expenditures in water resource investment from their social costs by estimating the proportion of labor and capital which would have been withdrawn from the idle resource pool to construct water resource projects during 1959-1964, a period characterized by considerable cyclical unemployment. This study has used an interregional national input-output model to trace the entire chain of requirements for the factors of production to support off-site input demand.[11] It is an ex post study which is limited to the short-term impact on idle resources during the construction phase of the project. The Upper Licking River Project Study (referred to henceforth as ULP)[12] by the Army Corps of Engineers has provided an ex ante sample study to illustrate how the benefits of utilizing an otherwise idle labor force[13] through

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[10]Robert H. Haveman and John V. Krutilla, Unemployment, Idle Capacity, and the Evaluation of Public Expenditures: National and Regional Analysis (Baltimore: The Johns Hopkins Press, 1968).

[11]While on-site demand is defined as demand for labor at the project site, off-site input demand is defined as the requirement for the factors of production to produce the material, equipment and supplies required for the investment project.

[12]U.S. Army Corps of Engineers, Interim Survey Report Upper Licking River Basin, Kentucky, 1967.

[13]In the Upper Licking Study, the benefits from utilizing idle labor for construction, and operation and maintenance of the project were defined as Redevelopment Benefits, and those from economic expansion were defined as Expansion Benefits. Both types of benefits together were called Development Benefits.

the expansion of local industries, induced by the output of the water resource investment, will be captured and entered into the overall benefit-cost ratio within the Upper Licking Area.[14] An extensive industrial location study was utilized, and long-term industrial growth was projected through the shift-share analysis. The demand for labor, which is available within the Upper Licking Area and imported from outside of the area for local industrial development, was estimated for three skill levels.

While there are differences, two recent studies by the Office of Business Economics[15] (OBE), U.S. Department of Commerce, and Kripalani,[16] are similar to the ULP study. One, an OBE study, is a modification of the ULP study in three aspects: (1) utilization of a cohort labor migration model in estimating unemployment in the Upper Licking Area, (2) use of a progressively larger multiplier in estimating growth of the service industry, and (3) utilization of the probability function in determining what portion of labor demanded for the projected industrial development will be satisfied from the otherwise idle local labor pool. The second study, by Kripalani, has estimated the proportion of surplus labor employed within the local area according to age and sex classification. All studies except Haveman and Krutilla are primarily concerned with the estimate of long-term impacts of economic development on idle resources. However, these studies are limited to the area adjacent to the project site and to labor resources only.

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[14]The Upper Licking Area is located in the Appalachian portion of Kentucky and includes six counties: Magoffin, Breathitt, Floyd, Johnson, Morgan and Wolfe. The Upper Licking Area was considered to be the main source of labor supply for the construction of the project and industrial expansion induced by the project.

[15]U.S. Department of Commerce, Office of Business Economics, Toward Development of a National Regional Impact Evaluation System and the Upper Licking Area Pilot Study, Staff paper in Economics and Statistics, No. 18, Mar. 1971.

[16]G.K. Kripalani, "Structural Unemployment in the Evaluation of Natural Resource Projects," in Estimation of First Round and Selected Subsequent Income Effects of Water Resources Investment, report submitted to the U.S. Army Engineers, Institute of Water Resources, by University of Chicago, under Contract No. DA49-129-CIVENG-65-11, ed. by George S. Tolley, 1970, pp. 85-119.

Purpose and Objectives of This Study

The purpose of this study is to improve the evaluation procedure for public expenditures under less than full employment conditions by measuring and analyzing the impact of EGB, resulting from those expenditures on the overall B/C ratio.

The specific objectives of this study are:

(1) To develop a model for measuring EGB resulting from a specific federal water resource investment in the Appalachian Region. Particular emphasis is placed upon the application of an input-output technique and the measurement of benefits from (a) an area extending well beyond the project area; (b) the use of both idle labor and capital resources; and (c) from direct project investment expenditures (short-term) as well as economic expansion induced by the project (long-term),

(2) To analyze the operational significance of the effect of EGB as a component of the B/C ratio in a public investment,

(3) To analyze the sensitivity of EGB under (a) various locations and types of water project investment and (b) by substituting private business ventures or consumer spending for public investment, and

(4) To test statistically the conceptually accepted hypothesis that social costs (opportunity costs) of a public investment in a depressed area are less than the actual monetary investments.

Methodology

The Appalachian Region has long been economically depressed, and this situation may continue into the future despite the emphasis on economic development. This region will be utilized to construct an economic model to capture long-term EGB in the evaluation of a public water resource investment in such a depressed area. This involves restudy of the

ULP which was recommended for construction in the Salyersville-Royalton area in the Appalachian portion of Kentucky by the U.S. Army Corps of Engineers.

The Corps recommended the ULP on the basis of the potential for large EGB, attributed to idle labor, resulting from area development expected to be induced by the project. Thus, the project was selected to minimize the burden of basic project study including the determination of area development induced by project output, and for the purpose of benefiting from a comparison of the results of this present study with those of the previous studies.

EGB are the result of the existence of idle resources. In Chapter I, historical trends of total national unemployments, and by major occupation,[17] and unemployment in Appalachia will be examined. A rationale showing the need to investigate idle resources by type and area and the selection of Appalachia as a model region to incorporate EGB not heretofore included in the traditional B/C analysis will be presented.

Idle resources are broadly classified into unemployed labor and industrial excess capacity which was assumed to be a proxy value for the idle capital factor. Unemployment and the excess capacity rate in each subregion of Appalachia and the Upper Licking Area will be projected over the period of 1970-2020 (period of effective project life including the construction period). Idle labor will be separated into nine categories and the excess capacity rate into 82 industrial sectors. Future unemployment in Appalachia and its subregions, in total and by occupation, will be projected by applying regression analysis and the relative share

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[17]Major occupation in this study refers to nine labor occupations which consist of (1) professional and technical workers, (2) managers, officials and proprietors, (3) clerical workers, (4) sales' workers, (5) craftsmen and foremen, (6) operatives, (7) nonfarm laborers, (8) service workers and (9) farmers and farm laborers.

method. The total national unemployment rate for the entire construction period (1970-1973)[18] will be projected by applying an average of total national unemployment rates from 1947 to 1969. The four percent unemployment rate which has been established as the national objective to maintain a full employment policy will be used for the period 1974-2020. To project total unemployment in Appalachia a trend equation, obtained through regression analysis of comparable U.S. and Appalachian unemployment rates, will be utilized. Unemployment by major occupation will be obtained by applying the relative share of each major occupation to total unemployment in 1960. Unemployment statistics for Appalachia and its three subregions by major occupation are available only for 1960. Unemployment in the three subregions and the Upper Licking Area will be projected by a method similar to that applied to Appalachia. Future excess capacity rates of the United States will be projected by using an average of historical rates of the U.S. excess industrial capacity which were obtained from the Wharton School of Finance and Commerce.[19] Since no regional excess capacity rate data is available, national data will be substituted for the subregions of Appalachia.

Both unemployed labor and excess capacity constitute the supply side of the prime factors of production.

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[18]The approval for the ULP is still pending. However, in order to demonstrate application of the procedures developed herein, construction was assumed to start in 1970 when this study was initiated.

[19]The Wharton School of Finance and Commerce publishes the U.S. Industrial Capacity Utilization Index for 37 industry sectors. The index is expressed in percentage terms. The excess industrial capacity rate is obtained by deducting the Utilization Index from 100 percent.

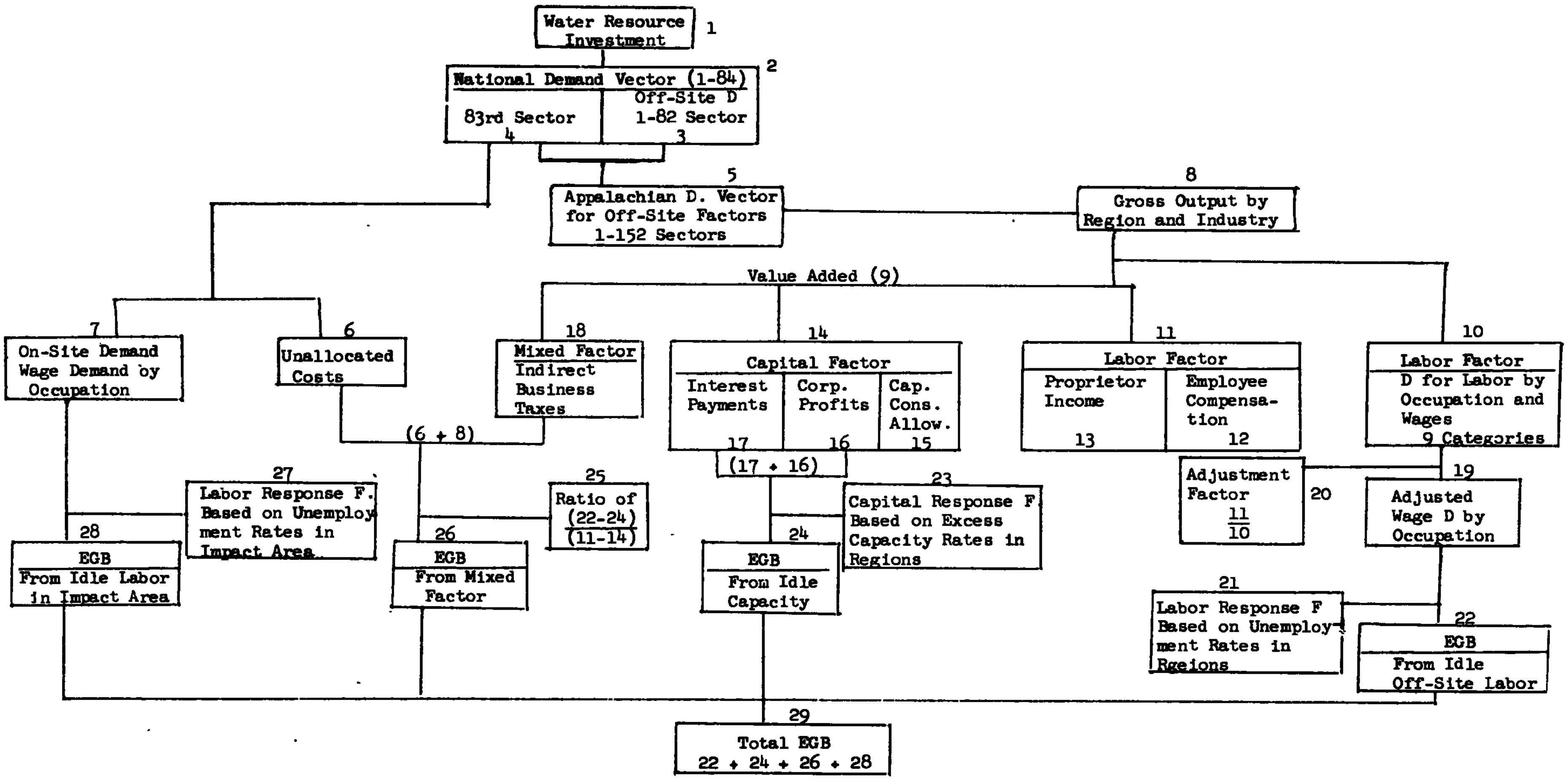
In Chapter II, the long-term demand for the prime factors of production in the subregions of Appalachia and the Upper Licking Area resulting from the ULP will be estimated. The long-term demand for the factors of production is the sum of the demand imposed by (1) project construction, (2) Operation and Maintenance (O & M), and (3) local economic development (represented by the increase in Appalachian export capacity to the rest of the world) stimulated by project output.

The portion of computer model to estimate EGB from investment expenditures is shown in Figure 1. Total demand (national demand) for inputs required for construction and O & M of the ULP and increased export capacity will be broken into (1) on-site labor demand by major occupation (2) unallocated costs (which represent mixed factors of labor and capital) and (3) off-site material demand. In order to estimate demand for the factors of production induced by off-site demand and increased local income from the project expenditures economic activities in terms of industrial demand will be estimated by applying the existing interregional Input-Output Model of Appalachia.[20] This input-output model is a closed type, which is designed to estimate gross industrial outputs resulting from direct, indirect and induced impacts (from the expenditure of earned income) determined by a given final demand vector. Separate regional (Appalachian) final demand vectors for construction, O & M and the increase in export capacity will be constructed for the input-output model.

[20]Research and Development Corporation, An Input-Output Model of Appalachia, prepared for Office of Appalachian Studies, U.S. Army Corps of Engineers (Washington, D.C.: Research Development Corporation, 1968). This is an interregional input-output model which treats the Northern, Central and Southern portions of Appalachia as separate, but interrelated regions. This is a closed model. The personal expenditure row and column are built in the transaction table so that income multiplier effects of any final demand vector will automatically be accounted for.

FIGURE 1

COMPUTER MODEL FOR DERIVING EMPLOYMENT GENERATION BENEFITS (EGB)



Gross outputs generated by each final demand vector will be equated with demand for labor, capital and mixed factors,[21] by industry and sub-region, by applying the ratio of each value added to gross output. Wage demands for major occupations will be estimated by multiplying the gross output for each industry by the corresponding labor and occupation coefficients and wage rates. Demand for wages by occupation then will be adjusted to the total value added by labor. Total demand for labor will be the sum of on-site and off-site labor demand.

In Chapter III, the rationale of EGB and social costs of the project will be presented. The portion of demand for wages and capital attributed to otherwise idle resources will be captured as EGB. Social costs of the project are equal to money costs of the project minus those costs attributed to otherwise idle resources. To determine the proportion of demand for resources for the project attributed to idle resources, four alternative sets of Resource Response Functions, by major occupation and industry sector, will be constructed. EGB resulting from the ULP and the social costs of the ULP will be estimated, and the impact of EGB on the original B/C ratio without EGB will be assessed.

In Chapter IV, the sensitivity of EGB from the project, social costs of the project and their impact on the B/C ratio resulting from changes in location and type of investment will be investigated. The ULP will be hypothetically located in other subregions of Appalachia for purposes of analysis. The impacts from different types of water resource investment of comparable magnitude will be investigated with using a

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[21]Mixed factors here are the value added portion of Business Indirect Taxes to produce gross output. The value was treated as demand for mixed factors on the assumption that the value would be spent to purchase labor and capital equipment by the government to provide necessary services used in producing the gross output.

flood control levee as the labor intensive project and a hydroelectric powerhouse as the capital intensive project, along with a representative private investment and a consumption spending program.

Following Chapter IV, Conclusions and Summary findings from this study will be presented separately.

Significance of This Study

The significance of this study is clearly indicated by the statement of its objectives. These are:

(1) To develop a functional economic model capable of estimating the short or long-term impacts of a public water resource investment on EGB under various less than full employment investment conditions;

(2) To emphasize the importance of minimizing speculative, over-favorable generalizations in planning public investments in depressed areas and to stress the needs for realistic anticipations of likely future benefits generated by such projects, which are consistent with limitations and constraints posed by individual project conditions;

(3) To offer a comprehensive model for estimating more adequately than previous studies the EGB in regard to (a) location, (b) types of factors of production, and (c) both construction and development phases of a project; and

(4) To assist policy makers in project evaluation by providing a comprehensive analysis of (a) the structure of total final demand imposed on the regional economy and (b) the geographical distribution of industrial and occupational demand.

CHAPTER I

ESTIMATES OF UNEMPLOYMENT AND OF EXCESS INDUSTRIAL CAPACITY

The severity and the duration of idle resources in an economy determines the extent to which benefits can be claimed for the productive use of such otherwise idle resources. This chapter includes a brief introductory review of the historical performance of the national economy in terms of total unemployment, disaggregated into occupational and regional categories. The Appalachian Region was selected to establish a model to determine the benefit from the productive use of idle resources induced by water resource investments, because it is officially identified as a place of persistent and severe unemployment or resource idleness. The estimate of unemployment in Appalachia will be derived from the relationship between historical unemployment data for the nation and for Appalachia. Therefore, the future unemployment rate of the U.S. will be estimated first. Unemployment rates in Appalachia will be estimated for the period 1970-2020,[1] in total, by occupation and subregion, and for The Upper Licking Area. In the last section, excess industrial capacity rate by industry for Appalachian Regions also will be estimated.

National Unemployment and Evaluation of Federal Water Resource Investments

The significance of the terms -- civilian labor force, employment and unemployment -- may vary according to different policy objectives. Since the unemployment statistics from the Department of Labor are heavily used in this study, the meaning of these terms follows

[1]The physical life of this project may extend beyond 100 years. Since projections beyond 50 years are subject to much uncertainty, physical projects life was not selected.

definitions from the Bureau of Labor Statistics.[2] The civilian labor force comprises the total of all civilians 16 years old, and over, who are classified as employed and unemployed. Unemployed persons comprise those in the civilian labor force who do not have jobs involuntarily, and the unemployment rate shows the percentage of unemployed people in the total civilian labor force.

Total National Unemployment

Table 1 shows the rates of U.S. unemployment, in total, as well as by major occupations during the twenty-four-year period between World War II and 1970. The lowest total unemployment rate in recent U.S. history was 2.9 percent in 1953, and the highest rate was 6.8 percent in 1958. Despite the existence of a full employment policy, only nine out of twenty-four years show a total unemployment rate below the four percent level. There have been two short lived recessions (1949-50 and 1954-55 with average unemployment rates of 5.6 percent and 5.0 percent respectively) and a fairly long one (1958-65 with 5.7 percent unemployment). The unemployment rate, starting in 1970 (4.9 percent), is rising again. Recent statistics show an average of 5.9 percent during the period January through September, 1971

National Unemployment by Major Occupation

Total unemployment figures often conceal or disguise the true picture of idle resources. If one looks at resources in terms of their detailed classification, the magnitude and the period of idleness should be more distinctive. Total and occupational unemployment rates since 1953 are shown in Figure 2 for ease of comparison. Except for a few

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[2]See detailed discussion U.S. Department of Labor, Bureau of Labor Statistics, "Technical Note" in Employment and Earnings series.

TABLE 1

U.S. UNEMPLOYMENT RATE OF PERSONS 16 YEARS OLD AND OVER[a] BY OCCUPATION GROUP
1947 - 1970

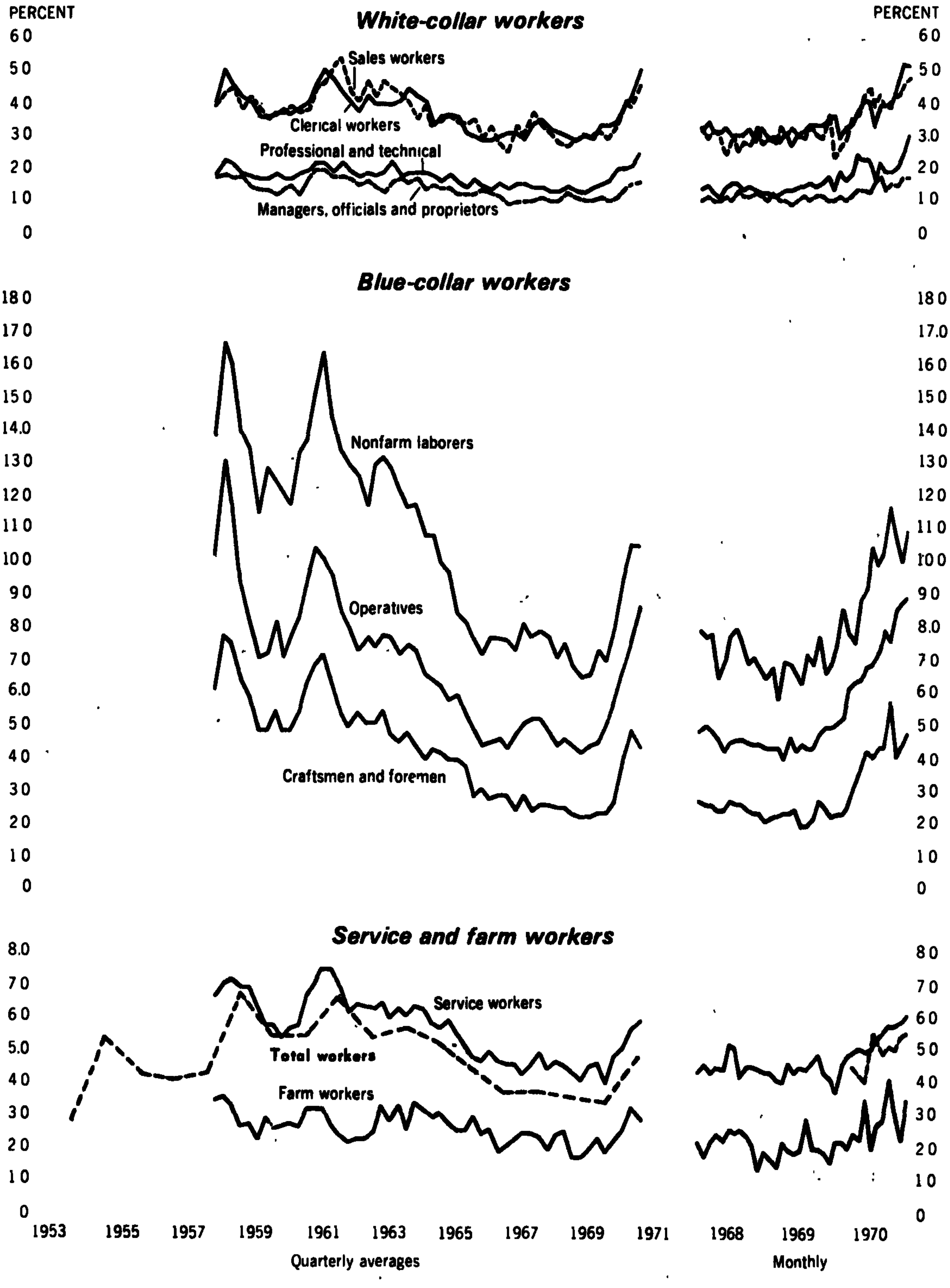
Year	Total Unemp.	Prof.& Tech.	Managrs. Officials Proprietors	Clerical Workers	Sales Workers	Craftsmen & Foremen	Operatives	Non-farm Labor	Service Workers	Farmers & Farm Laborers
1947	3.9	1.9	1.2	2.9	2.6	3.8	5.1	7.5	4.5	2.5
1948	3.8	1.7	1.0	2.3	3.4	2.9	4.1	7.5	4.5	2.1
1949	5.9	1.9	1.5	3.8	3.5	5.9	8.0	12.9	5.9	3.6
1950	5.3	2.2	1.6	3.4	4.0	5.6	6.8	11.7	6.5	4.6
1951	3.3	1.5	1.0	2.1	2.8	2.6	4.3	5.6	4.2	1.8
1952	3.0	1.0	.7	1.8	2.5	2.4	3.9	5.7	3.7	2.0
1953	2.9	.9	.9	1.7	2.1	2.6	3.2	6.1	3.4	2.2
1954	5.5	1.6	1.2	3.1	3.7	4.9	7.6	10.7	5.2	3.7
1955	4.4	1.0	.9	2.6	2.4	4.0	5.7	10.2	5.4	3.3
1956	4.1	1.0	.8	2.4	2.7	3.2	5.4	8.2	4.7	3.4
1957	4.3	1.2	1.0	2.8	2.6	3.8	6.3	9.4	4.8	3.3
1958	6.8	2.0	1.7	4.4	4.1	6.8	11.0	15.0	6.9	3.2
1959	5.5	1.7	1.3	3.7	3.8	5.3	7.6	12.6	6.1	2.6
1960	5.5	1.7	1.4	3.8	3.8	5.3	8.0	12.6	5.8	2.7
1961	6.7	2.0	1.8	4.6	4.9	6.3	9.6	14.7	7.2	2.8
1962	5.5	1.7	1.5	4.0	4.3	5.1	7.5	12.5	6.2	2.3
1963	5.7	1.8	1.5	4.0	4.3	4.8	7.5	12.4	6.1	3.0
1964	5.2	1.7	1.4	3.7	3.5	4.1	6.6	10.8	6.0	3.1
1965	4.5	1.5	1.1	3.3	3.4	3.6	5.5	8.6	5.3	2.6
1966	3.8	1.3	1.0	2.9	2.8	2.8	4.4	7.4	4.6	2.2
1967	3.8	1.3	.9	3.1	3.2	2.5	5.0	7.8	4.5	2.3
1968	3.6	1.2	1.0	3.0	2.8	2.4	4.5	7.2	4.4	2.1
1969	3.5	1.3	.9	3.0	2.9	2.2	4.4	6.7	4.2	1.9
1970	4.9	2.0	1.3	4.0	3.9	3.8	7.1	9.5	5.3	2.6

[a]Unemployment rate during 1947-1957 is based on persons of 14 years and over.

Sources: U.S. Department of Labor, Manpower Report to the President, 1966, pp. 169, and 1971 issue pp. 222.

FIGURE 2
UNEMPLOYMENT RATE BY OCCUPATION
1953–1970

(Seasonally adjusted)



Source: U.S. Department of Labor, B.L.S., Employment and Earnings (Jan., 1971).

years certain occupations, such as blue-collar and service workers, show higher unemployment rates than those of white collar-workers[3] and national average rates. Even during the low unemployment period of 1953, the unemployment rate of nonfarm laborers exceeded the national average by 200 percent. The fluctuation in the unemployment rate for each occupation has generally been in the same direction as the rate of total unemployment. However, the magnitude of the fluctuation for blue-collar workers far exceeds that of white-collar workers. In 1958, the unemployment rate of operatives and craftsmen exceeded that of professional workers by 300 to 500 percent. Nonfarm laborers exceeded the unemployment rate of professional workers by 700 percent. The total unemployment rate in 1958, 6.8 percent, had increased to about 234 percent of that in 1953, 2.9 percent. The unemployment rates for professional and technical workers, managers, officials and proprietors, sales and service workers, farmers and farm workers have not increased as quickly as has total unemployment. The increase in unemployment rates by occupations other than those listed in the above was more than the total unemployment rate, i.e.: 259 percent for clerical workers, 262 percent for craftsmen, 344 percent for operatives and 246 percent for nonfarm laborers.

Since significant differences in unemployment rates of each occupation were obscured by the total unemployment rate, it is highly desirable to distinguish unemployment by detailed occupation in order to determine a full employment policy. Due to the limited statistical information only nine major occupational groups will be distinguished for an estimation of unemployment in this study.

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[3]Blue-collar workers include craftsmen, operatives and nonfarm laborers, while white-collar workers include professional and technical workers, managerial, officials and proprietors, and clerical and sales workers.

Concept of Full Employment

Ever since the Great Depression of the 1930's, full employment has been a national goal. The concept of full employment is, however, an ambiguous one. Since frictional unemployment (unemployment during the process of shifting from job to job, either voluntarily or involuntarily) always exists in a free economy, there can be no full employment in the literal sense. A four percent unemployment rate is usually associated with a satisfactory full employment level for national planning purposes.[4] However, this rate shows a declining tendency as the information system related to unemployment improves. Since unemployment by each major occupation has been treated separately in this study, the frictional unemployment rate associated with full employment conditions will be presented for each major occupation, rather than an average total unemployment rate. The unemployment rate by each major occupational group during 1953 was selected to represent the frictional unemployment rates and the full employment level of each occupation. These rates are not the lowest experienced for each occupation in the past, but were selected because they existed when the total unemployment rate was at its lowest, 2.9 percent, since 1947. Thus, unemployment rates to represent a full employment level associated with each occupation are: .9 percent for

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[4]U.S. Government, Economic Report of the President (Washington: U.S. Government Printing Office, 1971), pp. 75-78. Most government projections are based on four percent unemployment as a tolerable limit. However, three percent has also been used recently. Since the tolerable limit constitutes a long-term allowance for the continuing short-term frictional unemployment cycle between jobs, the recent tendency to reduce this limit is seen as an adjustment to exclude recognized persistent long-term unemployment from the total figure. For further discussion see Thomas K. Hitch, "Meaning and Measurement of 'Full' or 'Maximum Employment'", The Review of Economics and Statistics, Vol. XXXIII (Feb., 1951), pp. 1-11 and Arthur Okun, "Potential GNP: Its Measurement and Significance" in Proceedings of the Business and Economic Statistics Section, American Statistical Association, 1962, pp. 98-104.

professional and technicians and managers, officials and proprietors, 1.7 percent for clerical workers, 2.1 percent for sales workers, 2.6 percent for craftsmen and foremen, 3.2 percent for operatives, 6.1 percent for nonfarm laborers, 3.4 percent for service workers and 2.2 percent for farmers and farm workers.

Plan Formulation and the Evaluation of Federal Water Resource Investments Under National Unemployment Conditions

Total national unemployment rates experienced during 1949-50, 1954-55, 1958-65 and those during 1970 to September 1971 were significantly high compared with either the four percent standard established under national objectives or the 2.9 percent attained in 1953. Unemployment rates disaggregated into occupational categories further reveal the significance of even high unemployments rates for blue-collar workers. Public investments in those years could well have generated substantial EGB or reduced social costs of public investments to a level well below their actual monetary price.

However, the national unemployment rate, no matter how high, is not an appropriate factor to use in the evaluation of public investments, in terms of EGB. This is particularly true with regard to public water resource investments, the main subject investigated in this study. The following reasons might be given as an explanation:

(1) The first prerequisite in the incorporation of EGB into project formulation is the identification of unemployed resources in terms of their use in project construction, O & M or subsequent economic expansion. This requires investigation not only of aggregate unemployment but its duration and also of subclassifications into more specific skills and areas; for EGB are attributed only to otherwise idle resources which are in fact employed as the result of the project investment.

(2) In the presence of an effective economic stabilization

policy, national unemployment would be either mild, or at least short-lived even if it is severe. Most sizable water resources projects require long planning, appropriation and construction periods, e.g., more than 10 years average. Even with a relatively ineffective national stabilization program, many construction programs would take place in the recovery period, following recessions. The presumption of long-term national unemployment is contrary to national policy.

(3) The national unemployment rate is the average of regional unemployment rates. Plan formulation using a national unemployment rate requires a cost analysis in terms of foregone EGB from alternative investment locations. If foregone EGB are assumed to be approximately equal to EGB from proposed investment,[5] plan formulation of a public project incorporating EGB becomes meaningless. In this study, therefore, the productive use of idle resources resulting from a project will be claimed if and only if the project will be invested in a chronically depressed region.

Appalachian Unemployment and Evaluation of Federal Water Resource Investment in Appalachia

Unemployment in Appalachia During the Period 1960-1969

Some regional dimensions of the unemployment rate are shown in Table 2. Table 2 shows the unemployment rate of the United States, Appalachia, and the six county Upper Licking Area from 1960 to 1969. The Upper Licking Area is located in the Commonwealth of Kentucky, in the central portion of Appalachia. The difference between unemployment rates for the nation and Appalachia in its entirety is gradually declining (from 3.2 percent in 1962 to .4 percent in 1969) but there are differences

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[5]It is not correct to say that EGB from investments in alternative areas with the same unemployment rate are equal. However, they are assumed to be equal until such time as more accurate measures can be developed.

TABLE 2

UNEMPLOYMENT RATE OF THE UNITED STATES, APPALACHIA AND THE UPPER LICKING AREA 1960 - 1969

	1960	1962	1965	1966	1967	1968	1969
U.S. Total	5.6	5.5	4.5	3.8	3.8	3.6	3.5
Appalachia (State)[a]							
Alabama	5.9	6.9	4.5	4.1	4.1	4.4	3.8
Georgia	4.8	8.0	5.0	4.2	4.8	4.2	3.6
Kentucky	8.6	13.0	10.5	9.6	9.1	8.7	7.5
Maryland	7.9	7.9	5.7	4.6	5.2	5.8	5.3
Mississippi	5.1	9.7	5.8	4.5	4.8	5.2	3.4
New York	5.2	5.7	4.3	3.5	3.7	3.7	4.0
North Carolina	4.4	6.2	4.4	4.0	3.9	3.3	3.0
Ohio	7.3	7.8	5.6	4.9	5.2	4.6	4.4
Pennsylvania	7.9	9.8	4.4	3.6	4.0	3.4	3.3
South Carolina	3.6	4.2	3.9	2.8	3.7	3.4	3.0
Tennessee	6.0	7.1	4.2	3.7	4.4	4.0	3.7
Virginia	7.0	7.5	5.4	4.6	4.9	4.9	4.8
West Virginia	8.4	12.1	7.9	6.8	6.4	6.2	5.5
Total	6.8	8.7	5.1	4.3	4.6	4.2	3.9
Upper Licking Area (County)[b]							
Breathitt	10.3	28.4	33.9	31.5	24.7	18.6	8.7
Floyd	12.9	16.6	15.0	14.2	11.5	11.5	8.6
Johnson	11.7	15.0	14.0	8.5	8.7	12.7	8.0
Magoffin	21.3	19.5	21.2	24.4	20.0	18.2	23.3
Morgan	5.8	12.4	9.0	12.6	6.0	5.2	6.4
Wolfe	3.6	5.7	13.8	18.8	14.2	11.5	7.4
Total	10.9	16.8	16.8	16.4	12.6	13.0	10.4

[a]States, except West Virginia, represent the Appalachian portion of State. All State of West Virginia is located in Appalachia

[b]The Upper Licking Area includes six counties in the Appalachian portion of the Commonwealth of Kentucky.

Sources: Appalachian Regional Commission, Data Book, Vol. 3, 1970, pp. 1 & 3-7 to 3-9, and unpublished data from that office.

between the nation and some of the Appalachian states that are still significant. The unemployment rates in the Appalachian portion of the Commonwealth of Kentucky and in the Upper Licking Area exceeded national average rates by 200 percent and 300 percent, respectively, throughout the past decade. Thus, in the midst of a highly employed economy one can find areas with significantly slack economies. Some of these are of a temporary nature, while others are chronically depressed, such as the Appalachian Region. This condition will probably continue in the future despite the national emphasis on the social and economic development of Appalachia.

Forecasting the extent of the existence of idle resources in the future in Appalachia is difficult, but it is likely that the unemployment rate will exceed the four percent level indicated as the national tolerable limit or 2.9 percent actually achieved by the nation in the past. If unemployment data by occupation for Appalachia were available for years other than 1960, they would indicate an even higher unemployment situation for blue-collar workers in Appalachia as compared to the relative difference in total unemployment between Appalachia and the United States.

Appalachia: A model for economic evaluation of water resource investments with EGB

The plan formulation and economic evaluation of water resource projects associated with EGB apply more directly to depressed areas with long-term unemployment, because timing of project design and construction are not crucial factors. Similar views are expressed both in the Report of Panel of Consultants to the Bureau of Budget[6] and by

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[6] Maynard M. Hufschmidt et.al., Standard and Criteria for Formulating and Evaluating Federal Water Resources Development, Report of Panel Consultants to the Bureau of the Budget, 1961, pp. 31-33.

Boxter <u>et. al.</u>[7] The Appalachian Region has been and would be depressed for a long time to come and thus, subject to a national development policy in recent years. The region has been selected as a pioneering model in which a plan formulation and economic evaluation of a federal water resource investment requires an estimation of the productive use of otherwise idle resources. Since the presumption of an extreme long-term future national unemployment conditions would not be allowed to prevail under established federal stabilization policy, the rest of the nation is assumed to be fully employed for the purpose of application of B/C analysis.

One cause of regional depression is associated with structual economic change, where private investments have proven to be unprofitable, especially in the short-run. However, if a long-term investment, alone or combined with other development projects, can induce needed economic activity, a substantial EGB in the long-run may counteract short-term inefficiency from the initial investment, if any. In fact, this is the general strategy applied in developing national economies.

Public project costs should be weighted against opportunity costs in terms of foregone EGB[8] from alternative use. These foregone EGB are associated with four alternative classes of investment opportunities. The first class of alternative opportunity is between an in-

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[7]Nevins D. Boxter <u>et. al.</u>, "Unemployment and Cost-Benefit Analysis," <u>Public Finance</u>, Vol. XXIV, No. 1 (1969).

[8]Benefits from investment are not limited to EGB and could include productivity gains. Productivity gains could be realized from investments both in depressed as well as in fully employed economics. Because of the difficulty in measuring productivity gains, foregone benefits in terms of these in a fully employed economy will not be included in this study. Costs associated with project investments may be direct, indirect, tangible or intangible. Costs other than those expressed in terms of direct monetary costs are excluded for the same reasons.

vestment in Appalachia and a similar one outside of Appalachia. Since a fully employed economy outside of Appalachia was assumed, EGB's foregone from the investment outside of Appalachia are not applicable. The second class is between investment in a public works project and a private project. This type of EGB foregone is not applicable since Appalachia is recognized as a depressed region, implying that private investment opportunities are discouraged without subsidy.[9] The third class is between a public investment in water resources and a public investment in non-water related programs and projects. This type of EGB foregone cannot be investigated due to a lack of available data. The fourth class is between different types of water projects associated with alternative project locations, and this will be investigated intensively in this study.

EGB resulting from water resource investment which are traced through the Appalachian model, therefore, should be considered to be net EGB from alternative investment opportunities, public and private, outside of Appalachia and private alternatives in Appalachia. Thus, estimated EGB resulting from this sutdy reflect additional net national income.

Estimate of the United States Total Unemployment Rate

National unemployment during the assumed construction phase of the ULP (1970-1973) is expected to vary from year to year. However, for simplicity, this will be estimated and treated as an average rate during the construction period. An appropriate long-term U.S. unemployment rate

[9]Private investment could be directed by anticipating profit either directly from private initiative and effort or indirectly through government subsidies. In this study, government subsidies to encourage private industry were not considered as an alternative.

will be used for this purpose. The long-term rate of 4.6 percent was obtained by averaging U.S. total unemployment rates during 1947-1969. The actual rate of total unemployment in 1970, determined after this study was initiated, was 4.9 percent. Although the average unemployment rate during the period January 1970 through September 1971 reached almost 5.9 percent, the projected long-term unemployment rate will be used for this study to provide a conservative bias.

Unemployment rates for the period 1973 to 2020, during the effective economic application of project costs and benefits, will be represented by four percent. The four percent figure is the normative rate set by the federal government under its full employment policy. The same rate was adopted by the Office of Business Economics in projecting U.S. employment during the perios 1940-2020.[10]

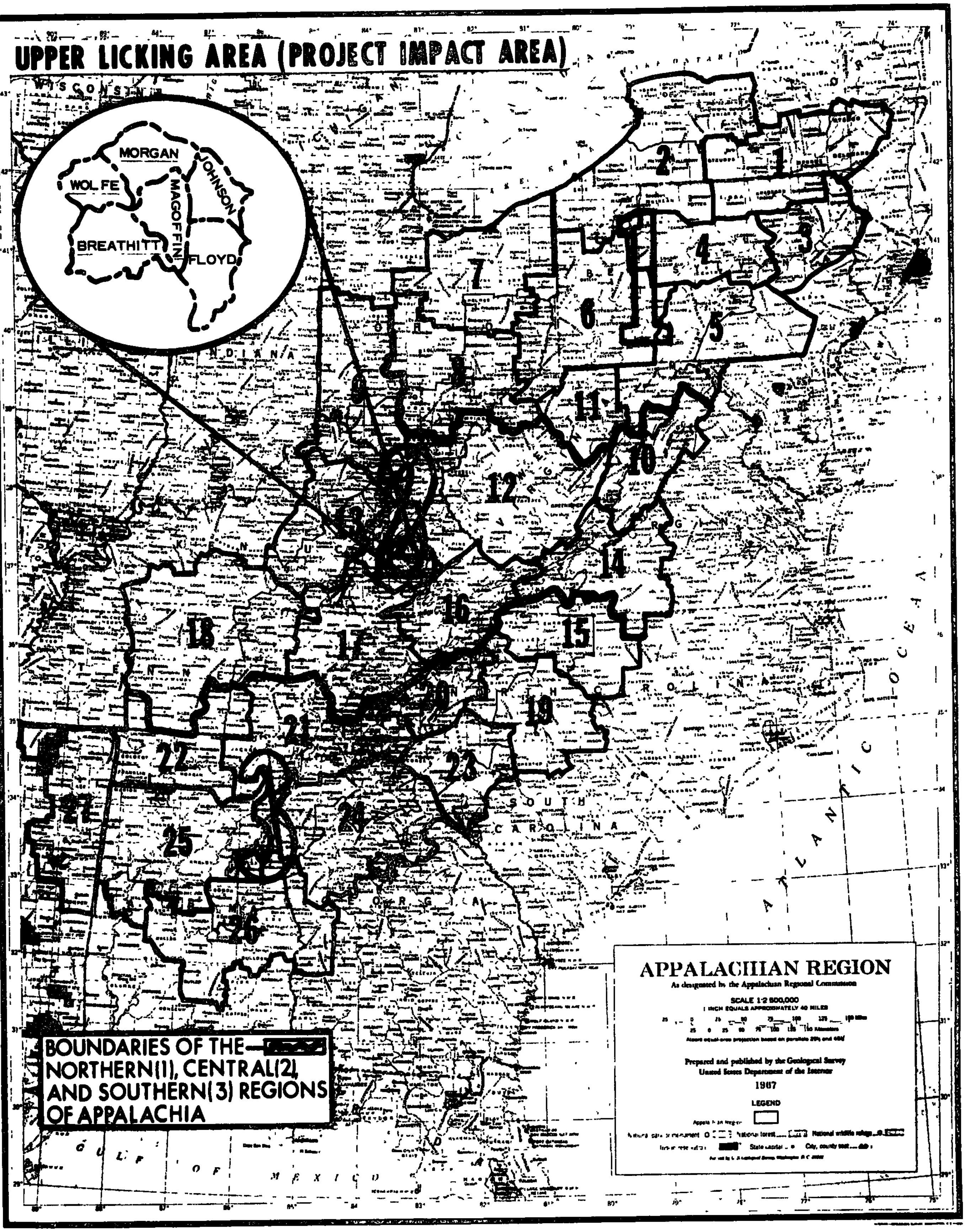
Estimates of Total Unemployment in Appalachia and its Subregions

Although Appalachia as a whole is depressed, the entire region is so extensive that it includes extremely depressed areas as well as fully employed economies, relative to the national average. In order to reflect more distinctive economic, social and spacial detail, Appalachia was divided into three subregions: Region 1 (Northern Subregion), Region 2 (Central Subregion), and Region 3 (Southern Subregion). The subdivisions of Appalachia and also the Upper Licking Area (the Project Impact Area of the ULP) are shown in Plate 1. The same subdivision of Appalachia was used in the existing Appalachian Input-Output Model,

[10] U.S. Army Corps of Engineers, Office of Appalachian Studies, Appendix E: Economic Base Study to Development of Water Resources in Appalachia, prepared by Office of Business Economics and Office of Appalachian Studies, Oct., 1968, pp. E-7 and E-18.

PLATE 1

APPALACHIAN REGION
AND
UPPER LICKING AREA



so that it could be used in this study.

Relationship Between Unemployment Data for
The United States and Appalachia

Data for total and occupational unemployment in Appalachia, its subregions and the Upper Licking Area are available from the 1960 census through the Appalachian Regional Commission. However, no such data are available for the period after 1960, except for the total unemployment rate of Appalachia and designated portions of each state in Appalachia, until 1969. As shown in Table 2, the unemployment rate in Appalachia has been declining along with the national rate during the past decade. Although the unemployment rate in Appalachia has been significantly higher than the national average, the gap between the two rates diminished toward the end of the last decade, from 3.2 percent to .4 percent.

Since there is expected to exist a relationship between the total unemployment rates of the United States and Appalachia, projections of unemployment in Appalachia will be made by utilizing this relationship along with the estimated future unemployment rate of the United States.

The relationship of these two rates can be estimated by regression analysis using the two sets of seven data points, shown in Table 2, Unemployment Rates of the United States and Appalachia During 1960-1969. The results of the regression analysis are shown below.

$$Y = 2.49765 + 1.81794\,X$$

$$r = .92609 \quad \text{(Coefficient of correlation)}$$

$$r^2 = .85765 \quad \text{(Coefficient of determination)}$$

Y = unemployment rate of Appalachia

X = unemployment rate of the U.S.

As expected, the regression analysis shows that there is a positive correlation between the unemployment rate of the nation and that of Appalachia, with a high coefficient of correlation, .926. About 85 percent of the variation in the unemployment rate for Appalachia can be explained by the variation in the national rate. By application of the analysis of variance technique, parameters of the regression equation and r value were proven to be significant, at a 95 percent limit. Although the regression equation was established through single correlation based on a small sample size, this equation will be used to project future unemployment rates in Appalachia.

Estimate of Total Unemployment in Appalachia

In the previous section, the total national average unemployment rates during the period of construction (1970 - 1973) and the remaining period of economic analysis of the ULP (1973 - 2020) were estimated. These were 4.6 percent and four percent, respectively. Unemployment rates in Appalachia were estimated by applying these rates to the regression equation. Estimated unemployment rates in Appalachia are 5.9 percent for the construction period and 4.8 percent for the remaining period.

In order to estimate the number of unemployed in Appalachia, it is necessary to know the size of the labor force. In the previously cited population and employment projections of the Office of Business Economics and Office of Appalachian Studies, employment figures in Appalachia were estimated by 20 year periods from 1940 to 2020. Since the estimated unemployment rate is 5.9 percent during the construction period (henceforth represented by 1970) and 4.8 percent for the remaining period (henceforth represented by 1980) the employment rate in the same periods will be 94.1 and 95.2 percent respectively. The labor force will be obtained by dividing the quantity employed by the employment rate and multiplying by 100. Estimated labor force, employment and unemployment (amounts and their rates) in Appalachia during 1970 - 2020 are shown in Table 3.

Figures for 1970 are not actual, but are estimated average figures for the construction period of the ULP. Average total unemployed labor during the construction period was estimated to be 422,000. In the remaining period through 1980 this amount reduces to 383,000, but is estimated to increase to 663,000 by 2020. The drop in unemployed labor in 1980 is causally related to the estimated 1.1 percent drop in the unemployment rate between 1973 and 1974.

Unemployment in Subregions of Appalachia

Unlike all Appalachia, there are no data relating to the labor force and unemployment in the Appalachian subregions since the 1960 census data tabulation. In the absence of such data future unemployment rates of these areas will be estimated by extending the relative share of subregional labor force and unemployment rates to those of all Appalachia in 1960. According to the 1960 census data the distribution of the total labor force of Appalachia among its subregions was 50.7 percent in Region 1, 19.6 percent in Region 2 and 29.7 percent in Region 3. The unemployment rate of Appalachia in 1960 was 6.5 percent, while the rate for the U.S. was 5.6 percent. The unemployment rate was 7.1 percent in Region 1, 7.3 percent in Region 2 and 4.8 percent in Region 3. These rates are equivalent to 109.2, 112.3, and 73.8 percent of Appalachia's unemployment rate respectively.[11] Although Region 3 is in Appalachia, its unemployment rate in 1960 was below the national average.

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[11]1960 census data for Appalachian Regions were tabulated through the "Quick Query System" so that the labor force and unemployment would be shown for each subregion of Appalachia.

TABLE 3

ESTIMATE OF LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT IN APPALACHIA 1970-2020

Year	Labor Force[c]	Employment[a]	Rate of Employment[b]	Unemployment	Rate of Unemployment
1970	7,154,922	6,732,782	94.1	422,140	5.9
1980	7,984,000	7,601,000	95.2	383,242	4.8
1990	9,226,000	8,783,000	95.2	442,848	4.8
2000	10,467,000	9,965,000	95.2	502,416	4.8
2010	11,980,000	11,405,000	95.2	575,040	4.8
2020	13,808,000	13,145,000	95.2	662,984	4.8

[a]Employment estimate is from U.S. Army Corps of Engineers, Office of Appalachian Studies, Appendix E: Economic Base Study to Development of Water Resources in Appalachia, prepared by Office of Business Economics and Office of Appalachian Studies, Oct., 1968, pp. E-7 and E-18.

[b]The rate of employment was determined as the remainder of 100 percent minus unemployment rate.

[c]The labor force was determined by dividing employment by the rate of employment, times 100.

In the absence of better information, these 1960 relationships among each subregion and total Appalachia will be assumed to continue in the future. The labor force and unemployment rate of each region will be obtained by multiplying the estimated future labor force and unemployment rate of Appalachia by the percentage share of each region in 1960. By so doing, the labor force, unemployment and its rate for each Appalachian subregion in 1970 and 1980 were estimated and are shown in Table 4. The unemployment rate of each region is expected to be 6.4 percent, 6.6 percent, and 4.4 percent for 1970 and 5.2, 5.4, and 3.5 percent for 1980. Unemployment rates of Region 3 for both decades are expected to be below the national rate.

The largest number of unemployed comes from Region 1, 234,000 for 1970 and 212,000 for 1980; these amounts are at least 50 percent greater than those of region 2 or 3.

Unemployment in The Upper Licking Area

The most significant and direct impact of the project is expected to fall on the idle resources within the project area and its immediate vicinity, the Upper Licking Area (Project Impact Area). Six counties in the Commonwealth of Kentucky were assigned to the Upper Licking Area which were expected to be the major source of the labor supply for project construction and for industries induced by the project. Unemployment rates in these counties from 1960 to 1969 were shown in Table 2, previously. The rate for the Upper Licking Area as a whole has been more than double that of the nation. The rate in Magoffin County, where the project was proposed to be located, was over five times the national average. It is expected that idle resources, labor and industrial facilities near the project site will be the first to be utilized. Therefore, unemployment in the Upper

TABLE 4

ESTIMATE OF LABOR FORCE AND UNEMPLOYMENT
IN SUBREGIONS OF APPALACHIA
1960, 1970 & 1980

	1960[a]	1970	1980
Labor Force			
Region 1	3,165,358	3,627,545	4,047,888
Region 2	3,975,558	1,402,365	1,564,864
Region 3	1,857,567	2.125,012	2,371,248
Appalachia	6,247,853	7,154,922	7,984,000
Unemployment			
Region 1	225,637	234,314	212,109
Region 2	89,453	92,556	84,346
Region 3	89,009	93,504	83,942
Appalachia	404,099	420,374	380,397
Unemployment Rate			
Region 1	7.1	6.4	5.2
Region 2	7.3	6.6	5.4
Region 3	4.8	4.4	3.5
Appalachia	6.5	5.9	4.8

[a]Statistics for 1960 are the result of a census report which was tabulated by the Appalachian Regional Commission.

Licking Area will be estimated separately.

The average unemployment rate during the 1960's for all Appalachia was 5.8 percent, and for the Upper Licking Area it was 13.8 percent. The rate in the Upper Licking Area was 258 percent of that in Appalachia. In the absence of a better method, the above relationship will be used to estimate the unemployment rate in the Upper Licking Area in 1970 and 1980. The estimated unemployment rate of the Upper Licking Area will be obtained as the result of multiplying the estimated unemployment rate of Appalachia by 258 percent. Thus, the unemployment rate of the Upper Licking Area is expected to be 15.2 perceint in 1970 and 12.4 percent in 1980.

The labor force of the Upper Licking Area in 1967 was 20,557.[12] The labor force in the area, during 1962-1967, declined at an annual rate of .72 percent, and this rate will be assumed to continue as a trend in the future. The estimated labor force in the Upper Licking Area is expected to be $20,557 \times (1 - .0072)^3 = 20,115$ for 1970 and $20,557 \times (1 - .0072)^{13} = 20,076$ for 1980. The number of unemployed in the Upper Licking Area will be estimated by multiplying the labor force by the rate of unemployment in the Upper Licking Area. Estimated unemployment in the Upper Licking Area will be 3,057 for 1970 and 2,549 for 1980.

Estimates of Occupational Unemployment in Appalachian Regions and The Upper Licking Area

Distribution Pattern of the Labor Force and Unemployment in Appalachia and its Subregions by Major Occupation

Table 1 and Figure 2 have shown a unique pattern of distribution

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[12]Appalachian Regional Commission, Appalachian Data Book, Vol. 3 - Kentucky, 2nd Ed., Apr., 1970.

of unemployment rates among major occupations at the national level. This pattern may not be appropriate in Appalachia. The distribution of occupations may be patterned by the industrial structure of the region. Industrialized urban centers require more professional and managerial talents and clerical and service workers, compared to rural areas. Rural towns may require more semi-skilled occupations and laborers. The distribution of the unemployment rate is naturally expected to follow the same pattern as the distribution of occupation.

The distribution pattern of unemployment rates, and percentage distribution of the labor force and unemployment among major occupations of the United States, Appalachia and the Appalachian regions in 1960 were so arranged in Table 5, that some comparative pattern of their distribution may be generalized. As might be expected, the proportion of occupations such as professional and technical workers, managers and officials, and clerical and service workers within the total labor force in Appalachia has been lower than that of national averages. But the relative shares of craftsmen and operatives and nonfarm laborers have been higher than their respective national averages. The distribution pattern of the labor force of the nation shows 54.5 percent for white-collar and service workers, 37.6 percent for blue-collar workers and 7.9 percent farmers and farm workers. The labor force in Appalachia was distributed among 44.8 percent white-collar and service workers, 48.4 percent blue-collar workers and 6.8 percent farmer and farm workers. This distribution pattern confirms the difference between the industrial structure in Appalachia and that of the nation. The percentage distribution of total unemployment among each occupation parallels to the pattern of labor force distribution except for sales workers. The relative percentage distribution of unemployment of white-collar and service workers is less

TABLE 5

UNEMPLOYMENT RATES; PERCENT DISTRIBUTION OF LABOR FORCE AND UNEMPLOYMENT, BY MAJOR OCCUPATION FOR U.S., APPALACHIA AND APPALACHIAN REGIONS IN 1960

Occupation	Unemployment Rate					% Distribution of Labor Force					% Distribution of Unemployment				
	U.S.	App.	Reg.1	Reg.2	Reg.3	U.S.	App.	Reg.1	Reg.2	Reg.3	U.S.	App.	Reg.1	Reg.2	Reg.3
Prof., & Tech.	1.7	1.3	1.4	1.3	1.2	10.8	9.0	9.9	8.9	7.9	3.4	1.9	2.0	1.6	2.0
Mgrs., officials, & propr's.	1.4	1.5	1.7	1.8	1.1	10.1	6.6	6.5	6.6	6.7	2.5	1.6	1.6	1.6	1.5
Clerical wkrs.	3.8	4.0	4.3	3.9	3.2	14.5	11.7	12.7	9.5	9.8	11.2	6.9	7.7	5.1	6.5
Sales wkrs.	3.7	4.1	4.5	4.4	3.2	6.5	6.9	7.4	6.9	6.1	4.8	4.4	4.7	4.2	4.1
Craftsmen	5.3	7.7	8.2	9.4	5.2	12.9	15.1	16.3	14.8	13.7	13.8	18.0	18.8	19.1	14.9
Operatives	8.0	9.0	10.2	10.9	6.2	18.7	26.1	24.8	25.9	28.5	30.2	36.5	35.2	39.0	37.1
Service wkrs.	5.7	6.1	6.3	8.0	5.7	12.6	10.6	10.4	9.8	11.9	14.6	10.1	9.2	8.2	14.1
Nonfarm laborers	12.5	15.5	17.0	18.5	10.4	6.0	7.2	7.9	6.6	6.6	15.2	17.4	18.9	16.8	14.3
Farmers, farm laborers	2.7	3.1	3.2	2.9	3.0	7.9	6.8	4.1	11.0	8.8	4.3	3.2	1.9	4.4	5.5
Total	5.6	6.5	7.1	7.3	4.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Manpower Report of the President, prepared by the Department of Labor, 1966 and unpublished date from Appalachian Regional Commission, 1970.

Unemployed labor whose occupation was not reported was distributed among major occupations according to the ratio of reported unemployed excluding professional and managerial classes.

in Appalachia, and that of blue-collar workers is higher in Appalachia compared to national averages. Of total national unemployment 36.5 percent belongs to white-collar and service workers and 59.2 percent to blue-collar workers, while the same rate in Appalachia is 24.9 and 71.9 percent, respectively.

Although the above patterns of distribution are not as prominent among the subregions of Appalachia as they were for the U.S. and all Appalachia, they reflect differences in production patterns and the degree of urbanization among regions.

Unemployment in Appalachia and its Subregions by Major Occupation

It is expected that there are some relationships between the rate of total and major occupational unemployment. As previously noted, occupational unemployment data are not available for Appalachian regions except for 1960. The occupational profile of the labor force is a function of the change in industrial structure, technology, urbanization and of inward and outward migration, of which the latter has been of importance for this region and likely to be so in the future. Industrialization with heavier capital assets and urbanization tend to shift the distribution pattern of occupation in favor of skilled labor at the expense of farmers and unskilled laborers. However the change in the occupational distribution pattern should be a gradual one accompanied by a slow process of change in the industrial structure, technology and urbanization, especially in depressed areas. Since there is no better alternative guide in estimating future unemployment and its rate by major occupation for Appalachia and its subregions, the relative share of occupation and unemployment in those regions in 1960 will be used to project future unemployment, given the total labor force and unemployment.

Total labor force and unemployment in Appalachia and its regions were already estimated in Table 4. Estimated labor force, unemployment and its rate by occupation in Appalachia and its regions for 1970 and 1980 were arrived at by multiplying estimated totals by their relative occupational share in these regions in 1960, and they are shown in Tables 6 and 7. Compared to actual U.S. unemployment rates by occupation in 1970, estimated rates of unemployment in Appalachia and its regions display special characteristics. The unemployment rate for professional workers has been significantly low, while the rate for blue-collar workers in Appalachian regions is significantly higher than the national average. As expected, region 3 is the exception which is below the national rate in almost all occupations. However, compared to rates in 1953 -- which were treated as the full employment level in this study -- rates in almost all occupations are below the full employment level. The rates of blue-collar workers especially are almost two times greater than rates comparable for the nation.

Estimate of Labor Force and Unemployment in the Upper Licking Area by Major Occupation

The distribution pattern of the labor force and unemployment in the Upper Licking Area was assumed to be generally the same as that of Region 2, which contains the Upper Licking Area. The labor force and unemployment and its rates by occupation were estimated in the same fashion as in the regional estimate, and they are shown in Table 8. In this estimate, unemployment rates of every occupation are significantly higher than those of the nation and subregions of Appalachia. Especially, unemployment rates of blue-collar workers for both 1970 and 1980 are more than five times those of 1953. The unemployment rate ranges of these occupations are 19.6 $\sim$ 38.7 percent for 1970 and 15.9 $\sim$ 31.5 percent for 1980.

TABLE 6

ESTIMATED LABOR FORCE, UNEMPLOYED AND UNEMPLOYMENT RATE BY MAJOR OCCUPATION FOR APPALACHIAN REGIONS IN 1970

Occupation	APPALACHIA			REGION 1			REGION 2			REGION 3		
	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate
Prof., tech. & kindred wkrs.	643,943	8,021	1.2	359,127	4,672	1.3	124,811	1,481	1.2	167,876	1,870	1.1
Mgrs., officials, & propr's.	472,225	6,754	1.4	235,790	3,735	1.6	92,556	1,481	1.6	142,376	1,403	1.0
Clerical & kindred wkrs.	837,126	29,128	3.5	460,698	17,918	3.9	133,225	4,700	3.5	208,251	6,078	2.9
Sales workers	493,690	18,574	3.8	268,438	10,980	4.1	96,763	3,887	4.0	129,626	3,834	3.0
Craftsmen, foremen & kin. wkrs.	1,080,393	75,985	7.0	591,290	45,919	7.4	207,550	17,679	8.5	291,127	13,932	4.8
Operatives & kindred wkrs.	1,867,435	154,081	8.3	899,631	82,933	9.2	363,213	36,097	9.9	605,628	34,689	5.7
Service wkrs.	758,422	42,636	5.6	377,265	21,492	5.7	137,431	7,590	5.5	252,876	13,184	5.2
Nonfarm laborers	515,154	73,452	14.3	286,576	44,153	15.4	154,260	15,547	10.1	140,251	13,371	9.5
Farmers and farm laborers	486,535	13,507	2.8	148,729	14,439	3.0	97,556	4,073	4.4	187,001	5,143	2.8
Total	7,154,922	422,140	5.9	3,627,545	234,314	6.5	1,402,365	92,556	6.6	2,125,012	93,504	4.4

Note: It is assumed that the national unemployment rate is 4.6 percent and the Appalachian rate is 5.9 percent.

Labor force and unemployed are derived through multiplying estimated total labor force and unemployed by their percent distribution in 1960 among major occupations.

TABLE 7

ESTIMATED LABOR FORCE, UNEMPLOYED AND UNEMPLOYMENT RATE
BY MAJOR OCCUPATION FOR APPALACHIAN REGIONS
IN 1980

	APPALACHIA			REGION 1			REGION 2			REGION 3		
Occupation	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate	Labor Force	Unem-ployed	Unemploy-ment rate
Prof., Tech. & kindred wkrs.	718,560	7,282	1.0	400,741	4,242	1.1	139,273	1,350	1.0	187,329	1,679	1.0
Mgrs., officials, & propr's.	526,944	6,132	1.2	263,113	3,394	1.3	103,281	1,350	1.3	158,874	1,259	1.0
Clerical & kindred wkrs.	934,128	26,443	2.8	514,082	16,332	3.2	148,662	4,301	2.9	232,382	5,456	2.3
Sales Wkrs.	550,896	16,862	3.1	299,544	9,969	3.3	107,976	3,543	3.3	144,646	3,442	2.4
Craftsmen, foremen & kindred wkrs.	1,205,584	68,982	5.7	659,806	39,877	6.0	231,600	16,110	7.0	324,881	12,507	3.9
Operatives & kindred wkrs.	2,083,824	139,980	6.7	1,003,876	74,662	7.4	405,300	32,895	8.1	675,806	31,142	4.6
Service wkrs.	846,304	38,706	4.6	420,980	19,514	4.6	153,357	6,916	4.5	282,178	11,836	4.2
Nonfarm laborers	574,848	66,682	11.6	319,783	40,089	12.5	103,281	14,170	13,7	156,502	12,004	7.7
Farmers & farm laborers	542,912	12,263	2.3	165,963	4,030	2.4	172,135	3,711	2.2	208,670	4,617	2.2
Total	7,984,000	383,232	4.8[a]	4,047,888	212,109	5.2	1,564,864	84,346	5.4	2,371,248	83,942	3.5

Note: [a] It is assumed that the rate of unemployment for the nation is 4.0 percent in 1980 and 4.8 percent in Appalachia.
Labor force and unemployed are derived through multiplying estimated total labor force and unemployed by their percent distribution in 1960 among major occupations.

TABLE 8

ESTIMATED LABOR FORCE, UNEMPLOYMENT AND UNEMPLOYMENT RATES
BY MAJOR OCCUPATION IN THE UPPER LICKING AREA
1970 and 1980

Occupation	1970 Labor Force	1970 Unemployment	1970 Unemployment Rate	1980 Labor Force	1980 Unemployment	1980 Unemployment Rate
Prof., tech. & kindred wkrs.	1,790	49	2.7	1,787	40	2.2
Mgrs., officials, & propr's.	1,328	49	3.6	1,325	40	3.0
Clerical & Kindred wkrs.	1,910	156	8.1	1,907	127	6.6
Sales workers	1,388	128	9.2	1,385	105	7.5
Crafesmen, foremen & kind. wkrs.	2,977	584	19.6	2,971	475	15.9
Operatives & kindred wkrs.	5.210	1,192	22.8	5.200	971	18.6
Service wkrs.	1,971	251	12.7	1,968	204	10.3
Nonfarm laborers	1,328	514	38.7	1,325	418	31.5
Farmers & farm laborers	2.213	134	6.0	2.208	109	4.9
Total	20,115	3,057	15.2	20,076	2,489	12.4

Note: Unemployment rates in the impact area are estimated to be 258 percent of the unemployment rates of Region 2 which are 15.2 percent in 1970 and 12.4 percent in 1980. Labor force and unemployment figures were derived from the distribution of total labor force and unemployment among occupation according to the percent distribution patterns of Region 2 in 1960.

Estimates of Unemployment in Appalachian Regions Based on 5.6 Percent National Unemployment Rate

Previous estimates of unemployment in Appalachian regions were based on the assumption that a 4.5 percent national unemployment rate, the long term unemployment rate of the U.S. reflecting the average national unemployment during 1947-1969, will prevail during the construction period of the ULP, 1970-1973. As has been mentioned, the actual unemployment rate from January 1970 to September 1971 has shown an average of 5.9 percent. It is not certain whether this high actual unemployment eate will be drastically reduced during the remaining construction period to a level whereby the actual average rate will be approximately equal to the predicted rate. A continuance of high unemployment, above five percent, for some time is probable. To test the sensitivity of EGB from a change in the national unemployment rate by one percent point, unemployment rates in Appalachian regions and the Upper Licking Area based on the assumption of a 5.6 percent national unemployment rate during the construction period will be estimated.

Average unemployment data in Appalachian regions and the Upper Licking Area during the construction period, represented by 1970, will be estimated by applying the same procedures as those introduced in the previous sections, along with the newly projected national unemployment rate. Estimated unemployed and unemployment rates are shown in Table 9. Average Appalachian unemployment rates were estimated to be 7.9 percent with 8.6 percent for Region 1, 8.9 percent for Region 2, 5.8 percent for Region 3 and 20.4 percent for the Upper Licking Area. The unemployment rate of blue-collar workers in Appalachia ranges from 10 percent to 20 percent. The unemployment rate for these same workers in the Upper Licking Area has been estimated to be even higher, 20 percent to 50 percent of this labor force.

TABLE 9

ESTIMATED UNEMPLOYED AND UNEMPLOYMENT RATE BY MAJOR OCCUPATION FOR APPALACHIAN REGIONS AND UPPER LICKING AREA FOR 1970 (Based on 5.6% national unemployment rate)

	Region 1		Region 2		Region 3		Appalachia		Upper Licking Area	
	labor force	unemployed %	labor force	unemployed %	labor force	unemployed %	labor force	unemployed %	labor force	unemployed %
Professional, Technical and kindred workers	359,127	6,259 (1.7)	124,810	1,997 (1.6)	167,876	2,478 (1.5)	643,943	10,671 (1.7)	1,790	66 (3.7)
Managers, officials and proprietors, except farmers	235,790	5,007 (2.1)	92,556	1,997 (2.2)	142,376	1,858 (1.3)	472,225	8,986 (1.9)	1,328	66 (5.0)
Clerical and kindred workers	460,698	24,096 (5.2)	133,225	6,365 (4.8)	208,251	8,053 (3.9)	837,126	38,753 (4.6)	1,911	209(10.9)
Sales Workers	268,438	14,708 (5.5)	96,763	5,242 (5.4)	129,626	5,076 (3.9)	493,690	24,712 (5.0)	1,388	172(12.4)
Craftsmen, foremen and kindred workers	594,917	58,833 (9.9)	207,550	23,839(11.5)	291,127	18,460 (6.3)	1,080,393	101,096 (9.4)	2,977	784(26.3)
Operatives and kindred workers	899,631	110,155(12.2)	363,213	48,676(13.4)	605,628	45,964 (7.6)	1,867,435	205,000(11.0)	5,210	1,600(30.7)
Service Workers	377,265	28,790 (7.6)	137,432	10,234 (7.4)	252,876	17,469 (6.9)	758,422	56,726 (7.5)	1,971	336(17.0)
Laborers, except farm and mine	286,576	59,146(20.6)	92,556	20,968(22.7)	140,251	17,717(12.6)	515,154	97,726(19.0)	1,328	689(51.8)
Farmers and farm laborers	148,729	5,946 (4.0)	154,260	5,492 (3.6)	187,001	6,814 (3.6)	486,535	17,973 (4.0)	2,213	181 (8.2)
All Occupations	$3,627,545	$312,941(8.6)	$1,402,365	$124,810 (8.9)	$2,125,012	$123,982 (5.8)	$7,154,922	$561,643 (7.9)	$20,115	$4,103(20.4)

Note: Labor force and unemployed are derived tnrough multiplying estimated total labor force and unemployed by their percentage distribution in 1960 among major occupations.
Columns and rows may not add because of rounding.

Estimate of Underemployment and Potential Unemployment[13]

Underemployment and Potential Unemployment in Appalachia

Unemployment as estimated by the Department of Labor -- registered civilian labor force multiplied by the unemployment rate -- does not offer a satisfactory measurement of surplus labor in depressed areas. The low labor participation rate and low level of income in these areas as compared to the national average cause significant underemployment problems. Thus conventional estimates of unemployment[14] in Appalachia could significantly understate the potential labor force and unemployment in this region. Since the unemployment rate is a key factor in determining EGB, the size of EGB will be significantly increased if a potential unemployment rate is applied instead of the conventional unemployment rate. This study will not use potential unemployment in estimating EGB in order to be conservative. However, to illustrate the difference in the magnitude of observed and potential undmployment in Appalachian regions, underemployment in the Upper Licking Area for 1970 and 1980 will be estimated.

Estimate of Underemployment and Potential Unemployment in the Upper Licking Area

(1) Underemployment and potential unemployment in 1960

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[13] Potential unemployment includes both unemployment and underemployment. Underemployment is the potential labor force minus the labor force actually registered. Potential labor force is arrived at by multiplying the size of population, 14 years and over, by the average national labor participation rate. Labor force and unemployment data are estimated in terms of the Labor Department concept, and may be called conventional as opposed to potential. The concept of labor force by the Department of Labor has changed to include labor force 16 years and over since 1965. Since no adjusted data for the new concept of labor force before 1965 has been made, labor force 14 years and over were used to project potential labor force. This has resulted in an upward bias of the size of underemployment.

[14] See footnote 13.

According to the census report, the ratio of labor force to population of the U.S. in 1960 was 57 percent, while the same ratio for the Upper Licking Area was 33.5 percent. Population 14 years of age and over, registered labor force and unemployed labor in the Upper Licking Area in the same year was 68,732, 23,030, and 2,505 respectively. The labor participation rate is a function of many factors. However, if the difference in the labor participation rate between the U.S. and the Upper Licking Area is considered as an approximate measure of the underestimation of the labor force, the potential labor force in the Upper Licking Area in 1960 would have been 68,732 X .57 = 39,177. Thus, the actually registered labor force was understated by 39.177 - 23,030 = 16,147. Potential unemployment (unemployment + underemployment), therefore, would have been 2,505 + 16,147 = 18,652. And the potential unemployment rate would have been (18,652/39,177) X 100 = 47.6 percent of the potential labor force instead of 10.9 percent, as reported in the census data. The number of underemployed would be more that 6 times (16,147 ÷ 2,505) the unemployed; thus conventional unemployment date understate the potential unemployment by more than 80 percent.

(2) Underemployment and potential unemployment for 1970 and 1980

According to the historical and projected population and employment trend of the U.S. and Appalachia by OBE and OAS, already cited, population per worker of both the U.S. and Appalachia is declining. The rate of decline of population per worker per decade is estimated to be 2.4 percent for the U.S. and 3.9 percent for Appalachia during the period 1950 - 2020.[15] In the absence of a projected labor participation

[15]Appendix E: Economic Base Study, Loc. Cit.

rate, the rate of population decline per worker will be substituted for any possible increase in the labor participation rate. Applying this rate, then, the labor participation rate for the future decade can be computed. If the labor force is known, the population eligible for work is derived through dividing the labor force by the participation rate. The future participation rate is computed by the following formula: $P^L \times (1 + r)^n = P_n$, P^L = present labor participation rate, r = rate of growth by decade, n = number of decade and P_n = labor participation rate at n future decade. Computed labor participation rates for 1960, 1970 and 1980 are shown in Table 10.

TABLE 10

LABOR PARTICIPATION RATE OF THE U.S., APPALACHIA AND THE UPPER LICKING AREA 1960, 1970, and 1980

	1960	1970	1980
U.S.	57.0%	58.4%	59.7%
Appalachia	50.0%	52.0%	54.0%
Upper Licking Area	33.5%	37.4%	38.9%

Note: The participation rate for 1960 was obtained from 1960 census data and an unpublished print-out by the Appalachian Regional Commission.

Applying the same techniques as in the calculation of the potential unemployment rate in 1960, the potential unemployment rate in the Upper Licking Area for 1970 and 1980 will be estimated. The detailed computation of potential unemployment in the Upper Licking Area in 1960, 1970 and 1980 is shown in Table 11. Estimated potential unemployment which includes both unemployment and underemployment in the Upper Licking Area is 14,291 for 1970 and 13,183 for 1980. The potential unemployment rates will be 45.5 percent and 52.8 percent for 1970 and 1980 respectively, whereas the estimated unemployment rate for these periods was 15.2 percent and 12.4 percent respectively.

TABLE 11

ESTIMATES OF POTENTIAL LABOR FORCE[a] AND UNEMPLOYMENT IN THE UPPER LICKING AREA 1960, 1970, and 1980

		1960[b]	1970	1980
1.	Estimated labor force before adjustment	23,030	20,115	20,076
2.	Labor participation rate in impact area	33.5	37.4[c]	38.9[c]
3.	Population 14 and over (1/2)	68,732	53,783	51,609
4.	Labor participation rate of U.S.	57.0	58.4[b]	59.7[b]
5.	Potential labor force (3X4)	39,177	31,409	30,810
6.	Added unemployment (5-1)	16,147	11,294	10,734
7.	Unemployment before adjustment	2,505	2,997	2,449
8.	Conventional unemployment rate[a] (7/1)	10.9	15.2	12.4
9.	Potential unemployment (6+7)	18,652	14,291	13,183
10.	Potential unemployment rate[a] (9/5)	47.6	45.5	42.8

[a]Potential labor force is arrived at by multiplying the size of population, 14 years and over, by the average national labor participation rate. Potential unemployment includes unemployment and underemployment. Underemployment is the potential labor force minus the labor force actually registered. Labor force and unemployment data are estimated in terms of the Labor Department concept, and may be called conventional as opposed to potential.

[b]Statistics for 1960 are from the census report.

[c]Labor participation rates between 1970 and 1980 are calculated assuming their growth rates are 3.9 percent for the impact area and 2.4 percent for the U.S., per decade.

(3) Underemployment by major occupation.

Distribution of underemployment by major occupation will not be estimated due to the absence of sufficient data. However, in this case, most of the underemployed labor should belong to semi-skilled or unskilled labor categories.

Estimate of Excess Industrial Capacity Rate

Concept and Measurement of Productive Capacity

The concept and measurement of productive capacity is more ambiguous than in the case of labor employment.[16] The term "Capacity" has been given various meanings. However, there seems to be general agreement that the term refers to the quantity of output that can be produced per unit of time with a given supply of plant and equipment. In general, it is assumed that labor and materials will be available in the necessary quantities and qualities, and that the limiting factor is the stock of plant and equipment together with the operating standards which determine the intensity with which the plant can be used at "capacity levels of output."

The economists' definition identifies capacity output as the output rate prevailing when the short-run average total cost per unit is at a minimum.[17] The economist's definition, therefore, is concerned with that output from a given set of productive facilities that coincides with minimum average cost under competitive conditions, and results in maximum profit for the enterprise. Explicitly or implicitly, the

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[16] For a detailed discussion of this subject see U.S. Congress, Measures of Productive Capacity, Report of the Subcommittee on Economic Statistics to the Joint Economic Committee, 87th Congress, 2nd Session, July 24, 1962.

[17] Ibid, pp. 6-7.

economist's definition typically includes that notion of some reserve of productive abilities over and beyond those in use at the preferred operating rate. However, these are not definitions that form the base on which existing capacities are measured.

The necessary rules or conventions have not been developed and generally agreed upon for use in measurement of capacity, although some individual industries (usually through trade associations) have agreed upon standards for their own industry. This explains in large part the unsatisfactory state of capacity measure and in some instances, the inconsistency and confusion in the preparation and presentation of existing data. This, of course, has resulted in a wide variety of capacity data which cannot be compared precisely with each other or with other economic data. Although there exist differences both with respect to definitions of capacity and to measurement criteria, these differences appear primarily in the magnitude of estimated utilization rates rather than in the direction of movement from year to year.

Wharton School Capacity Utilization Data

The Wharton School Capacity Utilization Data was adopted to measure U.S. excess industrial capacity rates in this study. This data was used because it was (1) readily accessible, and (2) it provides wider and more detailed coverage of industrial sectors than alternative measurements do.[18] For example, McGraw-Hill, the National Conference Board and the Federal Reserve Board publish Indexes which apply only to key manufacturing industries, while Wharton School Data measures capacity utilization in the mining, utility, and service industries as well as manufacturing.

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[18]For a detailed comparison of each measurement see ibid, pp. 7-13.

However,these data do not cover all industry sectors. They include approximately 52 percent of the value of GNP. The sectors excluded are agriculture, fisheries, commerce, and government. The capacity utilization rate by U.S. industry is the aggregate of 37 industry sectors. In the Wharton School measure, trend lines constructed through peaks of industrial output are assumed to represent that output which would have been forthcoming if all resources had been utilized. It was assumed that at each output peak in each industry there is no excess capacity. Of course, this is not the maximum physical output level that can be produced per unit of time. It is the maximum level which was attained under certain economic conditions. The ratio of actual output to the trend value represents the index of capacity utilization. The rate of excess industrial capacity, therefore, is the difference between the trend line, which is full production capacity (100 percent), and the actual capacity utilization rate.

Total Excess Industrial Capacity Rate in the U.S. During the Period 1947-1969

Total excess capacity rates of U.S. industry, based on the Warton School Data, from 1947 to 1970 are shown in Table 12. The total excess industrial capacity rate of the U.S. ranges from 3.38 percent in 1947 to 17.55 percent in 1958. Although past fluctuations in excess capacity rates did not exactly match those of total U.S. unemployment due to the effect of the acceleration principle on the production cycle, both rates are higher during recession periods. Excess capacity rates during the recession periods, 1954-55, 1958-65, and 1970 show 12.3 percent, 13 percent, and 10.5 percent respectively.

The U.S. Excess Industrial Capacity Rate by Industry

As in the case of unemployed labor resources, significant differences in excess capacity rates among industry sectors were obscured

TABLE 12

TOTAL EXCESS INDUSTRIAL CAPACITY RATES
OF THE UNITED STATES 1947-1970

Year	Excess Capacity Rate (%)	Year	Excess Capacity Rate(%)
1947	3.38	1959	12.66
1948	5.84	1960	13.43
1949	15.31	1961	15.91
1950	9.31	1962	13.66
1951	7.36	1963	12.94
1952	9.23	1964	10.65
1953	6.78	1965	7.56
1954	13.44	1966	4.24
1955	7.21	1967	7.34
1956	7.21	1968	6.50
1957	10.02	1969	5.86
1958	17.55	1970	10.47

SOURCE: Wharton School of Finance and Commerce, The U.S. Industrial Capacity Utilization Index, 1947-1970 (Wharton Econometric Forecasting Associates, Inc., 1971).

Annual average rate of capacity utilization is derived by averaging 4 quarter indices. Annual average excess capacity rates are derived by deducting annual average rate of capacity utilization from 100 percent, the full capacity rate.

by the total rate. Average excess capacity rates by 2 digit SIC[19] Code during three different years -- 1947, 1958 and 1969 -- and during 1947-69 are shown in Table 13. The ranges of excess capacity rates by industry sector are: .6 ~ 10.8 percent in 1947, 3.1 ~ 44.2 percent in 1958 and .1 ~ 44.9 percent in 1969. Significant differences in the excess capacity rate have not only been shown among industry sectors but also among different years in the same industry sectors.

Full Industrial Capacity Level

In the analysis of full employment levels, by occupation, a separate allowance for frictional unemployment was made for each occupational group. However, in each measurement of full capacity levels, the base was selected from actual peak output levels, and those levels were some preferred rate of physical output capacity. Therefore, a full capacity level of operation means 100 percent utilization of a profit maximizing operating rate and no frictional rate will be assigned.

Estimated U.S. Excess Industrial Capacity Rate During the Period 1970-2020

As shown in Table 12, the actual total excess capacity rate in 1970 was 10.5 percent. As in the estimate of an average unemployment rate during the construction period of the ULP, long-term excess capacity rates by industry sector will be estimated by averaging excess capacity rates during 1947-2020. These results are shown in Table 13. The esti-

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[19]The Standard Industrial Classification Code was developed for use in the classification of industries to facilitate the collection, tabulation, presentation and analysis of data relating to industries sponsored by the Bureau of Budget. The SIC provides various levels of detail -- two digit, three digit, and four digit. Each four digit industry has been defined in terms of two digit, three digit or four digit SIC, or by major groups, or industries.

TABLE 13

AVERAGE RATES OF EXCESS INDUSTRIAL CAPACITY BY INDUSTRY FOR THE YEARS 1947, 1958, 1969 AND THE PERIOD 1947-1969

Unit: Percentage

Industry	1947	1958	1969	1947-1969
Primary Metals (37,38)[a]	2.30	32.63	13.58	15.1
Fabricated metal products (39-42)	1.55	14.52	3.55	7.7
Non-electrical machinery (43-52)	2.25	30.38	7.23	15.7
Electrical machinery (52-58)	1.75	31.93	7.10	15.0
Motor vehicles and parts (59)	4.78	43.78	4.43	14.6
Aircraft and aircraft equipment (60-61)	10.83	18.88	10.23	19.6
Instrument and related products (62-64)	3.60	14.70	6.53	10.4
Clay, glass, and stone products (35,36)	4.25	19.83	1.85	8.7
Lumber products (20,21)	3.05	17.73	11.13	10.8
Furniture and fixtures (22,23)	2.83	16.30	7.25	6.5
Miscellaneous manufactures (64)	4.23	18.50	10.50	6.4
Textile Products (16,17)	9.40	17.73	1.88	7.5
Apparel products (18,19)	3.20	11.48	13.28	5.5
Leather and products (33,34)	3.80	9.63	12.85	6.8
Paper and products (24,25)	3.80	11.93	.10	6.8
Printing and publishing (26)	1.08	6.93	3.38	4.1
Chemical and products (27-30)	2.05	12.38	1.03	11.6
Petroleum products (31)	3.45	6.25	1.85	2.9
Rubber and elastic products (32)	6.73	18.33	.65	9.2
Food manufacturers (14)	2.43	8.53	1.05	3.3
Beverages (14)	7.38	21.38	2.75	11.7
Tobacco products (15)	3.33	4.60	18.08	7.6
Coal (7)	7.13	44.23	28.70	34.0
Crude oil (8)	.83	37.78	24.90	33.8
Gas and gas liquid (8)	1.20	7.00	1.98	13.9
Oil and gas drilling (8)	7.18	16.68	44.85	5.6
Metal mining (5,6)	2.33	22.78	4.53	13.9
Stone and earth minerals (9,10)	1.63	8.73	3.88	5.6
Electric (68)	.85	11.20	.73	8.0
Gas (68)	1.28	7.13	.13	4.6
Railroad (65)	3.33	22.96	1.20	12.6
Truck (65)	3.20	16.32	3.05	10.5
Air (65)	8.00	7.90	23.65	12.4
House (71)	.62	3.08	2.42	2.6
Office (71)	.92	4.05	5.05	4.5
Hotels (72)	1.12	27.07	34.84	23.4
Construction (11,12)	6.19	9.17	10.89	6.9
Total	3.38	17.55	5.86	9.7

[a]Number of SIC code for 1958 Input-Output Study.

Source: Wharton School of Finance and Commerce, The U.S. Industrial Capacity Utilization Index, 1947-1970 (Wharton Econometric Forecasting Associates, Inc., 1971).

mated long-term total excess capacity rate is 9.7 percent. Excess capacity rates by industries range from 2.6 percent in the housing sector to 33.8 percent in the crude oil industry. The total industrial excess capacity rate will be substituted for the excess capacity rates for those industries by SIC Code not shown in Table 13, except for agricultural products (sector 2), imports of goods and services (sector 80); office supplies (sector 82) and personal consumption expenditures (sector 83) which will be assigned a zero value. Agricultural products are considered to be surplus. Industry sector numbering by two digit SIC Code is shown in Table 14, Industry Numbering for the 1958 Input-Output Study.

Long-term excess capacity rates by industry sector, presented above, are relatively exempt from short-run fluctuation, and long-term rates will be substituted for the rates during construction period. These same rates will be applied during the period from project completion until year 2020. The assumption that there is a constant excess capacity rate for each industry over an extended time period is heroic. This is evidenced by the fact that there were significant fluctuations in the excess capacity rate of each industry from the average rate during 1947 - 1969, as shown in Table 13. Nevertheless, this rate was used as an analytical convenience against the possibility that short-run fluctuations might cancel each other in the long-run.

Estimates of Excess Capacity Rates for Appalachian Regions

There are no data available for excess capacity of a regional dimension such as exists in employment statistics. One implicit conclusion of high unemployment is that there exists industrial facilities laid idle or under-utilized. The types and magnitudes of the idleness of those industries in specific regions should be disclosed through

TABLE 14

INDUSTRY NUMBERING FOR THE 1958 INPUT-OUTPUT STUDY

Industry No. and industry title	Related SIC codes (1957 edition)
Agriculture, forestry and fisheries	
1 Livestock and livestock products	013, pt. 014, 0193 pt. 02, pt. 0729.
2 Other agricultural products	011, 012, pt. 014, 0192, 0199, pt. 02.
3 Forestry and fishery products	074, 081, 082, 084, 086, 091.
4 Agricultural, forestry and fisheries services.	071, 0723, pt. 0729, 085, 098.
Mining	
5 Iron and ferroalloy ores mining	1011, 106.
6 Nonferrous metal ores mining	102, 103, 104, 105, 108, 109.
7 Coal mining	11, 12.
8 Crude petroleum and natural gas	1311, 1321.
9 Stone and clay mining and quarrying	141, 142, 144, 145, 148, 149.
10 Chemical and fertilizer mineral mining.	147.
Construction	
11 New construction	138, pt. 15, pt. 16, pt. 17, pt. 6561.
12 Maintenance and repair construction	pt. 15, pt. 16, pt. 17.
Manufacturing	
13 Ordnance and accessories	19.
14 Food and kindred products	20.
15 Tobacco manufactures	21.
16 Broad and narrow fabrics, yarn and thread mills.	221, 222, 223, 224, 226, 228.
17 Miscellaneous textile goods and floor coverings.	227, 229.
18 Apparel	225, 23 (excluding 239), 3992.
19 Miscellaneous fabricated textile products.	239.
20 Lumber and wood products, except containers.	24 (excluding 244).
21 Wooden containers	244.
22 Household furniture	251.
23 Other furniture and fixtures	25 (excluding 251).
24 Paper and allied products, except containers and boxes.	26 (excluding 265).
25 Paperboard containers and boxes	265.
26 Printing and publishing	27.
27 Chemicals and selected chemical products.	281 (excluding alumina pt. of 2819), 286, 287, 289.
28 Plastics and synthetic materials	282.
29 Drugs, cleaning, and toilet preparations.	283, 284.
30 Paints and allied products	285.
31 Petroleum refining and related industries.	29.
32 Rubber and miscellaneous plastics products.	30.
33 Leather tanning and industrial leather products.	311, 312.
34 Footwear and other leather products	31 (excluding 311, 312).
35 Glass and glass products	321, 322, 323.
36 Stone and clay products	324, 325, 326, 327, 328, 329.
37 Primary iron and steel manufacturing.	331, 332, 3391, 3399.
38 Primary nonferrous metals manufacturing.	2819 (alumina only), 333, 334, 335, 336, 3392.
39 Metal containers	3411, 3491.
40 Heating, plumbing and fabricated structural metal products.	343, 344.
41 Screw machine products, bolts, nuts, etc., and metal stampings.	345, 346.
42 Other fabricated metal products	342, 347, 348, 349 (excluding 3491).
43 Engines and turbines	351.
44 Farm machinery and equipment	352.
45 Construction, mining, oil field machinery and equipment.	3531, 3532, 3533.
46 Materials handling machinery and equipment.	3534, 3535, 3536, 3537.
47 Metalworking machinery and equipment.	354.
48 Special industry machinery and equipment.	355.
49 General industrial machinery and equipment.	356.
50 Machine shop products	359.
51 Office, computing and accounting machines.	357.
52 Service industry machines	358.
53 Electric transmission and distribution equipment, and electrical industrial apparatus.	361, 362.
54 Household appliances	363.
55 Electric lighting and wiring equipment.	364.
56 Radio, television, and communication equipment.	365, 366.
57 Electronic components and accessories.	367.
58 Miscellaneous electrical machinery, equipment and supplies.	369.
59 Motor vehicles and equipment	371.
60 Aircraft and parts	372.
61 Other transportation equipment	373, 374, 375, 379.
62 Professional, scientific, and controlling instruments and supplies.	381, 382, 384, 387.
63 Optical, ophthalmic, and photographic equipment and supplies.	383, 385, 386.
64 Miscellaneous manufacturing	39 (excluding 3992).
Transportation, communication, electric, gas, and sanitary services	
65 Transportation and warehousing	40, 41, 42, 44, 45, 46, 47.
66 Communications, except radio and television broadcasting.	481, 482, 489.
67 Radio and T.V. broadcasting	483.
68 Electric, gas, water, and sanitary services.	49.
Wholesale and retail trade	
69 Wholesale and retail trade	50 (excluding manufacturers sales offices), 52, 53, 54, 55, 56 57, 58, 59, pt. 7399.
Finance insurance and real estate	
70 Finance and insurance	60, 61, 62, 63, 64, 66, 67.
71 Real estate and rental	65 (excluding 6541 and pt. 6561).
Services	
72 Hotels and lodging places; personal and repair services, except automobile repair.	70, 72, 76 (excluding 7694 and 7699).
73 Business services	6541, 73 (excluding 7361, 7391, and pt. 7399), 7694, 7699, 81, 89 (excluding 8921).
74 Research and development	....
75 Automobile repair and services	75.
76 Amusements	78, 79.
77 Medical, educational services, and nonprofit organizations.	0722, 7361, 80, 82, 84, 86, 8921.
Government enterprises	
78 Federal Government enterprises	....
79 State and local government enterprises.	....
Imports	
80 Gross imports of goods and services	....
Dummy industries	
81 Business travel, entertainment, and gifts.	....
82 Office supplies	....
83 Households	

Source: Research and Development Corporation, An Input-Output Model of Appalachia, prepared for the Office of Appalachian Studies, U. S. Army Corps of Engineers. Washington D. C.: Research and Development Corporation, 1968, Appendix G.

empirical research. In the absence of local data, the national rate of excess capacity will be assumed to prevail in Appalachia and in its subregions as a minimum.

CHAPTER II

ESTIMATES OF DEMAND FOR INDUSTRIAL OUTPUT AND FACTORS OF PRODUCTION INDUCED BY THE UPPER LICKING PROJECT

Comparable to the estimate of idle factors of production in the preceeding chapter, this chapter deals with the estimate of the demand side for factors of production resulting from the ULP. For this purpose a description of the ULP will be introduced. A model to esimtate the primary factors of production will be constructed. The model will incorporate an existing Appalachian input-output model. With this model, industrial output resulting from water resource investments will first be estimated, and then disaggregated into demand for the factors of production. Following the model construction, actual demand for industrial output and factors of production associated with the output resulting from the ULP will be estimated.

Description of the Upper Licking Project

Objectives of the ULP

The ULP was proposed for the Salyersville-Royalton area in Magoffin County, in the Appalachian Portion of the Commonwealth of Kentucky by the Army Corps of Engineers. The project plan is an integral part of the long-term economic development plan of the Appalachian Region as stated in the Appalachian Development Act of 1965.[1] Major

[1] Sec. 206(a) which states: The Secretary of the Army is hereby authorized and directed to prepare a comprehensive plan for the development and efficient utilization of the water and related resources of the Appalachian region, giving special attention to the need for an increase in the production of economic goods and services within the region as a means of expanding economic opportunities and thus enhancing the welfare of its people, which plan shall constitute an integral and harmonious component of the regional economic development program authorized by this Act.

See also footnote 6 in Introduction, p.3.

objectives of the water plan are expressed in the project report:

"The prime objective of the water related plan developed in this report is to reduce water related impediments to the growth potential of the Salyersville-Royalton Area. An associated objective is to outline an attendant plan of development which can be supported by the water plan and to define a course of implementation of the complementary developmental plan to provide for increased industrial and economic activity in the salyersville-Royalton area. Specifically, the comprehensive program of development must: (1) provide an adequate supply of lands reasonably free from flooding; (2) provide water supplies adequate to meet all reasonably expected water supply and water quality control need; (3) provide sufficient sites for industrial, commercial, residential, and public purposes responsive to the development plan and provide adequate access and utilities for these sites; (4) provide fishing, hunting and general outdoor recreation opportunities for an expanding population."[2]

Project Costs

The project consists of a water resources development plan and an area development plan. The water resources development plan includes the construction of four reservoirs, two channel improvements and accelerated land treatment. Table 15 shows the cost allocations for this project. Original costs for this project were estimated in 1969 prices, but they were translated into 1958 prices through price deflators to enable the use of input-output analysis. Total costs for the construction of the water plan were estimated to be $35,606,000, and $95,700 annually for the O & M of the water projects. The water plan has anticipated an area development plan of $200,782,000[3] for which private in-

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[2]U.S. Army Corps of Engineers, Office of Appalachian Studies, Development of Water Resources in Appalachia: Main Report Part III Project Analysis, 1969, pp. III-1-23-24. This project is also utilized by the Corps of Engineers (1) to test evaluation procedures for determining the incidence and magnitude of developmental benefits, and (2) to portray a role in which water resource development can be utilized to stimulate accelerated regional development (in the same source, pp. III-1-3).

[3]Ibid., pp. III-1-35 & 63, Table 1 and 17. For detailed plans and benefit-cost analysis see U.S. Army Corps of Engineers, Louisville District, Interim Survey Report Upper Licking River Basin Kentucky, 1967

TABLE 15

SUMMARY OF ESTIMATED COSTS FOR
SELECTED PLANS OF THE UPPER LICKING PRLJECT

Unit: 1958 dollars

Water Resource Plan	Total First Costs	Charges-Investment	Annual Operation, Maintenance & Replacement
Reservoirs:			
Royalton Reservoir	27,892,801	1,496,870	86,072
Rockhouse Fork Structure	8,129,890	39,906	5,477
Burning Fork Structure	754,303	37,167	391
Mash Fork Structure	386,541	19,014	391
Channel Improvements:			
Licking River Channel Improvement	4,092,332	201,252	2,817
State Road Fork Channel Improvement	280,125	13,772	470
Total -- Water Resource Structural Plan	34,219,092	1,807,825	95,696
Accelerated Land Treatment	1,387,324		
Total -- Water Resource Plan	35,606,416	1,807,825	95,696
Area Development Plan			
Investment Cost	200,782,473	3,377,934	
Total	$236,388,889	$5,185,759	$95,696

Source: U.S. Army Corps of Engineers Office of Appalachian Studies, Development of Water Resources in Appalachia, Main Report Part III, 1969, Table 1. Annual charges were computed based on 100 year project life.

terests would be primarily responsible. Private investments would be induced by the improvement in the industrial locational advantage stimulated by the water resource investments.

Sources of finance and average annual costs for the ULP in 1958 dollars are shown in Table 16. The shares of federal support for this project are: $32,707,000 (about 92 percent) for construction, $46,900 (about 50 percent) for the annual O & M of the water plan and $4,011,000 (about 7 percent) for area development. Project costs were converted into average annual equivalent amounts for 50 years, and average annual federal project costs are: $1,638,000 for the construction of the water plan, $40,000 for O & M and $215,000 for area development.

Expected Economic Expansion Induced by the Water Plan

According to the original study[4], prepared by the Spindletop Research Center for the Army Corps of Engineers, the proposed water projects and some public investments in overhead capital would create a significant locational advantage for certain industries in the Salyersville-Royalton Area. Extensive locational studies for 63 four digits SIC Code manufacturing industries have been conducted. Output levels of 21 manufacturing industry sectors, by two digit SIC Code and by decade have been projected from 1980 to 2020. Comparable to the estimate of outputs by manufacturing industries, values of outputs by

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and Spindletop Research Center, Expansion Benefits Analysis for the Salyersville-Royalton Area Pilot Project, prepared for O.A.S. U.S. Army Corps of Engineers (Lexington, Kentucky: 1967). Royalton reservoir and two channel improvements will be constructed by the Army Corps of Engineers and the rest by the U.S. Department of Agriculture.

[4] Spindletop Research Center, op. cit.

TABLE 16

ESTIMATED ANNUAL COSTS FOR THE UPPER LICKING PROJECT
(Thousands of 1958 dollars)

	Total Construction			Annual O & M			Total Area Development		
	Fed	Non-Fed	Total	Fed	Non-Fed	Total	Fed	Non-Fed	Total
1958 dollars (deflator - 1.278)	32,707	2,899	35,606	46.9	48.7	95.6	8,701	191,612	200,313
Yearly Cost	8,177	725	8,902	46.9	48.7	95.6		a	
Ann. growth rate	0	0	0	0	0	0		8.246%	
Discount rate				--- 4.875 ---					
Period of cost accural	1970-73	70-73	70-73	74-2020	74-2020	74-2020		1975-2020	
Present worth value	30,497	2,704	33,201	743	773	1,516	4,011	55,903	59,914
Capital recovery factor				--- .053722 ---					
Ann. cost for 50 years	1,638	145	1,783	40	41	81	215	3,003	3,218
Ann. Cost relevant to input-output model	1,638		+	40		+	215	=	1,893

Sources: U.S. Army Corps of Engineers, Office of Appalachian Studies, Development of Water Resources in Appalachia, Main Report Part III, 1969, Table 1 & 17 and Spindletop Research Center, Expansion Benefits Analysis for Salyersville-Royalton Area Pilot Project, 1967, Table 11.

[a]Costs for area development were assumed to begin in 1975 with $5,204.00 in 1958 prices. This is approximately .02598% of target year expenditures.

service industries have been projected by multiplying the level of manufacturing outputs by .74, the service industry multiplier. The projected increase in the values of industrial output, in terms of shipments in 1960 prices, by manufacturing sectors are shown in Table 17.

The officially stated objective of this project is to assist the growth potential of the area and not just to support idle labor on a short-term basis. This project aimed for explicitly larger long-term gains to the whole economy through economic development rather than for short-term gains from the direct output of the project. Therefore, questions concerning the ability of the water resource investments in this area to stimulate long-term economic development are most crucial for the justification of the project. The expected economic expansion induced by the water resource investments as presented in the original study is an estimate and does not accurately reflect actual future conditions. There is no precise and accurate method to predict the outcome of economic expansion from any investment. Judgments in this regard have depended chiefly on nonprecise locational analysis.[5] This is perhaps the weakest link in any study such as the ULP, where the primary objective is dependent on the potential of the project to stimulate future economic expansion.

The main purpose of this present study is to demonstrate an improved methodology to measure EGB resulting from water resource investments rather than to develop a location study. In order to keep the present study within manageable limits, therefore, the original industrial lo-

[5]For further discussion of location theory and comparative cost studies see Walter Isard, Location and Space Economy (New York: MIT John Wiley and Sons, 1956) and Method of Regional Analysis: An Introduction to Regional Science (New York: MIT John Wiley and Sons, 1960).

TABLE 17

POTENTIAL SHARE OF INCREMENTAL
INCREASES IN MANUFACTURING
OUTPUT SALYERSVILLE-ROYALTON AREA

Units: $1,000 1960 prices

SIC number	1980	1990	2000	2010	2020
24-25	$ 1,900	$ 4,800	$ 9,230	$ 15,470	$ 20,760
33	70	180	350	650	1,210
34	650	1,730	4,110	7,730	11,700
35-36	2,890	10,990	23,850	57,300	104,500
37 except 371	--	90	230	1,820	3,730
371	--	--	--	--	--
19,32,38,39	480	1,200	3,400	6,700	11,920
20	5,910	14,800	31,020	54,340	89,210
22	--	10	30	40	70
23	2,860	7.200	13.270	20.390	29,840
27	190	450	1,190	2,300	4,250
28	190	480	920	1,540	2,500
26	50	120	230	390	630
29	--	--	--	--	--
30	310	1,250	2,690	4,860	8,860
21, 31	570	2,270	6,120	11,910	20,090
Total Amount	$16,070	$45,570	$96,640	$185,440	$309,270

Source: Spindletop Research Center, Expansion Benefits Analysis for the Salyersville-Royalton Area Pilot Project, Report 222, prepared for the Office of Appalachian Studies, U.S. Army Corps of Engineers, Table 58, pp. 139.

cation studies and the impact studies of the project investments on the economic development in the project area have been adopted as given in the original report.

The Model Used to Estimate Sectoral Demand

Sources and Types of Demand

Sources of demand for the primary factors of production attributable to water resource investments may be:

(1) direct investment expenditures for such things as construction and O & M of the project and their multiplier effect,

(2) the increase in economic activities induced by the inter-industry demand and increase in income, and

(3) increased investment expenditures induced by the initial investment-economic expansion or area development effects.

Inputs demanded by water resource investments, like any other expenditures, generate sectoral demand through several rounds of inter-industry transactions within the national economy.

To estimate demand for the primary factors of production (labor and capital) resulting from the investments, therefore, it is necessary to trace each dollar of expenditure from the original or induced investments as it passes through several rounds of transactions until it culminates in payments for the use of some primary factors of production. To trace the impacts of each investment expenditure on various sectors of the economy an input-output analysis will be used. Through an input-output analysis, transactions among industries to deliver inputs required for the investment will be estimated. These outputs, then, will be disaggregated into the contribution of the primary factors of production by industry occupation and area, as data permit. For this purpose, a model to estimate the level of outputs and factors of production by major industry, occupation and Appalachian Regions will be constructed, which incorporates the existing Appalachian Input-Output Model.

The Appalachian Input-Output Model

The basic characteristics of the existing input-output model for the Appalachian Region "An Input-Output Model of Appalachia" are those of a Leontief model.[6] It is an interregional model which consists of three internal regions (Region 1, 2 & 3). Each internal region has a technical coefficient matrix, a matrix of 84 X 84, 84th sector being the

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[6]For a detailed discussion of the characteristics and assumptions of the Leontief model, see Wassily W. Leontief, The Structure of the American Economy, 1919-1939 (2nd Ed. enlarged; New York: Oxford University Press, 1951); and Wassily Leontief et al., Studies in the Structure of the American Economy (New York: Oxford University Press, 1953). "In this model the primary impact of a final expenditure is that which arises from the direct production sequence set into motion by the expenditure. The model is constrained by four assumptions: (1) All producers increase their output by an amount equal to the additional demand which the autonomous final demand levies on them (no inventory depletion). (2) All producers increase their demands on other producers and factor suppliers by an amount that is just sufficient to meet their output demands -- which are defined by a set of technical coefficients describing the marginal relationships between inputs and outputs for each sector. (3) The demands which producers levy on other producers are for current inputs only and are not for either increases in capacity or the replacement of plant and equipment worn out in the process of production. (4) There are no lags in the sequence of generated demands and output responces. While the marginal relationships determine the impact of an expenditure on the economy, the coefficients employed are average input-output coefficients." Quoted from the footnote, Haveman and Krutilla, op. cit., pp. 15-16. In order to use interregional input-output analysis, further heroic assumptions should be added. For further discussion see Charles M. Tiebout, "Regional and Interregional Input-Output Models: An Appraisal", Southern Economic Journal, (Vol. 24, Oct., 1957), and William H. Miernyk, The Elements of Input-Output Analysis (New York: Random House, 1967) Chap. 4.

sum of 1 ~ 82 sectors. Therefore, the technical coefficients for this model consists of a 252 X 252 matrix. These coefficients were built up from interregional input-output coefficients modified from the 1958 national coefficients based on the 1963 Census of Transportation.[7] This is a closed input-output model in which a household sector (th 83rd) was built into the technical coefficient matrix.[8] The closed model was designed to estimate total economic impacts -- direct, indirect and induced effects -- of investment expenditures on a region's output. The multiplier arrived at by inverting the technical coefficient matrix of a closed input-output system is called the Type II Multiplier, which takes into account the direct, indirect and induced changes in income resulting from an increase of one dollar in the output of all industries in the processing sectors. With this input-output model the gross output required, by industry sector and by subregion within Appalachia,

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[7]This input-output model is built up from 1958 national input-output coefficients and estimates of interregional trade. To estimate the interregional movement of goods and services, interregional shipments of each manufacturing sector terminating in Appalachia and the proportions of these shipments originating in each subregion of Appalachia and in the rest of the U.S. were estimated. A survey was utilized to determine the same ratio for the supplies of mineral and agricultural products, services and trade within Appalachia. The 1958 national input-output coefficients were disaggregated into three Appalachian regions weighted by their share of productivity and their proportion of national products in the Appalachian Region in 1963. See for detailed methodology: Research Development Corporation, An Input-Output Model of Appalachia, prepared for Office of Appalachian Studies, U.S. Army Corps of Engineers (Washington: 1968).

[8]To close the input-output model the local household sector was brought into the coefficient matrix by both row and column. The entries in the row will show what proportion of each sector's output will accrue, as income, to households within the region. This will be equal to that proportion of value added which represents payments received as factor incomes by persons living within the region. The column indicates propensity to consume each output from the household sector. See for further discussion, Miernyk, op. cit., Chap. 3, and for detailed estimate for row and column of household sector, Research Development Corporation, op. cit.

given the final demand imposed on Appalachia and its subregions, resulting from water resource investments can be estimated.

This input-output model, with constant technical coefficients, is a static model, in which substitution of factors, entry of new industries and changes in price level and technology are not considered. Therefore, this model is essentially valid for a short-term analysis and not suitable for a long-term dynamic analysis. Having recognized some short-comings in a long-term estimate, however, this model will be utilized for measuring the impact of O & M and induced investment impacts subsequent to project construction and over the period of economic life of the project.

Final Demand Used for the Appalachian Input-Output Model

In order to use the input-output model, it is necessary to develop an appropriate final demand vector. To measure comprehensively the impacts of water resource investments and distinguish their sources, three sets of final demand vectors will be constructed. These are demand vectors for construction, O & M of the project and for induced investments from the original investments. The final demand vector for the input-output analysis should contain the essential economic description of the exogenous event whose effect can be calculated through the use of the input-output model. In the model of Appalachia, final demand can be thought of as export from Appalachia, federal government expenditures to Appalachia and gross private fixed capital formation.

To develop regional final demand for the Appalachian model a national final demand vector should be developed. Patterns of final demand for national input-output analysis (national final demand), for 12 different water project construction expenditures, by 82 industry sectors are available from the Haveman & Krutilla Study.[9] This has been further supplemented for the closed input-output model by the Research Development Corporation.[10] The distribution pattern per $1,000 of water project construction cost for the closed national input-output analysis by 84 industry sectors, 83rd sector being household income and 84th sector is the sum of 1-82nd sectors, is shown in Appendix A.

Due to the regional dependence on goods and services from other regions, a portion of the demand for inputs in Appalachian regions will necessarily be met by imports from outside regions. Therefore, the final demand vector for the interregional input-out model of Appalachia (252 X 1) will be some portion of the national final demand vector and will be distributed over the three Appalachian regions. Due to differences in resource distribution patterns and production functions among subregions, the value of the regional final demand vector is expected to vary depending on the project region to be selected. The percentage distribution of the value of products and/or services of each

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[9]Haveman & Krutilla, op. cit., pp. 18-20 & Appendix 2.

[10]Research Development Corporation, op. cit., V-9-11 & Appendix C. The only difference between Haveman & Krutilla and the Research Development Corporation study is that Research Development Corporation covers 11 types of projects and allocates the remaining project construction cost after deducting costs required for goods and services to households, the 83rd sector. The distribution pattern of cost for the missing project type, powerhouse construction, was added by allocating the remaining value after deducting the sum of 1-82 sectors from $1,000, in the Haveman Study, to the 83rd sector. The values assigned to the 83rd sector were assumed to be primarily wage payments to on-site labor in this case. This is rather an over-statement, because some funds will be reserved for overhead costs and contingencies. For further discussion, see U.S. Department of Labor, B.L.S., Labor and Material Requirements for Civil Works Construction by the Corps of Engineers, Bulletin No. 1390 (Washington: 1964) and Haveman & Krutilla, op. cit., pp. 18-20 & Appendix 2.

industry sector imposed on Appalachia, according to region of origin, by region of destination has also been developed by the Research Development Corporation.[11] This ratio was rearranged in Appendix B (hereafter called regional demand coefficients) so that national final demand could be separated into final demand in Appalachia, by region, and outside of Appalachia. The regional final demand vector for construction will be derived by multiplying the national final demand in terms of federally financed construction costs, for a given type of project, by the set of regional demand coefficients relevant to the project region.

The distribution of annual O & M funds for different types of water resource investment is not available at this time. Based on the experience of the Corps of Engineers,[12] however, it is estimated that cost distribution between on-site and off-site demand is 70 and 30 percent respectively, but distribution patterns of costs by occupation and industry sector are similar to those of construction costs. Therefore, final demand arising from annual O & M expenditures will be constructed by applying this ratio to the regional demand vector for the particular type of project construction.

The final demand for induced investment generated by the original investment (economic expansion) can not be generalized, due to the variability associated with the different types and locations of water project to be selected. Either expected increases in induced investments, or resulting increases in export capacity (values) outside of Appalachia, by 83 industry sectors, can be used for the input-

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[11] Ibid., Appendix B.

[12] Information was provided by the Water Resource Institute, Army Corps of Engineers, Alexandria, Virginia.

output model. In this study, the later method will be used. Industry sectors by SIC Code for this study model have been shown in Table 14. Export capacity will increase gradually, if at all, over the period of analysis. To determine total export impact on industrial output over the relevant period, however, only one final demand vector for the year 2020 will be constructed. The demand for industrial output and the factors of production for the entire period will be determined by interpolating a growth trend.

Measurement of Industrial Output

Once the demand vector is determined, the estimation of gross industrial output, given a final demand vector, will become merely a matter of arithmetic. It will be the product of FD x A^{-1}, where FD and A^{-1} represent a final demand vector and the inverse of the technical coefficient matrix respectively. However, the final demand vector for O & M expenditures is only one segment of annual expenditure during the entire period of analysis. Therefore, the total gross outputs from the total O & M expenditures should be the sum of annual gross outputs induced by the annual O & M throughout the period of analysis. Likewise, gross output induced by the increase in export capacity will be measured as the sum of gross output induced by each increment of increased export capacity, by decade, during the period of analysis.

Model Used to Estimate Demand for Factors of Production

(1) Off-site demands, unallocated costs, and on-site demand by major occupation.

A water resource investment may generate demand for direct labor inputs (on-site demand) and material inputs (off-side demand) such as equipment, material and transportation services for the construction and O & M of the project. A certain portion of investment expenditures may be temporarily held during the initial phase of project investment for contingencies, as unallocated costs. The proportion of on-site demand, off-site demand and unallocated costs associated with 12 different types of water project construction costs are shown in Table 18. This table is derived from the study of 47 water resource investment projects by the Labor Department and adjusted by Haveman & Krutilla.[13] Demand for on-site labor by occupation will also be estimated by applying the information in Table 18. On-site demand is limited to labor factors, while all capital factors and labor other than on-site demand are obtained through the off-site demand estimate.

(2) Off-site demand for labor and capital

Demand for the factors of production induced by off-site demand and income received by the Appalachian Region attributable to entire project costs will be estimated from the gross output generated through the Appalachian Input-Output Model. Factors of production demanded to generate gross output in this model will be called off-site demand for the factors of production.

In order to estimate the off-site demand for the primary factors of production, gross industrial output resulting from water resource investments will be converted into total value added[14] and to its principal components: (1) employee compensation, (2) proprietor and rental income, (3) net interest payments, (4) capital consump-

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[13]See footnote 10 in this chapter

[14]Since the value of gross output is the sum of the total values of goods and services counted during all transactions made by each industry in producing final demand, it includes considerable double counting. To determine the value added portion of the gross output, the elements of double counting should be eliminated.

TABLE 18

DISTRIBUTION OF ON-SITE DEMAND[a] BY OCCUPATION, OFF-SITE DEMAND[a] AND UNALLOCATED COSTS[b] BY TYPE OF WATER PROJECT
(Per $1,000 Project Construction Cost)

Unit: 1958 dollars

	Lg. Earth Fill Dams	Sm. Earth Fill Dams	Loc. Flood Protection	Pile Dikes	Levees Constr.	Revet-ment	Power-house	Medium Conc.Dam	Lock & Conc.Dam	Lg. Mult. Pur. Pro.	Dredging	Misc. Proj.
Professional, Technical and kindred workers	27	19	22	32	38	10	19	41	20	47	99	27
Managers, officials and proprietors, except farmers	6	4	4	6	8	2	3	8	4	10	20	6
Clerical and kindred workers	4	3	3	4	5	1	3	6	3	6	13	4
Sales Workers	0	0	0	0	0	0	0	0	0	0	0	0
Craftsmen, foremen and kindred workers	157	202	214	137	170	37	108	176	155	253	56	132
Operatives and kindred workers	79	51	63	84	105	35	27	60	47	28	131	78
Service Workers	0	0	0	0	0	0	0	0	0	0	8	0
Laborers, except farm and mine	40	40	72	35	36	44	18	68	32	72	39	32
Farmers and farm laborers	0	0	0	0	0	0	0	0	0	0	0	0
Total on-site labor cost (On-site demand)	312	320	379	298	362	127	178	356	260	416	365	278
Off-site demand	467	397	502	543	409	740	811	535	723	514	453	597
Unallocated Cost	155	77	119	159	229	133	11	109	17	70	182	125

Source: Robert H. Haveman and John V. Krutilla, Unemployment, Idle Capacity and the Evaluation of Public Expenditures: National and Regional Analysis (Baltimore: Johns Hopkins Press, 1968), Table 6, pp. 20-21. In the original table, Professional and Technical, Managerial and Clerical workers are combined. In this table, however, these occupations are shown separately by applying 75, 15, and 10%, respectively, to original group total.

[a]On-site demand is the cost for labor on the project Construction site, while off-site demand is the cost for goods and services.

[b]Unallocated cost includes profit margin, overhead cost and contingency funds.

tion allowances, (5) corporate profits and (6) indirect business taxes. Total value added is the sum of the values contributed by the primary factors of production in generating the gross output required to satisfy a given final demand.

To derive total value added and its principal components by industry from gross output, two sets of data are required: (1) The proportion of total value added to the value of gross output and (2) the percentage share of each principal component within total value added by each industry sector.[15] These two sets of data are shown in Appendix C. The product of the multiplication of these two sets of data by gross output will yield the proportion of gross output accounted for by each component of value added in producing gross output by industry.

Each value added component represents the contribution of a specific factor of production or combination of factors of production.[16] Employee compensation represents a major portion of the labor contribution. Net interest; corporate profits and capital consumption allowances are capital contributions. Proprietor and rental income may be the contribution by labor, capital and land. Indirect business taxes are considered to be one source of the government contribution which is

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[15]The data for the proportion of total value added to gross output are used from 1958 national input-output analysis. See U.S. Department of Commerce, Office of Business Economis, "The Transactions Table of the 1958 Input-Output Study and Revised Direct and Total Requirements Data," Survey of Current Business, Vol. 45, September 1965, pp. 40-44. The date for the percentage distribution of each value added component within total value added by industry are used those amounts applicable to 1968 gross output from unpublished data provided by the Department of Commerce.

[16]Since the value added components are grouped for the convenience of national income accounting purposes, each of the components does not accurately identify the contribution of a specific factor of production. For a detailed procedure of national income tabulation see Nancy Ruggles: National Income Accounts and Income Analysis (New York: McGraw Hill, 1956) pp. 125-26.

necessary to produce output of society by hiring various factors of production, labor and capital. This study took the following positions: (1) Net interest payments, corporate profits and capital consumption allowances represent demand for capital, (2) employee compensation and proprietor and rental income represent demand for labor[17] and (3) indirect business taxes represent demand for mixed labor and capital.

By applying the ratio of value added components by industry sector to industrial output estimated through the Appalachian Input-Output Model, demand for labor, capital and mixed factors by industry and subregion of Appalachia can be estimated.

(3) Off-site labor demand by occupation

Estimation of off-site labor demand by major occupation and type of industry requires that the proportion of demand for each occupation to the value added by labor factor and wage rate by industry sector be known. Since no such data are available at this moment, demand for a number of major occupations will be estimated directly by multiplying gross output by man-year labor and occupational coefficients by industry sector. Demand for wage bill by major occupation will be estimated by multiplying estimated number of occupation required by annual occupational wage rate. Direct labor requirements per billion

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[17]This position was taken for practical reasons. In our estimates of the wage rate by major occupation, we adopted "Mean Money Earning" (from Census Bureau) which is the average mean earning by wage and salary workers and self-employed workers to which the proprietor and rental income belong.

dollars of output by industry based on the 1970 employment projection[18] and occupational coefficients by industry in the 1975 projection[19] are used for this model. Coefficients for both labor and occupational demand by industry are shown in Appendix D. The U.S. Mean Earnings[20] by each major occupation for all U.S. industries from the Census Bureau will be substituted for the wage rate of each major occupation. This rate is shown in Appendix E.

The sum of wages for off-site labor by occupation should theoretically be equal to the labor share derived through the value added approach. In practice, however, labor shares calculated through the two different approaches can hardly be the same, because statistics used in the two approaches are different sets, except for gross output by industry, and their use results in significant variations. There-

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[18]Unpublished data from Bureau of Labor Statistics, Department of Labor. Data for total Direct and Indirect Employment Coefficient Per Billion Dollars Delivery to Final Demand is also available. Since the use of the closed input-output model requires more than direct and indirect impact, the direct labor coefficient was used instead of the direct and indirect coefficient. Although the input-output table is basically the 1958 model, we have used the 1970 labor coefficient to show change in labor productivity since 1958.

[19]U.S. Department of Labor, B.L.S. Occupational Employment Patterns for 1960 and 1975, Bulletin No. 1599, Dec., 1968. Coefficients of Occupation, used in the 1975 projection are selected for this study.

[20]U.S. Department of Commerce, Bureau of Census, Consumer Income: Income in 1968 of Families and Persons in the United States, Series P-60, No. 66, Dec., 1969., and Consumer Income: Income Growth Rates in 1939 to 1968 for Persons by Occupation and Industry Groups, for the United States, Series P-60, No. 69, Apr., 1970 and unpublished reports from the same office. "Mean Earnings" are derived by averaging the algebraic sum of money income by full time wage and salaried and self-employed workers (farm and nonfarm). The original table separated male and female and did not include the average wage rate of total workers. In order to get average wage of total workers, average wages of male and female were multiplied by the relative share of each sex in the total number of workers as a first step. The weighted sum of the average wage rate of male and female, then, becomes the average wage rate of each occupation.

fore, the wage bill estimate will be so adjusted that the total wage bill estimate will be equal to the total value added by labor.

(4) Total demand for the factors of production

Total demand for the factors of production is the sum from both on-site and off-site sources. Unallocated costs also impose demand for either labor or capital directly or indirectly, as the investment plan develops. In order to count the impact of unallocated costs on resource demand at the planning stage, it is assumed that unallocated costs represent demand for mixed factors of production, as in the case of indirect business taxes, and these will be imposed on the entire Appalachian Region. Therefore, total demand for the factors of production from a given category of investment expenditures should be the sum of on-site and off-site demand for the factors of production as well as unallocated costs, if there are any.

Estimate of Industrial Demand

Detailed information concerning the likely investment impact on demand for resources, by type, industry and subregion of Appalachia, is very important to a policy maker. In this section, the characteristics of final demand for use in input-output analysis and industrial demand resulting from the final demand imposed on the Appalachian economy will be investigated before a determination is made of demand for the factors of production. To determine long-term demand for the factors of production, the investment impact of the ULP on resources will be classified into three categories: (1) from construction expenditures, (2) from annual O & M expenditures and (3) from economic expansion in terms of the increase in export values. For the purpose of comparison, the economic impact of three different expenditure categories on final demand and industrial output within Appalachia will be estimated and presented in that order.

Estimate of final demand

(1) From the construction expenditures

The $32,770,739 amount which is the federally financed portion of project costs, at 1958 prices was used as final demand from the construction of the ULP. The components are classified as follows, four reservoir projects ($26,661,972) as small earth fill dams, channel improvements ($4,918,623) as local flood protection, and accelerated land treatment measures ($1,126,761) as miscellaneous water resource investments.

The estimated on-site and off-site demand and unallocated costs per $1,000 construction costs are $325, $592, and $83 respectively. Estimated final demand for the input-output analysis per $1,000 project construction costs, by the nation and subregion of Appalachia, and by industry sector are shown in Table 19. Out of each $1,000 project cost, $636 is Appalachian demand, and $364 is leakage outside of Appalachia. Most of the Appalachian demand, $602, is expected to be imposed on Region 2, the project region. Only $34 will be imposed on Regions 1 & 3 combined.

Distribution of off-site demand by sector reveals some general characteristics. Out of total demand, construction equipment ($131), trade ($112), motor vehicles and equipment ($68), petroleum ($53), structural metal ($36) and transportation ($32) account for almost 90 percent of total off-side demand. Demand for almost all equipment, metal products, and about 60 percent of the petroleum and chemicals will be from outside of Appalachia, while almost all trade and service functions are provided by Appalachia.

TABLE 19

FINAL DEMAND FOR INPUTS TO CONSTRUCT THE UPPER LICKING PROJECT BY REGION AND INDUSTRY

(Per $1,000 Project Cost)

Unit: 1958 dollars

Sect. No.	Nation (Total)	Region 1	Region 2	Region 3	Appalachia	Sect. No.	Nation (Total)	Region 1	Region 2	Region 3	Appalachia
1	0	0	0	0	0	43	0	0	0	0	0
2	0	0	0	0	0	44	5	0	0	0	0
3	0	0	0	0	0	45	131	5	2	1	7
4	0	0	0	0	0	46	2	0	0	0	0
5	0	0	0	0	0	47	0	0	0	0	0
6	0	0	0	0	0	48	0	0	0	0	0
7	0	0	0	0	0	49	9	1	0	0	1
8	0	0	0	0	0	50	1	0	0	0	0
9	26	0	24	0	24	51	0	0	0	0	0
10	0	0	0	0	0	52	0	0	0	0	0
11	0	0	0	0	0	53	1	0	0	0	0
12	0	0	0	0	0	54	0	0	0	0	0
13	0	0	0	0	0	55	1	0	0	0	0
14	0	0	0	0	0	56	0	0	0	0	0
15	0	0	0	0	0	57	0	0	0	0	0
16	0	0	0	0	0	58	0	0	0	0	0
17	0	0	0	0	0	59	68	4	4	0	8
18	0	0	0	0	0	60	0	0	0	0	0
19	0	0	0	0	0	61	0	0	0	0	0
20	7	0	0	1	2	62	0	0	0	0	0
21	0	0	0	0	0	63	0	0	0	0	0
22	0	0	0	0	0	64	0	0	0	0	0
23	0	0	0	0	0	65	32	0	8	0	9
24	0	0	0	0	0	66	2	0	2	0	2
25	0	0	0	0	0	67	0	0	0	0	0
26	0	0	0	0	0	68	3	0	3	0	3
27	42	3	16	2	20	69	112	0	108	0	108
28	0	0	0	0	0	70	8	0	2	0	2
29	0	0	0	0	0	71	4	0	3	0	3
30	0	0	0	0	0	72	0	0	0	0	0
31	53	3	6	1	10	73	0	0	0	0	0
32	8	0	0	0	1	74	0	0	0	0	0
33	0	0	0	0	0	75	5	0	5	0	5
34	0	0	0	0	0	76	0	0	0	0	0
35	0	0	0	0	0	77	1	0	1	0	1
36	18	2	7	1	10	78	0	0	0	0	0
37	5	1	1	0	2	79	0	0	0	0	0
38	0	0	0	0	0	80	0	0	0	0	0
39	0	0	0	0	0	81	4	0	4	0	4
40	36	4	2	3	8	82	0	0	0	0	0
41	0	0	0	0	0	83	408	0	402	0	402
42	6	0	0	0	1	84[a]	1,000	25	602	9	636

Note: [a]Sum of Sectors 1-83. Colums and rows may not add because of rounding.

(2) From annual O & M expenditures

Federally financed annual costs for O & M of the water plan are limited to the Royalton Reservoir. Annual costs are estimated to be $46,857 at 1958 prices, of which $32,800 ($700 per $1,000 O & M expenditure) is for on-site demand and $14,057 ($300 per $1,000 O & M expenditure) is for off-site demand. There is no provision for unallocated costs.

The distribution patterns of on-site and off-site demand by occupation and industry sector are assumed to be the same as the distribution patterns in the case of construction expenditures.[21] Table 20 shows the distribution of final demand per $1,000 O & M expenditures by industry sector. Due to the larger proportion of on-site demand, however, $806 out of $1,000 O & M costs will be retained in the Appalachian Region as compared to $636 in the case of construction expenditures. The pattern of distribution among industry sectors is generally the same as in the case of construction expenditures.

(3) From the increase in export values outside of Applachia

The importance in estimating potential area development resulting from the ULP has already been emphasized. It has also been mentioned that the original estimate of projected area development would be utilized in this study to demonstrate a methodology to estimate long-term demand for resources imposed on Appalachia. According to the original study the ULP is expected to induce $256,600,000 (1969 prices) in investment, 95.7 percent of which is expected from private investments, while manufacturing output would eventually reach a total of $309,270,000 (1960 prices) in the Salyersville-Royalton Area, around

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[21]See footnote 12 in this chapter

TABLE 20

FINAL DEMAND FOR ANNUAL INPUTS TO O & M OF THE UPPER LICKING PROJECT BY REGION AND INDUSTRY

(Per $1,000 O & M Cost)

Unit: 1958 dollars

Sect. No.	Nation	Region 1	Region 2	Region 3	Appalachia	Sect. No.	Nation	Region 1	Region 2	Region 3	Appalachia
1	0	0	0	0	0	43	0	0	0	0	0
2	0	0	0	0	0	44	0	0	0	0	0
3	0	0	0	0	0	45	75	3	1	0	4
4	0	0	0	0	0	46	1	0	0	0	0
5	0	0	0	0	0	47	0	0	0	0	0
6	0	0	0	0	0	48	0	0	0	0	0
7	0	0	0	0	0	49	5	1	0	0	1
8	0	0	0	0	0	50	0	0	0	0	0
9	12	0	11	0	11	51	0	0	0	0	0
10	0	0	0	0	0	52	0	0	0	0	0
11	0	0	0	0	0	53	0	0	0	0	0
12	0	0	0	0	0	54	0	0	0	0	0
13	0	0	0	0	0	55	0	0	0	0	0
14	0	0	0	0	0	56	0	0	0	0	0
15	0	0	0	0	0	57	0	0	0	0	0
16	0	0	0	0	0	58	0	0	0	0	0
17	0	0	0	0	0	59	37	2	2	0	5
18	0	0	0	0	0	60	0	0	0	0	0
19	0	0	0	0	0	61	0	0	0	0	0
20	3	0	1	0	1	62	0	0	0	0	0
21	0	0	0	0	0	63	0	0	0	0	0
22	0	0	0	0	0	64	0	0	0	0	0
23	0	0	0	0	0	65	16	0	4	0	4
24	0	0	0	0	0	66	1	0	1	0	1
25	0	0	0	0	0	67	0	0	0	0	0
26	0	0	0	0	0	68	1	0	1	0	1
27	24	2	9	1	12	69	58	0	56	0	56
28	0	0	0	0	0	70	4	0	1	0	1
29	0	0	0	0	0	71	2	0	2	0	2
30	0	0	0	0	0	72	0	0	0	0	0
31	28	1	3	0	5	73	0	0	0	0	0
32	4	0	0	0	0	74	0	0	0	0	0
33	0	0	0	0	0	75	2	0	2	0	2
34	0	0	0	0	0	76	0	0	0	0	0
35	0	0	0	0	0	77	1	0	1	0	1
36	5	1	0	0	1	78	0	0	0	0	0
37	2	0	0	0	1	79	0	0	0	0	0
38	0	0	0	0	0	80	0	0	0	0	0
39	0	0	0	0	0	81	2	0	2	0	2
40	13	1	1	1	3	82	0	0	0	0	0
41	0	0	0	0	0	83	701	0	691	0	691
42	2	0	0	0	0	84[a]	1,000	12	790	4	806

Note: Columns and rows do not add because of rounding. [a]Sum of sectors 1-83.

the project site. To determine the increase in export values from the Appalachian Region, resulting from the increased manufacturing output induced by the ULP, the location quotient method[22] was utilized. For this purpose, the ratio of employment for each manufacturing industry to total manufacturing employment in the Upper Licking Area was correlated with corresponding employment ratios of the U.S. manufacturing industry. A positive ratio was considered surplus output of any one industry for Appalachian consumption,[23] and the magnitude of export was measured by multiplying industry output by its surplus ratio. Estimated export values by 2020, from Appalachia by two digit SIC Code at the 1958 price level, are shown in Table 21. Export values from Appalachia were estimated to be about 74 million dollars. Export items which exceed $5 million are: apparel ($22 million), electronic components ($10 million), engines and turbines ($7 million), metal working-machinery ($7 million) and general industrial machines and equipment ($6 million). The detailed method for arriving at export values from total manufacturing output is shown in Appendix F. Since all export values are distributed among industry sectors, no on-site demand was allocated.

Estimate of Gross Industrial Output

(1) From the construction expenditures

Gross industrial output expected to be generated by the ULP,

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[22]For further discussion of the various location quotient analysis see, Walter Isard, Methods of Regional Analysis: An Introduction to Regional Science (New York: MIT Press John Wiley & Sons Inc., 1960), Chap. 7.

[23]Surplus production in an area does not necessarily mean there is no import of the same product from other areas, nor that all surplus will be exported. For simplicity, here, all surplus is assumed to be exported. In this study the relative employment ratio of each manufacturing industry to total manufacturing employment in the Upper Licking Area was implicitly assumed to be approximately equal to that ratio in the Appalachian Region.

TABLE 21

INCREASED EXPORT CAPACITY BY 2020 RESULTING FROM THE UPPER LICKING PROJECT BY REGION AND INDUSTRY

Unit: 1958 dollars

Sect. No.	Region 1	Region 2	Region 3	Appalachia (All)
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	3,433,498	0	3,433,498
16	0	0	0	0
17	0	0	0	0
18	0	22,102,267	0	22,102,267
19	0	0	0	0
20	0	5,450,267	0	5,450,267
21	0	0	0	0
22	0	0	0	0
23	0	3,449,881	0	0
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	2,091,933	0	2,091,933
35	0	0	0	0
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
42	0	0	0	0

Sect. No.	Region 1	Region 2	Region 3	Appalachia (All)
43	0	7,218,641	0	7,218,641
44	0	0	0	0
45	0	0	0	0
46	0	0	0	0
47	0	7,196,975	0	7,196,975
48	0	0	0	0
49	0	6,344,106	0	6,344,106
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	0	1,122,209	0	1,122,209
55	0	2,492,878	0	2,492,878
56	0	0	0	0
57	0	10,461,106	0	10,461,106
58	0	2,953,856	0	2,953,856
59	0	0	0	0
60	0	0	0	0
61	0	0	0	0
62	0	0	0	0
63	0	0	0	0
64	0	0	0	0
65	0	0	0	0
66	0	0	0	0
67	0	0	0	0
68	0	0	0	0
69	0	0	0	0
70	0	0	0	0
71	0	0	0	0
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	0	0	0	0
77	0	0	0	0
78	0	0	0	0
79	0	0	0	0
80	0	0	0	0
81	0	0	0	0
82	0	0	0	0
83	0	0	0	0
84[a]	0	74,317,617	0	0

Note: Export capacity of Region 2 is meant by export to outside of Appalachia, so that it becomes export capacity of Appalachia. Increase in export capacity becomes the final demand vector for the input-output analysis.

[a]Sum of sectors 1-82.

given three different types of final demand categories, is shown in Appendix G. The same material aggregated into 19 major industrial sectors by subregion of Appalachia is shown in Table 22. Table 22 reveals that for each $1,000 of project construction expenditures, $931 gross output within Appalachia is required. Of this, 84 percent ($782) is generated within the project region and 16 percent ($149) is in the remaining regions. Two sectors, service ($416) and trade ($269), together account for 74 percent of total output and 92 percent of these are concentrated in the project region. About 10 percent ($99) of outputs fall on the non-durable goods industry, of which 50 percent are produced in the project region, 30 percent in Region 3 and 20 percent in Region 1. Only 7.5 percent ($70) of outputs are durable goods, of which 37 percent are produced in the project region, 4 percent in Region 1 and 17 percent in Region 3.

(2) From annual O & M expenditures

Expected gross industrial output generated from annual O & M expenditures is shown in Table 23. Table 23 shown that $1,058 gross output is expected per $1,000 of O & M expenditures of which $835 (79 percent) is from trade and service sectors. The sectoral and regional distributions of gross output is quite similar to that of construction. Total gross output requirements resulting from all O & M expenditures should be the sum of the entire annual gross output over the effective life period of the project (1974-2020).

(3) From the increase in export capacity

Table 24 shows gross output generated by each $1,000 increase in Appalachian export. In order to increase exports by $1,000, $1,737 of gross output must be generated. This is a higher gross output than either $931, in Construction or $1,058 in O & M. The larger gross

TABLE 22

INDUSTRIAL DEMAND RESULTING FROM THE CONSTRUCTION OF THE UPPER LICKING PROJECT BY REGION AND MAJOR INDUSTRY
(Per $1,000 Project Cost)

Unit: 1958 dollars

INDUSTRY & INPUT-OUTPUT STUDY SECTORS	Region 1	Region 2	Region 3	All Appalachia
Agriculture, forestry & fisheries, 1-4	1	7	2	10 (1.1)
Mining, including crude petroleum, 5-10	2	29	0	31 (3.3)
Construction, 12	2	19	0	21 (2.3)
Nondurable goods manufacturing, 14-19, 24-34	21	50	23	92 (9.9)
Foods, textile & apparel, 14-19	6	14	15	34 (3.7)
Other nondurable goods, 24-34	13	37	8	58 (6.2)
Durable goods manufacturing, 13, 20-23, 35-64	33	26	12	70 (7.5)
Lumber & wood products, 20-23	1	3	2	5 (.5)
Stone, clay & glass products, 35-36	4	9	2	15 (1.6)
Primary metals, 37-38	5	2	1	8 (.9)
Fabricated metals, 39-42	5	2	3	11 (1.2)
Nonelectrical machinery, 43-44, 46-52	3	0	1	3 (.3)
Construction machinery, 45	5	2	1	8 (.9)
Electrical machinery, 53-58	1	0	1	2 (.2)
Transportation equipment, 13, 59-61	8	7	1	16 (1.7)
Miscellaneous, 62-64	1	a	a	2 (.2)
Transportation & Warehousing, 65	3	18	a	21 (2.3)
Wholesale & Retail trade, 69	8	257	a	269 (28.9)
Service, 66-68, 70-82	31	376	a	416 (44.7)
Gross Output by all Industries	98 (10.5)	82 (84.2)	51 (5.5)	931 (100.0)

Note: Columns and rows may not add because of rounding.
a represents less than .5 dollars ( ) represents percentage

TABLE 23
ANNUAL INDUSTRIAL DEMAND RESULTING FROM THE O & M
OF THE UPPER LICKING PROJECT BY REGION AND MAJOR INDUSTRY
(Per $1,000 O & M Costs)

Unit: 1958 dollars

INDUSTRY & INPUT-OUTPUT STUDY SECTORS	Region 1	Region 2	Region 3	All Appalachia
Agriculture, forestry & fisheries, 1-4	1	10	3	14 (1.3)
Mining, including crude petroleum, 5-10	2	15	a	17 (1.6)
Construction, 12	2	25	1	28 (2.6)
Nondurable goods manufacturing, 14-19, 24-35	20	50	29	99 (9.4)
Foods, textile & apparel, 14-19	8	20	21	49 (4.6)
Other nondurable goods, 24-34	12	30	8	50 (4.7)
Durable goods manufacturing, 13, 20-23, 35-64	23	15	9	47 (4.4)
Lumber & wood products, 20-23	1	2	2	6 (.6)
Stone, clay & glass products, 35-36	2	2	1	5 (.5)
Primary metals, 37-38	3	1	1	5 (.5)
Fabricated metals, 39-42	3	1	2	6 (.6)
Nonelectrical machinery, 43-44, 46-52	2	a	a	2 (.2)
Construction machinery, 45	3	1	a	4 (.4)
Electrical machinery, 53-58	1	a	1	3 (.3)
Transportation equipment, 13, 59-61	7	6	1	14 (1.3)
Miscellaneous, 62-64	1	a	a	2 (.2)
Transportation & Warehousing, 65	2	16	a	19 (7.9)
Wholesale & Retail trade, 69	8	270	4	283 (26.7)
Service, 66-68, 70-82	35	506	10	552 (52.2)
Gross output by all industries	94 (8.9)	908 (85.8)	56 (5.3)	1058 (100.0)

Note: Columns and rows may not add because of rounding.

a = less than .5 dollars. ( ) represents percentage.

TABLE 24

INDUSTRIAL DEMAND IN 2020 INDUCED THROUGH INCREASED EXPORT CAPACITY RESULTING FROM THE UPPER LICKING PROJECT BY REGION AND MAJOR INDUSTRY

(Per $1,000 Export Capacity)

Unit: 1958 dollars

INDUSTRY & INPUT-OUTPUT STUDY SECTORS	Region 1	Region 2	Region 3	All Appalachia
Agriculture, forestry & fisheries, 1-4	1	19	4	23 (1.3)
Mining, including crude petroleum, 5-10	1	3	a	5 (.3)
Construction, 12	2	13	1	16 (.9)
Nondurable goods manufacturing, 14-19, 24-34	17	413	72	501 (28.8)
Foods, textile & apparel, 14-19	7	362	61	431 (24.8)
Other nondurable goods, 24-34	10	50	11	71 (4.1)
Durable goods manufacturing, 13, 20-23, 35-64	39	657	14	709 (4.08)
Lumber & Wood products, 20-23	1	126	4	131 (7.5)
Stone, clay & glass products, 35-36	3	5	1	9 (.5)
Primary metals, 37-38	15	12	4	32 (1.8)
Fabricated metals, 39-42	3	1	1	5 (.3)
Nonelectrical machinery, 43-44, 46-52	6	280	1	287 (16.5)
Construction machinery, 45	a	a	a	a b
Electrical machinery, 53-58	5	230	2	236 (13.6)
Transportation equipment, 13, 59-61	4	3	1	7 (.4)
Miscellaneous, 62-64	1	a	a	2 (.1)
Transportation & Warehousing, 65	2	10	a	13 (.7)
Wholesale & Retail trade, 69	8	133	9	150 (8.6)
Service, 66-68, 70-82	26	275	19	320 (18.4)
Gross output by all industries	95 (5.5)	1523 (87.7)	119 (6.9)	1737 (100.00)

Note: a = less than .5 dollars. b = less than .5 %.

Columns and rows may not add because of rounding.

output from each $1,000 export value compared to those from construction and O & M is not only attributable to an ability to retain larger regional final demand but also seems attributable to the greater inter-industry demand. The larger the impact of investments on inter-industry demand the larger is the stimulation to the local economy.

Since basic demand is related to export industry sectors rather than to increases in household income, the main impacts fall on durable ($709) and nondurable ($501) sectors. These two sectors account for almost 80 percent of total output. Almost 88 percent of total output is concentrated in the project region.

The total size of gross output expected from an increase in export capacity during the entire period depends on two factors: (1) Distribution, by type and level of export capacity, during the period between 1970-2020 and (2) the effects of agglomeration stimulus on industrial growth within the local economy.[24] According to the original location study, manufacturing industries should have increased at an annual 7.7 percent rate from 1980 to 2020. The same rate was assumed to apply for the increase in export capacity, and in related cummulative gross output between 1970 and 2020. This can be measured by extrapolating the gross output by each year starting 1970 with a 7.7 percent annual growth rate[25] until 2020. The output in 2020 has already

[24]The basic weakness of the input-output model used here is in the projection of future output resulting from O & M and induced investment. Although 1958 technical coefficients are adjusted to 1963 census levels, they may not adequately represent a current and future production function. Since the coefficients are static, substitution of factors of production, entry of new industries, and change in technology are precluded. Externalities which play a vital role in a developing economy, such as the agglomeration effect, are not reflected.

[25]Since each industry has a different growth rate, it is not adequate to use a uniform rate for all industries. However, to keep the problem simple, a uniform annual growth rate of 7.7 percent will be used. This percentage is derived from the average growth rate in the manufacturing shipment values from 1980 to 2020 in the original project report.

been estimated to be $129,080,202 as shown in Appendix F.

The main purpose of estimating gross output imposed on various final demand vectors in this study is to estimate the demand for primary factors of production induced by these final demand vectors. The gross output expected due to O & M and the increase in export capacity during the entire project life period will be estimated in terms of demand value for the factors of production in the next section.

Estimate of Demand for Factor of Production

Estimate of on-site labor demand

There is no on-site labor demand associated with export capacity. On-site demand in terms of wages and man-year labor requirements by occupation for project construction and O & M is shown in Table 25. Project construction was estimated to require 2012 man-year laborers and $10,649,076 wage bill. Annual O & M requires 7 man-year laborers and $32,800 in annual wages. Demand for wages by occupation is derived by applying Table 18. The number of job opportunities is derived by dividing the wage bill for each occupation by the corresponding wage rate. The distribution pattern of demand for labor by occupation reflects a heavy concentration of blue-collar workers, 93 percent for construction and 100 percent for O & M. Distribution of demand for blue-collar workers for project construction is: 62 percent for craftsmen, foremen and kindred workers and 18 percent for operatives and kindred workers, but only 13 percent for unskilled labor which tends to be the most significant category of unemployed labor in any depressed area.

Estimate of off-site factor demand

Table 26 summarizes the national and regional final demand, gross output and value added components to maintain the gross output

TABLE 25

ON-SITE DEMAND FOR LABOR AND WAGE BILL BY OCCUPATION RESULTING FROM PROJECT CONSTRUCTION AND ANNUAL O & M

Unit: Labor - Man-Year
Wage - 1958 dollars

	Construction	Annual O & M
Professional, Technical and kindred workers	84	0
	$ 642,150	0
Managers, officials and proprietors, except farmers	14	0
	$ 133,083	0
Clerical and kindred workers	27	0
	$ 99,249	0
Sales Workers	0	0
	0	0
Craftsmen, foremen and kindred workers	1,033	2
	$ 6,574,911	$10,777
Operatives and kindred workers	392	3
	$ 1,745,285	$15,463
Service Workers	0	0
	0	0
Laborers, except farm and mine	462	2
	$ 1,424,050	$ 6,560
Farmers and farm laborers	0	0
	0	0
All Occupations	2,012	7
	$10,649,076	$32,800

Note: Columns may not add because of rounding. Upper row in each occupation shows demand for labor and bottom row shows demand for wage bill. Annual O & M wage distribution was based on that 23%, 33% and 14% per $1,000 O & M expenditures go to craftsmen, operatives and non-farm laborers respectively.

TABLE 26

NATIONAL & REGIONAL FINAL DEMAND GROSS OUTPUT AND VALUE ADDED COMPONENTS DEMAND BY EXPENDITURE CATEGORY

Unit: 1958 dollars

		Construction	Annual O & M	Export in 2020
1.	National final demand	32,770,739	46,857	
2.	Regional final demand	20,849,169	37,767	74,317,617
3.	Gross output	30,515,510	49,591	129,080,202
4.	Employee compensation	8,588,171	13,562	37,966,372
5.	Proprietor and rental income	2,593,422	4,851	4,673,986
6.	Corporate profit	1,690,154	2,548	7,094,512
7.	Net interest	1,043,149	1,996	2,167,199
8.	Capital consumption allowances	1,746,310	2,916	4,473,090
9.	Indirect business tax	2,494,314	4,168	5,194,818
10.	Total value added	18,155,520	30,040	61,569,923
11.	Labor share (4+5)	11,181,593	18,413	42,640,358
12.	Capital share (6+7+8)	4,479,613	7,459	13,734,747

within Appalachia due to project construction, annual O & M expenditures and the increase in associated export capacity in the Appalachian Region. Value added components are values paid out to the primary factors of production, in generating gross output to yield a final demand, which is off-site demand for the factors of production. Total value added is estimated to be: $18,155,520 for project construction, $30,040 for annual O & M and $61,569,923 for the increase in export capacity.

The values of demand for labor for the three expenditures are $11,181,593, $18,413 and $42,640,358 respectively. Demands for capital are $4,479,613, $7,459 and $13,734,747. Indirect business taxes which represent demand for mixed factors of labor and capital are $2,494,314, $4,168 and $5,194,818 respectively. Value added components generated per $1,000 project cost and export capacity are shown in Table 27. Total off-site demand for the factors of production from each $1,000 of construction cost is $554, of which $341 is for labor, $137 for capital and $76 for mixed labor and capital. Total off-site demand for annual O & M is $646, with $393 for labor, $159 for capital and $89 for mixed factors. Total off-site demand for the increase in export capacity is the largest impact value of the three expenditure categories. Total off-site demand for resources is $828, with $574 for labor, $185 for capital and $70 for mixed factors. Each type of off-site demand for the primary factors of production by industry and subregion of Appalachia was estimated, but was not shown here to avoid complexity.

It is interesting to note that off-site demand for the factors of production ($554) from $1,000 project construction exceeds on-site demand and unallocated costs combined ($408), and that off-site labor demand alone ($341) exceeds on-site labor demand ($325). Total off-

TABLE 27

NATIONAL & REGIONAL FINAL DEMAND GROSS OUTPUT AND
VALUE ADDED COMPONENTS BY EXPENDITURE CATEGORY

(Per $1,000 total final demand and export capacity)

Unit: 1958 dollars

		Construction	Annual O & M	Export in 2020
1.	National final demand	$1,000	$1,000	0
2.	Regional final demand	636	806	1,000
3.	Gross output	931	1,058	1,737
4.	Employee compensation	262	289	511
5.	Proprietor and rental income	79	104	63
6.	Corporate profit	52	54	95
7.	Net interest	32	43	29
8.	Capital consumption allowances	53	62	60
9.	Indirest business tax	76	89	70
10.	Total value added	554	641	828
11.	Labor share (4+5)	341	393	574
12.	Capital Share (6+7+8)	137	159	185

site demand from annual O & M ($641) is almost equal to on-site demand ($700), but off-site labor demand is slightly below 60 percent of on-site demand. Although no on-site labor is counted, the increase in export value has shown itself to be the most powerful potential source of demand for off-site labor ($574) among the three different expenditure categories.

Estimate of off-site labor demand by occupation

There is no data vailable to disaggregate demand for labor by major occupation through the value added by labor approach used in the preceeding section. Therefore, off-site demand for labor and wages, by industry, occupation and subregion of Appalachia were estimated by applying both labor and occupation coefficients and the average wage rate of each major occupation by industry. Estimated off-site labor demand from construction is shown in Table 28.

Total demand for labor is estimated to be 1,961 man-years and the wage bill required is estimated to be $10,098,052. Hypothetically, the value should be equal to the labor share derived through the value added approach shown in Table 26. However, the wage bill estimation is short by $1,083,541 (9.7 percent) compared to the labor share through the value added approach. This difference may be caused by (1) underestimation of demand for labor by using a direct labor coefficient,[26] and (2) an error in the estimate of the wage rate.[27] In this study,

[26]The direct labor coefficient is the requirement for labor in producing $1 billion dollars of output. Application of this ratio to the delivery of $1 billion dollars of final demand could be a source of underestimation. In order to make a realistic estimate it is necessary to use the labor coefficient applicable to a closed input-output model which counts direct, indirect & induced effects.

[27]Since the wage rate is estimated by the Bureau of Census through a monthly survey, it is subject to errors.

TABLE 28

OFF-SITE DEMAND FOR LABOR AND WAGE BILL BY OCCUPATION
AND REGION RESULTING FROM PROJECT CONSTRUCTION

Unit: Labor - Man-Year
Wage - 1958 dollars

	Region 1	Region 2	Region 3	All Appalachia
Professional, technical and kindred workers	14 110,177	202 1,539,375	7 55,053	203 1,704,605
Managers, officials and proprietors, except farmers	15 135,312	242 2,224,057	7 62,299	264 2,421,669
Clerical and kindred workers	23 82,989	298 1,092,401	10 38,279	331 1,213,670
Sales workers	12 47,736	226 935,254	5 22,229	243 1,005,219
Craftsmen, foremen and kindred workers	19 119,118	171 1,090,906	10 61,694	200 1,271,718
Operatives and kindred workers	29 129,399	202 897,696	24 106,108	255 1,133,202
Service workers	5 10,378	60 130,173	5 5,837	68 146,388
Laborers, except farm and mine	16 48,311	353 1,080,055	8 23,201	377 1,151,567
Farmers and farm laborers	2 3,830	14 35,466	4 10,718	20 50,014
All Occupations	135 $687,250	1,708 $9,025,383	78 $385,418	1,961 $10,098,052

Note: Columns and rows may not add because of rounding. Upper row in each occupation shows demand for labor and bottom row shows demand for wage bill.

the wage bill, by occupation, will be adjusted to the value added component contributed by labor, according to the weight of the wage bill for each occupation relative to the total wage bill demand. Adjusted demand based on labor and wage bill data by occupation and region is shown in Table 29. Off-site labor required within Appalachia resulting from project construction is estimated to be 1,961 man-years and wage bill demand is $11,182,782. Off-site demand for blue-collar workers and all other workers in terms of the wage bill is 35 and 65 percent respectively, contrasted to 93 and 7 percent in the case of on-site demand. Demand for blue-collar workers is distributed as follows: 13 percent to craftsmen and kindred workers and 6 percent for each operatives and unskilled labor.

Adjusted demand for labor and wages resulting from annual O & M and export capacity is shown in Tables 30 and 31. Annual O & M requires approximately 4 man-years of labor and $18,266. The labor requirement due to increased export capacity in 2020 is estimated to be 6,842 workers and the wage bill will be $41,156,135.[28] About 54 percent of the labor demand from increased export capacity is for blue-collar workers,

[28] The values of demand for labor by occupation associated with O & M and export capacity are based on 1970 wage rates. Since the wage rate represents the productivity of labor, it is not realistic to assume that future labor productivity will be constant. An increase in labor productivity, however, means reduced man-year labor requirements for a unit of production. Let us assume that the relationship of productivity among various factors of production remains constant in the future. Since we use a constant wage rate and labor and occupation coefficient in projecting future wage demand, the proportion of under-statement of wage demand for each occupation is in the same proportion as the under-statement of labor productivity or over-statement of man-year labor requirements by occupation. We assume that labor productivity will definitely increase. Therefore, we recognize that the labor projection associated with O & M and export capacity is over-stated by the same percentage as the increase in labor productivity, but the total wage demand by each occupation is still useful to approximate the total wage requirements associated with a reduction in man-year labor.

TABLE 29

OFF-SITE DEMAND FOR LABOR AND WAGE BILL BY OCCUPATION
AND REGION RESULTING FROM THE UPPER LICKING PROJECT CONSTRUCTION
(Adjusted to Value added approach)

Unit: Labor - Man-Year
Wage - 1958 dollars

	Region 1	Region 2	Region 3	All Appalachia
Professional, technical	14	202	7	203
and kindred workers	122,012	1,704,734	60,967	1,887,713 (58)
Managers, officials and pro-	15	242	7	264
prietors, except farmers	149,847	2,462,965	68,914	2,681,804 (82)
Clerical and kindred	23	298	10	331
workers	91,904	1,209,746	42,397	1,344,042 (41)
Sales workers	12	226	5	243
	52,864	1,136,183	24,617	1,221,179 (37)
Craftsmen, foremen and	19	171	10	200
kindred workers	131,914	1,208,091	68,321	1,408,326 (43)
Operatives and kindred	29	202	24	255
workers	143,299	994,126	117,506	1,254,930 (38)
Service workers	5	60	5	68
	11,493	144,156	6,464	162,113 (5)
Laborers, except	16	353	8	377
farm and mine	53,501	1,196,074	25,693	1,275,268 (39)
Farmers and farm	2	14	4	20
laborers	4,241	39,276	11,869	55,386 (2)
All Occupations	135	1,708	78	1,961
	761,074	9,994,887 (305)	426,819 (13)	11,182,782 (341)

Note: Columns and rows may not add because of rounding. Upper row in each occupation shows demand for labor and bottom row shows demand for wage bill. Figures inside of parentheses means demand for wage per $1,000 project cost.

TABLE 30

OFF-SITE DEMAND FOR LABOR AND WAGE BILL BY OCCUPATION
AND REGION RESULTING FROM O & M
(Adjusted to Value added approach)

Unit: Labor - Man-Year
Wage - 1958 dollars

	Region 1	Region 2	Region 3	All Appalachia
Professional, technical and kindred workers	.02	.43	.01	.46
	159	3,292	91	3,541
Managers, officials and proprietors, except farmers	.23	.42	.01	.45
	212	3,844	107	4,162
Clerical and kindred workers	.04	.55	.02	.60
	130	2,015	67	2,211
Sales workers	.02	.38	.10	.41
	77	1,584	39	1,701
Craftsmen, foremen and kindred workers	.03	.29	.02	.33
	163	1,867	98	2,126
Operatives and kindred workers	.04	.33	.04	.41
	188	1,453	199	1,839
Service workers	.01	.10	-	.12
	15	227	9	251
Laborers, except farm and mine	.02	.72	.01	.75
	75	2,209	40	2,326
Farmers and farm laborers	-	.03	.01	.04
	8	76	23	107
All Occupations	.41	3.25	.30	3,57
	1.027	16,567	672	18,266

Note: Columns and rows may not add because of rounding. Upper row of each occupation shows demand for labor and bottom row shows demand for wage bill. (-) means less than .005.

TABLE 31

OFF-SITE DEMAND FOR LABOR AND WAGE BILL BY OCCUPATION AND REGION INDUCED BY INCREASE IN EXPORT CAPACITY
(Adjusted to value added approach)

Unit: Labor - Man-Year
Wage - 1958 dollars

	Region 1	Region 2	Region 3	All Appalachia
Professional, technical and kindred workers	34	608	31	673
	304,761	5,515,310	277,737	6,097,808 (82)
Managers, officials and proprietors, except farmers	32	500	31	563
	347,602	5,496,958	344,918	6,189,478 (83)
Clerical and kindred workers	49	775	49	873
	214,181	3,377,446	207,957	3,799,584 (51)
Sales workers	25	353	24	402
	122,023	1,740,089	119,109	1,981,221 (27)
Craftsmen, foremen and kindred workers	44	767	45	856
	355,830	5,802,676	342,898	6,501,404 (87)
Operatives and kindred workers	81	2,312	147	2,540
	426,245	12,226,541	779,049	13,431,835 (181)
Service workers	12	214	14	240
	30,087	552,687	36,362	619,636 (8)
Laborers, except farm and mine	34	534	36	604
	126,282	1,958,362	131,369	2,216,013 (30)
Farmers and farm laborers	3	76	12	91
	9,534	279,618	45,752	334,906 (5)
All Occupations	314	6,139		6,842
	$1,916,545 (26)	$36,949,687 (497)	$2,289,903 (31)	$41,156,135 (554)

Note: Columns and rows amy not add because of rounding. Upper row of each occupation shows demand for labor, and bottom row shows demand for wage bill. Parentheses means demand for wage for $1,000 increase in export capacity.

and 46 percent for all other occupations. Of the demand for blue-collar workers, 33 percent is for operatives and kindred workers, 16 percent for craftsmen and kindred workers and only 5 percent unskilled labor. About 90 percent of the demand for labor is in the project region.

Total Demand for the Factors of Production

Total demands (on-site and off-site) for labor and wage bill values resulting from project construction and O & M by region are shown in Table 32. A total wage bill of $21,832,858 and 3,973 labor man-years are required for project construction, and $51,066 and 11 labor man-years are required to support the annual operation and maintenance cost of the project. Each $1,000 of project construction costs induces $666 of labor demand. About 63 percent of this demand accrues to blue-collar workers (37 percent to craftsmen, foremen and kindred workers, 14 percent to operatives and kindred workers and 12 percent to unskilled labor). About 90 percent of total labor demand and almost all the demand for unskilled labor will be imposed on the project region, Region 2. Each $1,000 of annual O & M costs induces $1,090 in labor demand, of which more than 70 percent is for blue-collar workers.

If on-site demand is added to off-site demand, estimated total demand for the primary factors of production per $1,000 expenditure for all categories is: $879 from construction, $1,341 from annual O & M and $828 from the increase in export. If unallocated costs, ($83), is added, each $1,000 of construction expenditures will induce $962 of demand for the primary factors of production. More than 70 percent of the demand for the primary factors of production is for labor.

Summary

The sources of demand for the factors of production within Appalachia are not limited to the sum of project investment expenditures,

TABLE 32

TOTAL DEMAND (OFF-SITE AND ON-SITE) FOR LABOR AND
WAGE RESULTING FROM PROJECT CONSTRUCTION AND O & M
(Adjusted to value added approach)

Unit: Labor - Man-Year
Wage - 1958 dollars

	Region 1	Region 2	Region 3	All Appalachia	Region 1	Region 2	Region 3	All Appalachia
Professional, Technical	14	286	7	287	-	-	-	-
and kindred workers	122,012	2,346,884	60,967	2,529,863 (77)	159	3,293	91	3,541 (76)
Managers, officials and pro-	15	256	7	278	-	-	-	-
prietors, except farmers	149,847	2,596,048	68,914	2,814,887 (86)	212	3,844	107	4,162 (89)
Clerical and kindred	23	325	10	358	-	-	-	1
workers	91,904	1,308,995	42,397	1,443,291 (44)	130	2,051	67	2,211 (47)
Sales Workers	12	226	5	243	-	-	-	-
	52,864	1,136,183	24,617	1,221,179 (37)	77	1,584	39	1,701 (36)
Craftsmen, foremen and	19	1,204	10	1,233	-	2	-	2
kindred workers	131,914	7,783,327	68,321	7,983,237 (244)	163	12,644	98	12,903 (275)
Operatives and kindred	29	594	24	647	-	3	-	3
workers	143,299	2,739,411	117,506	3,000,215 (92)	188	16,916	199	17,302 (369)
Service Workers	5	60	5	68	-	-	-	-
	11,493	144,156	6,464	162,113 (5)	15	227	9	251 (5)
Laborers, except	16	815	8	839	-	1	-	1
farm and mine	53,501	2,620,124	25,693	2,699,318 (82)	75	8,769	40	8,886 (90)
Farmers and farm	2	14	4	20	-	-	-	-
laborers	4,241	39,276	11,869	55,386 (2)	8	76	23	107 (2)
	135	3,720	78	3,973	-	10	-	11
All Occupations	$761,074 (23)	$20,643,963 (630)	$426,819 (13)	$21,831,858 (666)	$1,027	$49,367	$672	$51,066 (1090)

Note: Columns and rows may not add because of rounding. Upper row in each occupation shows demand for labor and bottom row shows demand for wage. (- represents less than .05). Parentheses mean demand for wage per $1,000 project and annual O & M cost.

but include the potential of the investments to stimulate the Appalachian economy. Water resource investments will require labor as direct inputs, as well as material inputs, the major indirect source of demand for the primary factors of production. The magnitude of demand for the primary factors of production, from the investment expenditures other than on-site demand, depends upon the ability of the project to impose demands on the Appalachian Region and to stimulate the local economy. The ability of a water project to impose demands on Appalachia and to stimulate the local economy depends on the type and location of the project selected.

Off-site demand for the primary factors of production per $1,000 of construction cost for the ULP far exceeds on-site demand. In the case of O & M expenditures, on-site and off-site demand are approximately equal. Total demand for labor has been the determinant impact factor; it exceeds by 70 percent the demand for the total factors of production resulting from the project investment.

On-site demand for labor is primarily for blue-collar workers. This class accounts for a greater proportion of the labor supply with a higher unemployment rate in Appalachian Regions, particularly in the Upper Licking Area. In the case of off-site demand for labor, however, the demand for blue-collar workers is approximately equal to or less than for white-collar and service workers together. Demand for unskilled labor from both on-site and off-site sources is less than 12 percent of the total demand for labor.

Public investments in a depressed region do not necessarily create sufficient demand of the proper type and location to utilize all of the primary factors of production which are in an idle status. Water resource investment is not necessarily the best approach to solving mass unemployment, unskilled labor problems. Different types and locations of projects may stimulate local economies in diverse ways and result in different patterns of demand for resources. Larger on-site demand does not guarantee a larger demand for labor. If a public project in a depressed region is to be effective, it is necessary to investigate the impacts of project costs in addition to the economic expansion induced by the project on the detailed demand pattern of various primary factors of production.

CHAPTER III

EMPLOYMENT GENERATION BENEFITS FROM THE UPPER LICKING PROJECT AND THEIR IMPACT ON THE BENEFIT-COST ANALYSIS

In this chapter, the demand for and supply of the factors of production associated with the ULP estimated in Chapters I and II will be briefly compared, and the nature of EGB will be investigated. A model used to estimate EGB, given demand for and supply of the factors of production, will be constructed by establishing a functional relationship between demand and supply, in terms of a percentage utilization of incremental demands from their idle sources. EGB resulting from the ULP will be measured and discussed in terms of cost offset elements to equate social costs of the project from money costs. Finally, the impacts of EGB on the benefit-cost analysis of the ULP will be evaluated.

Comparison of Demand for and Supply of the Factors of Production Associated with the ULP

In Chapters I and II, demand for and supply of the factors of production are estimated by type (labor by 9 major occupations and capital by 82 industry sectors) and by subregion of Appalachia and for the Upper Licking Area associated with the ULP. Estimates were also made with regard to areas where the factors of production might be utilized (on-site and off-site) and to each category of expenditures (for construction, annual O & M and the increase in export values). On-site demand is the demand imposed on the project site. In this case, this demand was assumed to be imposed on the Upper Licking Area, where there is a major source of labor supply within reasonable commuting distance. Off-site demands are imposed on various subregions of Appalachia.

In Chapter II, estimated total demand for a labor force during the construction period of the ULP was estimated to be approximately 2,000 (on-site demand) from the Upper Licking Area and about 2,600 from the three Appalachian regions. Out of the 2,600, 2,400 in labor demand was estimated to be imposed on Region 2. Estimated demand for labor for annual O & M is 3 from on-site demand and 4 from off-site demand. The highest level of labor demand was estimated to be about 6,000 from the increase in export values by 2020. The major portion of this demand will be imposed on Region 2.

Comparable to the demand for labor, estimated supply based on 4.6 percent of the National unemployment rate during the construction period is about 3,000 for the Upper Licking Area and 92,000 for Region 2 alone. The number of unemployed, in total and by occupation, is enough to meet the entire demand imposed on the subdivisions of Appalachia during the period of analysis. Although it is difficult to measure the actual excess capacities in the Appalachian regions, they will be assumed sufficient to meet the entire demand for them, because the demand will be imposed on the entire Appalachian Region.

The Nature of Employment Generation Benefits

EGB have been equated with benefits generated by utilizing otherwise idle resources. In Chapter II, each value added component in the process of production to satisfy a given final demand has been treated as the demand for each factor of production. In a competitive economy, the share of labor is considered to be equal to its marginal value product,[1] which is the value of the output added by the last unit of labor. Therefore, the labor share is the value of the socially

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[1]Milton Friedman, Price Theory (Chicago: Aldine Publishing Co., 1962), Chapt. 9.

desirable products (benefits) created by the labor. The value added components of employee compensation and proprietor and rental income have been considered to be the benefits to society contributed by labor. The value added by major occupation has been derived through the demand for wages by major occupation. Since the labor factor is perishable if not used, the values added by otherwise idle labor will increase benefits to the society without foregoing alternative benefits, that is to say there is no alternative cost associated with the idle labor.[2]

As in the case of the labor share, the capital share is the marginal value product of the invested capital, which can also be expressed as the value of output which the marginal unit of capital[3] can produce. The capital share of outputs produced to satisfy a given final demand is considered to consist of the value added components of: (1) net interest payments, (2) corporate profits, and (3) capital consumption allowances.

Unlike the labor force, physical production capacity is not perishable except through natural wear and tear during the storage period. If we assume that capital consumption allowances consist primarily of depreciation charges against capital[4] when it is used, idle

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[2]An implicit assumption is that the utility attached involuntary leisure time should be ignored.

[3]The input of capital is defined as the service of a unit of the existing real plant and equipment with which labor works in producing society's output.

[4]This is a simplified assumption. Capital consumption allowances include both depreciation and obsolescence charges. Of course, one could question the adequacy of allowances in terms of obsolescence due to the rapid technological progress. An accurate division of these charges is not possible due to the lack of statistics. In order to arrive at a conservative estimation of benefits,

production capacity can be held for deferred use in the future.[5] Therefore, the benefits foregone by not utilizing existing production capacity will be limited to the lost opportunity of earning interest payments and profits. That is to say if otherwise idle production capacity is utilized due to the project, the benefits to the society will be added by an amount equal to the value added by interest payments and corporate profits. Unlike in the case of labor, the opportunity cost of using otherwise idle capital is not zero but equivalent to the value of the associated consumption allowances.

Model Used to Estimate Employment Generation Benefits

Mobility of resources

The mobility of the factors of production depends upon many circumstances. Some of these may be: (1) the types of factors of production, (2) the period in which they function (3) their geographical distance from jobs, (4) flow of information between supply and demand elements (5) levels of education and (6) other social, economic and political conditions. There are also differential mobilities among occupations, industrial capital investments and regions. Occupations requiring less skill may be shifted to other occupations without difficulty, with minor training, but they may be less mobile beyond certain area limits. Highly skilled occupations on the other hand, may have much higher geographical mobility as compared to occupations with a lower level of skill. In the long-run, labor and capital are more mobile among different occupations and different in-

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however, we treated consumption allowances solely as depreciation charges.

[5]It is implicitly assumed that natural wear and tear is not significant.

dustrial enterprises and among regions.

One of the most important causes of a high rate of resource idleness is the immobility of resources over a moderate period of time in addition to the shortage of effective demand or price rigidity.

In this study, the factors of production were assumed to be immobile[6] among different Appalachian subregions and between Appalachia and external regions, at least during the moderately short-time construction period. Labor among the nine major occupations and capital among the 82 industry sectors was also assumed to be immobile. Detailed evaluation of reaction patterns between the demand for and supply of the factors of production under various economic conditions is a vital area requiring future exploration.

Expected Resource Response Functions

In order to estimate EGB it is necessary to determine the extent to which the estimated demand for each factor of production will be utilized from their idle resource stock. Empirical information about the reaction patterns of various factors of production to incremental demand for them is not available at this stage. However, it is expected that there is a positive relationship between the rate of idleness of the factors of production and the probability of employment these factors to satisfy the increased demand generated by the resource development investment. Therefore, the higher the rate of unemployment, the greater the expectation that otherwise idle labor will be hired instead of displacing those already employed elsewhere. Similarly, the response of industry to increments of demand depends on the level of industrial ex-

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[6]Of course such an assumption is probably not true. With few exceptions factors could be moved. However, such an assumption is necessary in order to permit a formulation of a mathematical function.

cess capacity. The demand increments are far less likely to displace existing alternative production capacity when substantial local excess capacity exists than when local production is at capacity output.

The diversity of the rate of idleness of resources among occupations and industries dictates that reaction patterns of various idle factors, to demand, varies among occupations and industries. In this study the Resource Response Function[7] for labor by major occupation and for capital by 82 sector industries has been hypothesized. The resource response function is built up from two extreme reference points: (1) the level of the unemployment rate or excess capacity rate (r_f) below which any incremental demand for the factor will be satisfied entirely by diverting employed factors from competing purposes, the full employment or full capacity level, and (2) the unemployment rate (excess capacity rate) (r_n) beyond which all incremental demands will be supplied directly or indirectly from otherwise idle factors.

In figures 3 and 4 Resource Functions are pictured in which the percentage of incremental labor and capital demands which will be supplied from nonutilized resources are related to the level of unemployment and idle capacity. For each of the major occupational categories and for capital, a set of four possible reaction patterns were developed to obtain the estimates of the percentage of labor and capital drawn from idle sources. These are: Upper-bound (H), lower-bound (L), Intermediate (I) and Linear (S) functions. These functions are the

[7]Response functions, as synthesized here were borrowed from the Haveman & Krutilla study with minor modification. For the full employment level of nonfarm labor, a 6.1 percent unemployment rate was used. A linear functional relationship was added to the original three sets of functions. See Haveman and Krutilla, op. cit., pp. 70-74.

only four chosen to represent the infinite possible reaction patterns to link two extreme reference points. The lines "H", "L" and "I" are various portions of sine functions and "S" is based on the assumption that there is a linear relationship between the unemployment (excess capacity) rate and the probability of using idle factors. Mathematically these functional relationships are expressed as follows:

$$Y_L = 1.0 - \cos(\pi/2.0 \times Y_S)$$

$$Y_H = \sin(\pi/2.0 \times Y_S)$$

$$Y_I = .5 \times \left\{\sin(\pi \times Y_S - \pi/2.0) + 1.0\right\}$$

$$Y_S = (r - r_f), / (r_n - r_f)$$

Where Y_H, Y_L, and Y_I, represent values of each function of Upper-bound, and Intermediate

Y_S = Value of Linear function: percentage of incremental demand for labor (capital) that will be drawn from idle resources

r = rate of unemployment (excess industrial capacity)

r_f = unemployment (excess capacity) rate below which an increment of demand for that factor will be filled by entirely displacing an alternative use.

r_n = unemployment (excess capacity) rate beyond which an increment of demand for those factors are filled entirely from idle sources.

Since there is no empirical generalization of labor and capital response functions to incremental demand for them, the range of functional values will be measured against this set of possible behavior patterns.

On the abscissa of each of these figures, the range of unemployment or idle capacity, (r) existing at a point in time in any occupation (figure 3) or industry (figure 4), has been plotted. The ordinate measures the proportion of the increment of demand for a factor which will be supplied from the stock of unutilized factors of production, y. In both figures, the points labeled r_f are taken to be the rate of un-

FIGURE 3. LABOR RESPONSE FUNCTIONS

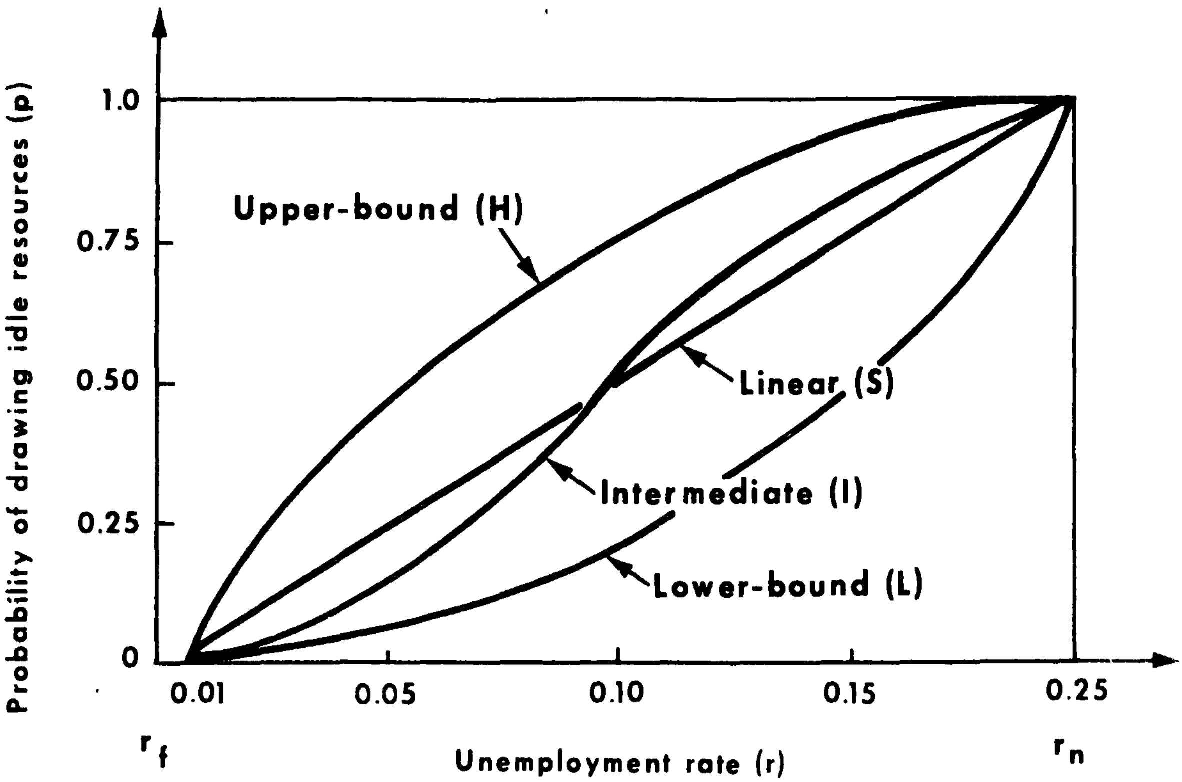
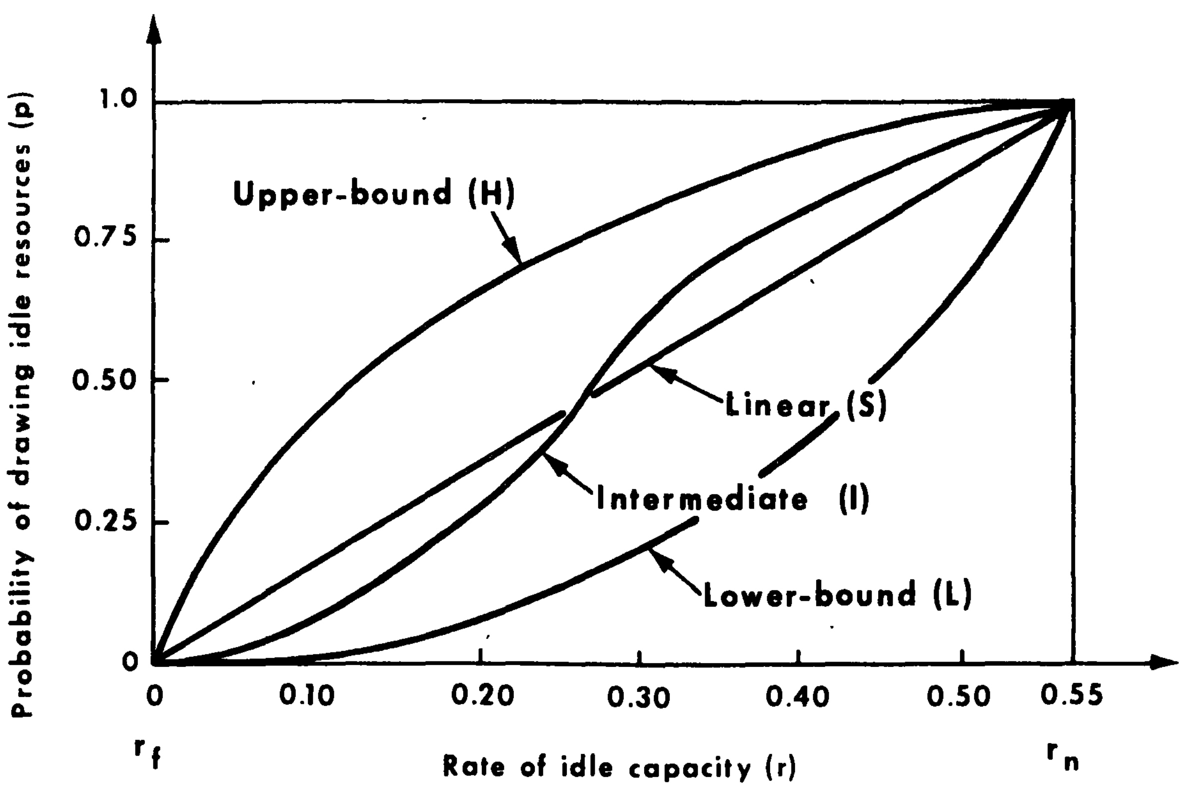


FIGURE 4. CAPITAL RESPONSE FUNCTIONS



employment (excess capacity rate) associated with "full employment" (full capacity) for the occupation (or industry). In the case of labor response functions, "full employment" is defined as the national unemployment rate experienced by each occupational group in 1953, the year with the lowest annual average total unemployment rate in the post-World War II U.S. economy.[8] For capital functions, full capacity utilization is assumed to occur when the rate of excess capacity is zero.

The points labeled r_n on the figures signify the rate of unemployment or excess capacity at which an increment of factor demand would be entirely supplied from otherwise unutilized resources. In the case of the labor response functions, r_n is taken to be .25. For the capital functions, the rate is .55. These numbers are the estimated rates of unemployment and unutilized capacity at the height of the Great Depression.[9] In choosing these figures, it is assumed that such depressed conditions represent an absolute magnitude wherein increments to the demand for labor and capital would always be satisfied with no displacement of alternative outputs.

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[8] The unemployment rate by major occupation in 1953 is snown in Table 1, but it is repeated for closer reference, as follows: Total unemployment (2.9), Professional, technical & kindred workers (.9), Managers, officials, & proprietors (.9), Clerical & kindred workers (1.7), Sales workers (2.1), Craftsmen, foremen & kindred workers (2.6), Operatives & kindred workers (3.2), Service workers (3.4), Farmers & farm workers (2.2) and Laborers, except farm & mine (6.1).

[9] In 1933, 24.9 percent of the civilian labor force was classified as unemployed and the capacity utilization rate at the height of the depression was estimated to be between 42 & 45 percent. See U.S. Council of Economic Advisors, Supplement to Economic Indicators (Washington: 1964) and Donald C. Streever, Capacity Utilization and Business Investment (Urbana: University of Illisois, Bureau of Economic and Research, 1960), pp. 40 & 43. From Haveman & Krutilla, op.cit.

Formula to compute EGB

Once labor and capital response functions are established and the anticipated rate of idle factors along with the demand for them are known, the estimation of EGB resulting from various phases of water resource investment impacts is not a difficult task. The following formulas are used in computing EGB:

Benefits attributable to idle labor resulting from on-site demand (L_BI)

$$L_BI = W^I \cdot Y^I \quad \text{(I)}$$

Where W^I = on-site occupational wage demand matrix

Y^I = occupational response function matrix in the Project Impact Area

Benefits attributable to idle labor resulting from off-site labor demand (L_BR)

$$L_BR = W^R \cdot Y^R \quad \text{(II)}$$

Where W^R = off-site occupational wage demand matrix by region

Y^R = occupational response function matrix by region

EGB attributable to idle labor (L_B)

$$L_B = L_BI + L_BR \quad \text{(III)}$$

Befefits attributable to idle capacity (C_B)

$$C_B = C^* \times C_Y \quad \text{(IV)}$$

Where C^* = Expected net interest payments and corporate profits matrix

C_Y = Capital response function matrix

There is no functional formula available to measure benefits resulting from demand for mixed factors. These demands are two: (1) unallocated costs from project expenditures and (2) indirect business taxes. The proportion of benefits of these demands attributable to idle factors with labor and capital mixed (M_B) will be computed in the same proportion as the combined benefits arrived at in equation II and IV to the sum of off-site wage and capital demand.

$$M_B = (u + t) \times \frac{L_B^R + C_B}{W^R + C} \qquad (V)$$

Where
- u = Unallocated cost
- t = The portion of value added by indirect taxes in delivery of given final demand
- W^R = Total off-site wage demand
- C = Total off-site capital demand
- L_B^R = Benefits from off-site labor demand
- C_B = Benefits from off-site capital demand

Benefits attributable to all idle factors of production (B)

$$B = L_3^I + L_B^R + C_B + M_B \qquad (VI)$$

Equation VI applies to any phase of the impact of water resource expenditures on the economy: i.e. project construction, O & M or industrial development subsequent to the project construction. If we expect significatn economic development to be induced by project construction, the benefits attributable to idle resources from the project construction (B_C), O & M (B_O) and induced economic development (B_D) should be estimated.

Total EGB resulting from and induced by water resource investments (B_P), will be:

$$B_P = B_C + B_O + B_D \qquad (VII)$$

Estimate of EGB resulting from ULP

Total and sources of EGB

EGB directly and indirectly resulting from the ULP were estimated according to the formula presented in the preceding section. Table 33 shows EGB from three different phases of economic impacts: Construction, O & M and export capacity. Benefits are measured under four different types of resource response function and by various sources such as: off-site & on-site wage benefits, capital return benefits and benefits from mixed factors.[10]

Benefits from project construction are total benefits over the four year consturction period (1970 - 1973). The estimated benefits range from $8 million (applying the lower-bound function) to $13 million (upper-bound function) at 1958 prices. Benefits derived from both Linear ($11.5 million) and Intermediate response functions ($10 million) fall within the above range. The benefits per $1,000 project cost range from $242 to $407. The largest source of benefits is on-site wages which account for a benefit range of $215 to $287. All other benefits from off-site demand for the factors of production range from $26 to $120.

The benefits from the O & M of the project are only a one-year portion of the benefits stream from this source, and they range from $20,600 to $39,000. Benefits per $1,000 of O & M expenditures range from $440 to $790 of which on-site wage benefits range from $146 to $677. The high ratio of benefits per $1,000 of O & M expenditure is

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[10] Wage and capital return benefits are attributable to the use of idle labor and capital respectively. Benefits from the combined factors were derived from unallocated cost and indirect business taxes which were not assignable to any single factor of production.

TABLE 33

ESTIMATE OF EMPLOYMENT GENERATION BENEFITS
RESULTING FROM THE UPPER LICKING PROJECT

Unit: 1958 dollars

(1) Benefits from project construction

Type of response function	Off-site wage benefits	On-site wage benefits	Capital return benefits	Benefits from mixed factors	Total Benefits
Linear	1,311,496 (40)	8,873,231 (246)	596,265 (18)	712,012 (22)	11,493,004 (351)
Intermediate	653,187 (20)	8,832,394 (270)	330,011 (10)	69,310 (11)	10,184,902 (311)
Lower-bound	461,124 (14)	7,053,619 (215)	176,798 (5)	239,620 (7)	7,931,111 (242)
Upper-bound	1,993,551 (61)	9,396,562 (287)	865,668 (26)	1,074,056 (33)	13,329,837 (407)

(2) Benefits from the annual operation and maintainance of the project

Type of response function	Off-site wage benefits	On-site wage benefits	Capital return benefits	Benefits from mixed factors	Total Benefits
Linear	1,993 (43)	23,882 (510)	963 (21)	537 (11)	27,375 (584)
Intermediate	1,291 (28)	25,914 (553)	610 (13)	345 (7)	28,160 (601)
Lower-bound	645 (14)	19,499 (146)	311 (7)	174 (4)	20,629 (440)
Upper-bound	3,010 (64)	31,738 (677)	1,458 (31)	815 (17)	39,021 (790)

(3) Benefits induced by the increase in expost capacity in 2020

Type of response function	Off-site wage benefits	On-site wage benefits	Capital return benefits	Benefits from mixed factors	Total Benefits
Linear	5,381,065 (72)	0	1,945,629 (26)	733,301 (10)	8,059,995 (108)
Intermediate	2,827,201 (38)	0	1,088,033 (15)	391,845 (5)	4,307,079 (58)
Lower-bound	1,481,571 (20)	0	524,163 (7)	200,728 (3)	2,206,462 (30)
Upper-bound	8,206,535 (110)	0	3,398,645 (46)	1,161,507 (16)	12,766,689 (172)

Note: Parentheses benefits per $1,000 of project cost (Annual O & M) or export capacity.

attributable to the fact that about 70 percent of the O & M expenditures are allocated to on-site demand compared to about 30 percent in the case of project construction. Benefits induced by the increase in export capacity from the Appalachia Region were estimated for the target year 2020. The benefits range from $2.2 million to $12.7 million. Benefits per $1,000 increase in export capacity range from $30 to $172.[11]

Present Worth and Average Annual
Equivalent of EGB

In order to compare the stream of EGB over the project life period with the dissimilar stream of cost outlay, it is necessary to measure benefit and cost streams in common terms. For this purpose, streams of benefits and costs over 50 years will be measured in terms of present worth. The year 1970 will be used as the base year for the present worth

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[11] EGB induced by the Area Development Plan, which are based on the impact of the increase in export capacity on utilization of idle resources, are significantly under-stated for two reasons. The first reason is that only exports, which are approximately 25 percent of the increase in total manufacturing output produced in the Impact Area by 2020, are counted. The Impact of the Area Development Plan on idle resources should include all industrial development induced by the water project and should not be limited by the level of increase in export capacity.

The increase in export capacity in the Impact Area assumes that the Impact Area will become a new production center. To increase production it is necessary to obtain material inputs and primary factors of production. Although some material and labor might be expected to originate throughout Region 2, it is assumed that normally, factors of production near the production site within the Impact Area would first be utilized. Therefore, the second reason is that we used Region 2 unemployment rates to estimate EGB from off-site demand in Region 2, without allowing for the more extreme situation within the Impact Area. Thus, to apply Region 2 unemployment rates, instead of Impact Area unemployment rates may under-state the potential benefits. If we apply the unemployment rates in the Impact Area to measure EGB in Region 2, the benefit range per $1,000 of project associated cost will be as follows: $316~$515 for project construction, $614~$1,122 for annual O & M and $179~$365 for the increase in export capacity.

calculation at 1958 price levels. A discount rate of 4.87 percent[12] which was used in the original project report, was used here. The present worth of the benefits resulting from the project will further be expressed in terms of average annual equivalent values, over a 50 year period.[13]

Average annual equivalents of EGB from the various sources, under different resource response functions are shown in Table 34. Estimated annual benefits from project construction range from $397,275 $667,702 in 1958 prices. Annual benefits from the O & M of the project range from $21,296 $38,218, while benefits induced by the increase in export capacity range from $314,817 $1,821,542.

Total annual EGB benefits range from $733,388 $2,527,462. In terms of total present worth, the benefits range from $13,651,530 $47,047,055 in 1958 prices.

Social Costs of the Upper Licking Project

Rationale and model used to estimate social costs of public expenditures

Until now, the utilization of otherwise idle resources has been

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[12]The primary emphasis of the present study is to estimate EGB resulting from public expenditures. This does not mean that the discount rate has any less important role in determining the level of EGB. The discount rate in public investment criteria has been one of the most critically debated subjects. For a further discussion on this subject see, U.S. Congress, Economic Analysis of Public Investment Decisions: Interest Policy and Discounting Analysis, Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, 90th Congress, 2nd Session, 1968, Western Agricultural Economic Research Council, The Discount Rate and Public Investment Evaluation, Conference proceedings of the committee on the economics of the Western Agricultural Economic Research Council, 1968, and William J. Baumol, "On the Social Rate of Discount," AER (September, 1968), among others.

[13]Average annual equivalent values of the benefits from, and costs of the project were arrived at by multiplying values of the present worth of future benefits or costs by the appropriate average annual equivalent factor for 50 years, which is 0.053722.

TABLE 34

AVERAGE ANNUAL EMPLOYMENT GENERATION BENEFITS
FROM THE UPPER LICKING PROJECT

Unit: 1958 dollars

Sources of Benefits	Linear	Intermediate	Lowerbound	Upperbound
1) Project Construction	575,694	510,168	397,275	667,702
off-site wage	65,692	32,717	23,098	99,855
on-site wage	444,465	442,418	353,320	470,676
capital return	29,867	16,529	8,855	43,361
mixed factors	35,664	3,469	12,002	53,797
2) O & M	28,281	29,070	21,296	38,218
off-site wage	2,059	1,295	664	2,946
on-site wage	24,672	26,024	20,129	31,083
capital return	993	611	319	1,426
mixed factors	554	345	179	795
3) Export Capacity	1,149,995	614,531	314,817	1,821,542
off-site wage	767,737	403,378	211,368	1,170,887
on-site wage	0	0	0	0
capital return	277,494	155,231	74,769	484,894
mixed factors	104,535	55,861	28,617	165,578
4) Total Benefits	1,753,970	1,153,769	733,388	2,527,462
off-site wage	835,488	437,390	235,178	1,273,688
on-site wage	469,137	468,442	373,449	501,759
capital return	308,354	172,371	83,943	529,681
mixed factors	140,753	59,675	40,798	220,170

Note: Does not add because of rounding. The 4.785% discount rate and the .053722 average annual factor were applied.

treated as benefits which accrue to the society in addition to benefits from the output of the project (primary benefits). However, this treatment was implicitly based on the assumption that the project costs, based on going market prices (money costs of the project), overstated the associated opportunity costs to society (social costs of the project) under less than full-employment conditions. The portion of project inputs drawn from idle resources may be treated as a cost off-set element to equate money costs of the project to their social costs instead of being captured as EGB.

The opportunity cost of any demand imposed on an economy is the value to society of alternatives foregone in satisfying the demand.[14] Assume, for example, that an additional ton of steel production is required of the economy. The social cost of this requirement is represented by the alternative output which the resources devoted to steel production (and to the production of the inputs demanded by the steel industry) would have produced were they not used in producing the ton of steel. In a competitive and fully employed market economy, the price of unit of labor or capital will equate the minimum monetary inducement necessary to bring forth the marginal unit of labor or capital with its marginal value product. Thus in a reasonable fully employed market economy, the social cost of a diverted marginal unit of labor or capital is measured by the associated market price, and the value of the alternative product equals the sum of the payments to diverted factors.

In the less than fully employed economy, however, market price fails to provide an accurate measurement of the social value required by factor utilization. To the extent that otherwise idle factors are

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[14] George J. Stigler, The Theory of Price (New York: The Macmillan Co., 1962) Chap. 6, pp. 96-110.

employed, society forgoes no alternative outputs.[15] Social costs of public expenditures, therefore, are not the same as their money costs in a depressed economy. In the previous section EGB were defined as the value of outputs contributed by otherwise idle resources. Social costs of public investments, then, become money payments for the inputs required for the investment less the portion of payments to those input which would have been idle without the project investment of equivalent to EGB.[16]

EGB were computed by the formulas (W·Y) and (C·Y), where W and C are defined as the demand for labor and for industrial capacity respectively and Y is defined as the corresponding functional values to represent the proportion of the value attributable to idle resources under various rates of idleness. Therefore, social costs of water resource investment expenditures (Sc) can be expressed as in the following formula:

$$Sc = Mc\,(1 - Yi) = Mc - McYi \qquad \text{(VIII)}$$

Mc = Total money costs of the project
Yi = Proportion of money costs for the inputs drawn from idle resources under ith response function

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[15] See footnote 2 in this chapter.

[16] The portion of project costs paid to those inputs drawn from otherwise idle resources are equal to EGB to the extent that EGB are estimated from direct impact of investment expenditures on idle resources. If the impact of investments on idle resources extends to indirect and induced investment or induced economic expansion, however, the EGB could exceed original project costs. If EGB exceed original project costs, the social costs of the project become negative. A negative cost sign means EGB are greater than the original costs. The EGB approach was adopted in this study for application in the B/C analysis. This was partly based on a need to avoid confusion in B/C analysis that might be caused by using negative costs.

Since McYi was defined as EGB (B)

$$Sc = Mc - B \qquad \text{(IX)}$$

The term (1 - Yi) in this case becomes the <u>shadow factor</u> of the money costs of the project to equate with the social costs and will be arrived at by using the weighted sum of each ith Resource Response Function associated with a particular resource demand imposed on a specific region.

Estimate of Social Costs of the ULP

Applying the formula, Sc = Mc - B, the annual social costs of the ULP were estimated. Since the value of the shadow factor (1 - Yi) or EGB (B) depends on the resource response functions to be selected, annual social costs of the ULP will be estimated in terms of range. The range of annual social costs of the project in 1958 prices were estimated as follows:

1) Annual social cost of the water plan
 = Mc($1,678,000) -B($418,571 ~ $705,920)
 = $11,259,429 ~ $972,080

2) Annual social cost of total project
 = Mc($1,893,000) -B($733,388 ~ $2,527,462)
 = $11,159,612 ~ (-) $634,462

Or, the ranges of the shadow factor of the money costs of the project are:

3) Water project = .751 ~ .579

4) Total project = .613 ~ (-).335

The social costs of the water project range from 75 percent to 58 percent of project costs depending on the selected resource response function. The negative sign in the case of total project cost which includes investments for area development means that EGB alone will be greater than initial investment expenditures.[17] According to the estimated shadow factors the upper limit of social costs are equivalent to 75 percent of project costs in the case of the water plan and 60 percent in terms of the total project. The social costs of the ULP, therefore, are significantly lower than original project costs.

Conversely, this means that for each $1,000 of total project costs accrue at least $400 in EGB.

Evaluation of the Impact of EGB on the B/C Analysis of the ULP

Annual EGB per $1,000 Project Costs

Table 35 shows average annual EGB per $1,000 federal cost for the ULP. This table provides a rough idea of the relationship between the cost and EGB from various sources under different resource response functions. The average annual EGB per $1,000 annual project cost (Federal cost) range $243~$408 for project construction, $532~$955 for O & M and $1,464~$8,472 for the increase in export capacity.[18] EGB per $1,000 cost of the water plan range $249~$421,[19] and the benefits for the entire project per $1,000 project cost range from $387 to $1,335.

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[17] This situation does not hold for every investment. This depends on the condition of idle resources and the magnitude of the stimulus of locational advantage in comparison with competing regions.

[18] Benefits from increased export capacity or the area development plan are not soley attributable to the investment cost of the area development project. The prime factor of area development is the locational advantage which will be enhanced by the water project. Therefore, the benefit range per 1,000 federal support to area development has no special meaning unless it is related to the water plan.

[19] This was attained by dividing annual benefits by those annual project costs associated with both project construction and O & M.

TABLE 35

AVERAGE ANNUAL EMPLOYMENT GENERATION BENEFITS PER $1,000 COST OF THE UPPER LICKING PROJECT

Unit: 1958 dollars

Sources of Benefits	Linear	Intermediate	Lower-bound	Upper-bound
1) Project Construction	351	311	243	408
off-site wage	40	20	14	61
on-site wage	271	270	216	287
capital return	18	10	5	26
mixed factors	22	2	7	33
2) O & M	707	727	532	955
off-site wage	51	32	17	74
on-site wage	617	651	503	777
capital return	25	15	8	36
mixed factors	14	9	4	20
3) Export Capacity	5349	2858	1464	8472
off-site wage	3571	1876	983	5446
on-site wage	0	0	0	0
capital return	1291	722	348	2255
mixed factors	486	260	133	770
4) Total Project Benefits	927	609	387	1335
off-site wage	441	231	124	673
on-site wage	248	247	197	265
capital return	163	91	44	280
mixed factors	74	32	22	116
5) Water Plan Benefits	360	321	249	421

Note: Annual costs (Federal Sources): $1,638,000 for Construction, $40,000 for O & M, $215,000 for Area Development and $1,893,000 for Total Project.

Does not add because of rounding.

The Impact of EGB on the B/C Ratio

Benefit ranges per $1,000 of various project costs estimated in the preceding section implicitly constitute the range of benefit-cost ratios of the project without counting primary benefits. The ranges of benefit-cost ratios per $1,000 project costs for the Upper Licking Project, treating EGB as the only benefits are:

1) From project construction = .243 ~ .408
2) From O & M = .532 ~ .955
3) From the water plan = .249 ~ .421
4) From the entire project including area development = .283 ~ 1.355

EGB as well as benefits-cost ratios associated with these benefits were estimated in terms of ranges, due to the lack of precise knowledge concerning the various types of resource response patterns to incremental demand under various conditions. From the four sets of alternative functions, the Linear Response Function has been selected as an average response pattern of the idle resources to the incremental demand for them. According to this function, EGB per $1,000 project costs, and also benefit-cost ratios which were available from Table 35 were selected and are shown below:

Type of Project Cost	Employment-Generation Benefits	Benefit-Cost Ratio
Project Construction	$351	.351
O & M	$707	.707
Total Water Plan	$360	.360
Total Project	$927	.927

To calaculate the overall benefit-cost ratio of the project it is necessary to estimate the primary benefits. The estimated annual primary benefits are $512,000. These benefits are estimated in the original study but have been adjusted for this study model.[20] Three types of B/C ratios have been developed: (1) a B/C ratio associated with the water plan without EGB; (2) with EGB; and (3) a B/C ratio associated with the total project with EGB. According to the model used in this study the cost of project was limited to the federal expenditures. Estimated B/C ratios based on the Linear Resource Response Function are:

1) Water project without EGB $= \frac{\$\ 512,000}{\$1,678,000} = .3051$

2) Water project with EGB $= \frac{\$1,115,975}{\$1,678,000} = .665$

3) Total project including Area Development Plan $= \frac{\$2,265,970}{\$1,893,000} = 1.197$[21]

As was shown in the above, the B/C ratio of the ULP is only .3:1 based on the traditional B/C analysis, in which only the primary benefits are counted, and thus does not appear to satisfy economic efficiency criteria. If the expected EGB resulting from the ULP are

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[20] Office of Appalachian Studies, op. cit. Table 18, pp. III-I-76. The $569,000 was the original estimate of user benefits. Since our model included only federal expenditures in the investments, the benefits are adjusted downward according to the ratio of federal cost to the total water project cost. It was implicitly assumed that benefits are proportional to costs.

[21] In this model EGB are computed from the increase in exported manufacturing outputs, while the original study counted the entire wage demand generated by the entire manufacturing and service industry by 2020. To compare the B/C ratios of total project EGB, in this model, should be adjusted upward. The present EGB from export may be adjusted through multiplying them by the ratio of total manufacturing values to the export values in 2020. This implicitly assumed that the EGB will be proportional to the size of the final demand vector for the input-output model. With this adjustment the B/C ratio for the total project equals to $\frac{\$5,096,000}{\$1,893,000} = 2.164$. B/C ratios developed in the original study, adjusted for 50 year analysis, according to the same B/C ratio classification in my study are: (1) $\frac{569}{1864} = .305$ (2) $\frac{703}{1864} = .377$ (3) $\frac{4114}{2879} = 1.729$
The costs used here are public expenditures, federal and nonfederal sources.

taken into consideration, however, the new B/C ratio will be significantly altered from the traditional B/C ratio. If the impacts of expenditures for the construction and O & M of the ULP on EGB are counted, the B/C ratio will change from .3:1 to .6:1. As the economic development of the area takes place, stimulated by the initial investments, the B/C ratio with the EGB will further increase to 1.2:1. This indicates that the project would be economically feasible.

EGB and Benefit-Cost Ratios Based on 5.6 Percent National Unemployment Rate

In the preceeding sections, EGB and their impact on the B/C ratio of the ULP were estimated based on a 4.6 percent national unemployment rate during the construction period. In Chapter II, unemployment rates in Appalachian regions and the Upper Licking Area have also been estimated based on 5.6 percent national unemployment rate. The total unemployment rate in all Appalachia has been estimated to rise by two percent for every one percent increase in the national rate. The increased national unemployment rate was applied only during the construction period. Excess capacity rates during the same period have not been adjusted upward due to lack of statistics.

Estimated EGB, in 1958 prices, and their impact on the B/C ratio of the ULP based on a 5.6 percent national unemployment rate and a Linear Resources Response Function are shown as follows:

(1) EGB from the construction of the ULP

Sources	Total Benefits	Average Annual Benefits	Average Annual Benefits per $1,000 Annual Cost
off-site wage	$ 2,764,973	$138,249	84
on-site wage	$ 9,880,679	$494,034	302
capital return	$ 596,265	$ 29,867	18
mixed factors	$ 712,012	$ 35,664	22
Total Benefits	$13,953,926	$697,[illegible]	426

(2) Average annual EGB by type of project

Type of Project	Average Annual EGB	Average Annual EGB per $1,000 Annual Cost
Project Construction	$ 697,814	$426
Water plan including O & M	$ 726,095	$433
Total project including area development	$1,876,090	$991

(3) Impact of EGB on the B/C ratio of ULP

(a) Water project without EGB $\frac{\$\ 512,000}{\$1,678,000} = .3051$

(b) Water project with EGB $\frac{\$1,238,095}{\$1,078,000} = .7378$

(c) Total project with EGB $\frac{\$2,388,000}{\$1,893,000} = 1.2615$

Total EGB and their impact on the B/C ratio have been significantly increased compared to those based on the 4.6 percent national unemployment rate. EGB have been increased from $11,493.004 to $13,953,926. The increase is approximately 20 percent of the original EGB. The average annual EGB per $1,000 annual cost has increased from $351 to $426. Average annual EGB per $1,000 project cost for the water plan (construction and O & M) will be $433, and $991 for the entire project including area development. This means the impact of EGB for each type of expenditure on the B/C ratio would be: .426 for construction, .433 for the water plan and .991 for the total project.

The impact of EGB on the overall B/C ratio of the ULP has been raised above those based on the 4.6 percent unemployment rate. The magnitude of the rise in B/C ratio with EGB is: approximately 11 percent if project impact is limited to the water plan and about five percent for the total project.

Summary

Economic efficiency is not the sole criterion for the justification of a public works project. Efficiency criteria for a public works project in a depressed area, based on the traditional B/C analysis, may not accurately reflect benefits and costs to the society resulting from the project investment. This is due to the exclusion of all but primary benefits along with the fact that project costs are based on market prices.

Although there are deficiencies in the projection of future idle resources, the projection of dynamic economic growth with a static model and in resource response functions, the analysis of social benefits and costs resulting from the ULP has revealed that the traditional B/C analysis has significantly understated project benefits in terms of EGB or has overstated social costs of the project by using project costs based on market prices. This may lead to a significant understatement of the index of project desirability to the society or may fail to recognize a great potential for long-run efficiency which might overcome a short-run inefficiency.

The justification of potential for long-term growth is difficult to establish, and requires intensive study. In an investment in a depressed area where a water project is estimated to stimulate the potential for long-term growth, such as the ULP, the impact of the investment on the use of idle resources should be investigated to reflect true social benefits and costs resulting from the project.

The source of EGB from the ULP is 34 percent from the water plan (32.5 percent from construction and 1.5 percent from O & M) and 66 percent is from area development. Since the local excess capacity rate was assumed to be equal to the national rate, the variation of EGB depends primarily on the rate of unemployment. EGB attributable to idle labor are the single largest factor of all EGB. More than 90 percent of the EGB are attributable to labor for both construction and O & M, with 67 percent from the increase in export values. Because of an extremely high unemployment rate in the Project Impact Area, EGB attributable to on-site labor for construction and O & M are more than 80 percent of EGB attributable to labor.

The change in EGB due to the increase in the national unemployment rate was primarily during the short-term construction period. EGB and resulting changes in the B/C ratio were more elastic than the change in the rate of unemployment. A one-percent change in the national unemployment rate induced a two-percent rise in the Appalachian rate and a rise of 20 percent in EGB during the construction phase and ultimately a five percent increase in the overall B/C ratio of the ULP.

CHAPTER IV

SENSITIVITY OF OUTPUT TO CHANGES IN THE LOCATION AND TYPE OF EXPENDITURES

In the preceding chapter the range of EGB and social costs per $1,000 of ULP were estimated and the impacts of these benefits on the benefit-cost ratio were examined. In the early chapters, it was suggested that the level of EGB might vary under various investment conditions such as (1) location, (2) type of project and (3) condition of the local economy.

Since different locations are associated with unique production functions and resource distribution patterns, a change in the location of a project may influence the size of final demand imposed on the local economy and gross outputs induced from it. A change in the type of project, a given cost, may require a substantial change in the composition and level of demand for resources from the local economy.

The level and composition of gross output induced by different final demands under various local economic conditions, such as the status of idle resources and their potential to satisfy demand, should determine the level of EGB.

In this chapter, (1) the regional final demand vector, (2) gross output (3) EGB and (4) impacts of EGB on B/C ratios and social costs associated with the changes in the location and type of project within the Appalachian Region will be investigated with regard to their sensitivity to investment criteria. However, this investigation will be limited to the construction phase of the project.

To test the variability of impacts attributable to changes in the location of a project, the ULP will be shifted from its present location in Region 2 to Regions 1 and 3.[1] To test investment impacts from the changes in types of project, two additional water resource investment projects and two types of private expenditures other than water projects, involving costs equivalent to the ULP, will be substituted for the ULP.[2] The two water resource investments are: (1) Levee construction which generates the highest demand for on-site labor and unallocated costs combined, and (2) powerhouse construction which represents the lowest demand for on-site labor among 12 different types of water projects. The two types of private expenditures are: (1) Gross Domestic Private Investment which represents an average private business investment and (2) private consumption expenditures.[3]

Sensitivity of Final Demand

Sectoral demand (gross outputs required to deliver a given final demand by industry sectors) resulting from a water resource investment in the Appalachian Region depends on two factors: (1) the level of regional final demand vectors and (2) production functions of Appalachian regions which were expressed in terms of technical coefficients of the Input-Output Model of Appalachia. The higher the level of the final demand vector imposed on the region from an investment, the greater are the gross outputs required to deliver the final demand in Appalachia. Therefore, the size of gross output required in Appalachia

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[1]The change in the location of the Upper Licking Project is merely hypothetical. Because of differences in economic needs and geographical features it is hardly possible to change a project location without changing project type, design and its costs.

[2]See footnote 1 in this chapter.

[3]Consumption expenditures are not directly comparable to an investment project but can be treated as a project package (such as a welfare project) in order to compare the impact of these expenditures on the local economy to other project expenditures.

depends on the relative ability to retain input requirements within Appalachia given the same level of expenditures under different investment conditions, primarily region and type of project selected.

The Appalachian economy has been thought to be highly dependent on the national economy. Naturally, there is a substantial leakage in inputs demanded by investment in the Appalachian Region. Since each subregion of Appalachia has its unique production function and pattern of resource distribution, the degree of self-sufficiency of each region is expected to be different from others. Therefore, the level and composition of the final demand vector for Appalachia for a given level of investment is expected to vary according to the region and type of investment selected. Table 36 shows Appalachian final demand and leakage for each $1,000 of program expenditure associated with a hypothetical change in the location of the ULP, and the introduction of two additional types of water projects (powerhouse and levee), a private business investment and personal consumption expenditures in place of the ULP.

Total Appalachian demand is separated into off-site and on-site demand and unallocated costs.[4] Final demand vectors for two types of private expenditures are derived from the project percentage distribution of industrial composition of Gross Domestic Private Investment and Personal Consumption Expenditures for the year 1970 by the Bureau

[4]For the allocation of various water project costs, by source and by industry and major occupation see Appendix A & B and Table 16. The ULP is a complex type of water project consisting of a small Earth Fill Dam, Local Flood Protection facilities and miscellaneous subprojects.

TABLE 36

APPALACHIAN DEMAND AND LEAKAGE PER $1,000 EXPENDITURES, WITH CHANGES IN THE LOCATION AND MEASURE USED

Unit: 1958 dollars

Location & measure used	Appalachian Demand				
	Off-site demand	On-site demand[b]	Unallocated costs[b]	Total Appalachian demand	Leakages
Upper Licking Project Construction (U.L.P.) in R[a]-2	234	325	83	636	364
U.L.P. Shifted to R-1	258	325	83	662	338
U.L.P. Shifted to R-3	228	325	83	631	369
Levee Construction R-2	186	362	229	768	232
Powerhouse Construction R-2	216	178	11	399	601
Private Investment R-2	617	0	0	617	383
Consumption Expenditures R-2	601	0	0	601	399

Note: [a]R represents subregion of Appalachia.
[b]Since on-site demand and unallocated costs are not adjusted for the input-output model, the sum of off-site, on-site demand and unallocated costs may not equal to Total Appalachian demand.

of Labor Statistics.[5] Since detailed knowledge of on-site labor and unallocated costs related to these private expenditures are not known, the values were assumed to be negligible.[6]

The ULP construction will impose a $636 demand on the Appalachian economy per $1,000 project cost: $234 of off-site demand, $325 on-site demand and $83 of unallocated costs.[7] The leakage from the Appalachian Region will be $364 per $1,000 project cost. If the same project is shifted to Region 1 or 3, the Appalachian demand will become $662 or

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[5]U.S. Department of Labor, B.L.S. Projections 1970: Interindustry Relationships, Potential Demand and Employment, Bulletin No. 1936 (Washington: Government Printing Office), 1966, Table IV-8&9, pp. 71-74. This projection was based on a four percent unemployment rate, and the basic model was applied. The original projection was made by 87 sector industries in terms of actual values. In this study the 87 sector industries were adjusted into 82 sector industries. The percentage distribution of private investment and personal consumption expenditures by industry sectors are shown in Appendix H.

Consumption patterns projected here are national patterns. Due to the lack of information related to Appalachia, these patterns were substituted for Appalachian patterns. This may tend to overstate Appalachian expenditures for the products which are available through a sophisticated production process. Since these products are generally assumed to be imported from the rest of the world, substitution of a National consumption pattern for the Appalachian patterms tends to reduce the level of Appalachian demand and subsequent sectoral demand and EGB.

[6]It is unrealistic to assume that there is no on-site demand and that there are no unallocated costs associated with private investment. If we assume that there is no on-site demand, this means that all project costs will be allocated to off-site demand and this tends to inflate off-site demand. This will tend to over-state gross outputs to satisfy increased final demand. However, this does not automatically over-state EGB. The absence of EGB from on-site demand may off-set the benefits resulting from the increase in off-site demand.

[7]Off-site demand shown here is the portion of off-site demand which is imposed on the Appalachian Region. However, on-site and unallocated costs do not consist entirely of regional demand. Some portion of these will leak out from Appalachia, but this amount is not significant. The magnitude of leakage from on-site demand and unallocated costs is measured by the difference between Appalachian demand and the sum of off-site, on-site demand and unallocated costs. For example in the ULP case, the leakage from on-site demand and unallocated costs per $1,000 project cost will be $636 - ($234 + $325 + $83) = - $6.

or $631; leakages, therefore, become $338 and $369 respectively. It seems Region 1 has the highest capability in holding final demand within Appalachia for the particular set of inputs demanded for the ULP.[8] The range of Appalachian demand will be $631 ~ $622 or a difference of $31 per $1,000 project cost.

Appalachian demands resulting from the three alternative water projects in the same location range from $399 (powerhouse) to $768 (levee construction), and the difference is $369 per $1,000 project cost. This is a greater variation compared to that expected from the selection of an alternative project location.[9] In the case of levee construction, low off-site demand which is expected to be retained in Appalachia ($186) is offset by the high value of on-site and unallocated costs. In the case of powerhouse construction, on-site and unallocated costs per $1,000 project cost are lowest ($189). This coincides with the highest total off-site demand ($817). However, the major portion of this total off-site demand ($601) will be expected to leak out from Appalachia and this leakage is far greater than that for the other two alternative water projects. The greater leakage may be due to the fact that the powerhouse construction needs more sophisticated equipment for both construction and operation of the project, and depends heavily on supplies from outside of Appalachia. The level of Appalachian demand among alternative water projects appears to be dependent on the level of on-site demand including unallocated costs and the availability of inputs from local resources. The project

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[8] For a detailed breakdown of total off-site demand for the project by industry sectors see Table 14, Chap. I of this study. Sector 83 is the sum of on-site demand and unallocated costs.

[9] Since only one project type (the Upper Licking Project) was tested in this study, the conclusion may be premature.

which is oriented toward more labor intensive, local resource use, will impose a larger demand on the Appalachian Region. Thus, the demand from levee construction will be almost twice that from powerhouse construction.

Appalachian demands resulting from the two types of private expenditures are $617 from an average private investment and $601 from personal consumption expenditures.[10] Although no on-site demand and unallocated costs were designated for non-water projects, Appalachian demands from these outlays are well above the mid-range between the two extreme water projects. These spending patterns demonstrate that leakage from off-site demand outside of Appalachia are much less than those from water resource investments. No off-site demands imposed on Appalachia from water projects exceed 25 percent of project costs, while those from the two private expenditures exceed 60 percent. This means that more off-site demand will be retained in Appalachia from most private investment and personal consumption expenditures compared to those from water resource projects.

Sensitivity of Gross Output

Gross outputs required to deliver the final demand imposed on the Appalachian Region per $1,000 expenditure by major industry and

[10]Private investment and consumption expenditures as alternatives to public water resource investment are also hypothetical and are not realistic actualities since public water expenditures are planned in the absence of private industry. Therefore, it is meaningless to compare public and private investments in terms of ability to retain regional demand unless it is to find out the possibility of a public subsidy to private industry. It is also unrealistic to assume that all project costs might be given to the region merely for the purpose of spending, as with a welfare grant. However, these tests are still useful in finding out the relative strength of water resource investments in utilizing local resources compared to those of other alternative types of projects.

type of expenditure is shown in Table 37. The first three columns show the impacts of ULP construction on the gross outputs to deliver $1,000 project cost at the planned location and those if the project location is shifted to other regions in Appalachia. Gross outputs resulting from the ULP at each alternative location are: $931 in Region 2, $966 in Region 1 and $897 in Region 3. The range of difference in gross outputs from alternative locations is $69 for each $1,000 of project cost. The major difference in gross outputs resulting from alternative project regions is mainly attributable to the differences in the demands for service, transportation, warehousing and, to a lesser extent, to demands for durable goods.

The differences in gross outputs expected from the three alternative water projects at the same location are much more distinctive than those from alternative locations. Outputs from a powerhouse are $627, the lowest value, while those from levee construction are $1,053 per $1,000 project cost, the highest among the three projects. The range of variation is $426 per $1,000 project cost. Gross outputs expected from levee construction are almost 170 percent higher than those from powerhouse construction. Levee construction requires over two times the mining projucts and 1¼ times the service products but substantially fewer manufactured durable goods than does the ULP. On the other hand, powerhouse construction requirements are 40 percent less for nondurable goods and 60 percent less for products from the trade and service industries combined, than those for the ULP, but it requires almost twice the durable goods.

Both consumption and private investment expenditures have the potential to induce higher gross outputs per $1,000 project cost than those from the water projects listed here. Gross outputs of $1,170 are

TABLE 37

DISTRIBUTION OF GROSS OUTPUT BY MAJOR INDUSTRY
PER $1,000 EXPENDITURES WITH CHANGES IN
THE LOCATION AND THE MEASURE USED

Unit: 1958 dollars

Industry & Input-Output Study Sectors	U.L.P.[a] Construction	U.L.P. in Region 1	U.L.P. in Region 2	Levee Construction	Powerhouse Construction	Consumption Expenditures	Private Investment
Agriculture, forestry & fisheries, 1-4	10	6	12	13	6	23	11
Mining, including crude petroleum, 5-10	31	34	29	77	3	10	11
Construction, 11 & 12	21	20	19	26	12	32	482
Non-durable goods manufacturing, 14-19, 24-34	92	78	89	90	35	118	45
foods, textile & apparel, 14-19	34	28	39	44	19	80	19
other non-durable goods, 24-34	58	50	48	46	16	38	26
Durable goods manufacturing, 13, 20-23, 35-64	70	106	81	43	134	35	132
Lumber & wood products, 20-23	5	5	6	5	6	6	16
Stone, clay & glass products, 35-36	15	15	15	6	10	4	26
Primary metals, 37-38	8	12	11	5	15	2	22
Fabricated metals, 39-42	11	15	17	4	10	2	16
Non-electrical machinery, 43-44, 46-52	3	5	3	2	43	2	15
Construction machinery, 45	8	11	6	4	1	-	2
Electrical machinery, 53-58	2	3	3	3	42	4	11
Transportation equipment, 13, 59-61	16	39	19	12	5	12	21
Miscellaneous, 2-64	2	2	2	2	1	3	3
Transportation & Warehousing, 65	21	48	9	29	14	17	15
Wholesale & Retail trade, 69	269	274	267	260	179	31	192
Service, 66-68, 70-82	931	966	897	1,053	627	1,170	1,141

Note: [a]The Upper Licking Project which will be located in Region 2.

Columns may not add because of rounding.

expected to be induced per $1,000 consumption expenditures and $1,140 per $1,000 representative private investment expenditures. It is interesting to note the fact that although the Appalachian final demands per $1,000 expenditures resulting from these two measures are lower than those from water projects except for the powerhouse, the level of gross outputs induced by private expenditures are higher than those induced by water projects. It seems that consumption and private investment expenditures stimulate the parts of the economy which have greater linkage effects among industries, as compared to investments from water projects.[11]

Looking into gross outputs by industry sector, the final demand vector imposed by consumption expenditures on the local economy induce substantially more nondurable goods and service products than those induced by water projects. An average private investment expenditure, on the other hand, will induce very high construction demand which will be more than 40 percent of gross outputs. This indicates a predominant need for durable goods and minor requirements for output from the trade and sercice sectors, relative to the other types of investment shown here.

Sensitivity of Employment Generation Benefits

As in the case of the analysis of Appalachian demand and gross output to satisfy the Appalachian demand, the sensitivity of EGB resulting from alternative regions and types of projects, according to their

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[11] Linkage effects are one very important investment criterion in a developing economy. For further discussion of linkage effects see, Alberto O. Hirshman, Strategy of Economic Development (New Haven: Yale University Press, 1958). While sectoral analysis is not the main purpose of this study, a sectoral study through input-output analysis will reveal important relationships between the types of input demanded and industrial outputs required to satisfy these demands. These relationships will, in turn, give the direction of inter-industry relationships and the level of gross outputs to the economy.

sources of origin, will be investigated. The measurement of EGB will be based on the Linear Resource Response Function, which is a representative average resource response function.

EGB from on-site demand have depended on the unemployment rate, by major occupation, in a Project Impact Area[12] such as the Upper Licking Area, in Region 2, in the case of the ULP. In order to measure EGB from alternative project locations for the ULP, therefore, project impact areas associated with alternative project regions should be designated, and the major occupational unemployment rates in those areas should be estimated. Since alternative location associated with alternative project regions are hypothetical, no precise location can be given. Therefore, the estimation of unemployment rates in the new impact area is impossible. For planning purposes, however, it is assumed that the major occupational unemployment rates in the new impact areas associated with alternative ULP regions will be similar to those average rates, for the construction period, in the corresponding project region.[13]

Employment Generation Benefits from On-Site Wage Demand

Table 38 shows estimated EGB from on-site wage demand per $1,000

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[12]Project impact area is used as an area limited by the major source of local labor supply and within commuting distance from the project. For example, the Project Impact Area for the ULP is the Upper Licking Area which includes six county areas surrounding the Project site.

[13]The estimated average unemployment rate in the Upper Licking Area for the construction period was 12.5 percent. The estimated average unemployment rates in Regions 1 and 3 were 6.4 and 4.4 percent respectively, which are substantially lower than the rate in the Upper Licking Area. Chapter II has revealed that the major portion of off-site demand for resources which is almost equal to on-site demand, will be imposed on the project region. Therefore, total EGB depend largely on the rate of unemployment in the project region as well as in the project impact area. The assumption of an unemployment rate in the Project Impact Area which is associated with the average for Region 1 or 3 may significantly under-state the outcome of EGB compared to a project located in the Upper Licking Area.

TABLE 38

EMPLOYMENT GENERATION BENEFITS FROM ON-SITE WAGE DEMAND RESULTING FROM PROJECT CONSTRUCTION AND ITS DISTRIBUTION PER $1,000 PROJECT COST BY OCCUPATION & TYPE OF PROJECT BASED ON LINEAR RESPONSE FUNCTION

Unit: 1958 dollars

Occupation	Upper Licking Project (ULP)	ULP Shifted to Region 1	ULP Shifted to Region 3	Levee Construction	Powerhouse Construction
Professional, technical and kindred workers	$ 47,962 (1)[a]	$ 10,660 (-)[b]	$ 5,330 (-)	$ 93,011(3)	$ 46,505(1)
Managers, officials and proprietors, except farmers	14,909 (-)	3,866 (-)	552 (-)	29,370(1)	11,014(-)
Clerical and kindred workers	27,262 (1)	9,371 (-)	5,111 (-)	45,007(1)	27,004(1)
Sales Workers	0	0	0	0	0
Craftsmen, foremen and kindred workers	4,985,755 (152)	1,408,938 (43)	645,722 (20)	4,228,019(129)	2,664,800(81)
Operatives and kindred workers	1,571,848 (48)	480,355 (15)	200,149 (6)	3,093,670(94)	795,515(24)
Service workers	0	0	0	0	0
Laborers, except farm and mine	1,424,050 (43)	700,718 (21)	256,172 (8)	1,179,747(36)	589,873(18)
Farmers and farm laborers	0	0	0	0	0
All Occupations	$8,073,232 (246)	$2,613,908 (79)	$1,113,036 (34)	$8,668,824(265)	$4,134,711(126)

Note: [a]Figures in parentheses show dollars per $1,000 project cost.
[b](-) means less than $.5.
To arrive employment generation benefits occupational unemployment rates in the Impact Area were applied for the Upper Licking, Levee, and Powerhouse Project, and Unemployment rates in Project Region were applied when ULP shifted to Region 1 & 3.
Columns may not add because of rounding.

expenditure by occupation and type of expenditures. No on-site wage demands were assumed for private investment and consumption expenditures. On-site EGB from the ULP in Region 2 were estimated to be $246 per $1,000 project cost, but this will be drastically reduced if the project region is altered. On-site EGB derived for Region 1 are $79 and $34 in Region 3. The range of difference between EGB at the planned ULP location and in Region 3 will be approximately $200 per $1,000 of project costs; conversely EGB from Region 2 are expected to exceed those if the ULP is shifted to Region 3, by more than 700 percent. The range of gross outputs resulting from alternative project locations was only $69. The large difference in the range of EGB is attributed to the variation in the occupational unemployment rates in each Impact Area of a region. The average unemployment rate for the construction period in Regions 1 and 3 are 6.4 and 4.4 percent respectively contrasted to 15.2 percent in the Upper Licking Area.

On-site EGB from alternative types of expenditures in the Upper Licking Area are also shown in Table 38. Estimated EGB from the two types of water project other than the ULP are: $265 for levees and $126 for powerhouse construction. These differences are naturally due to the differences in the level of total on-site wage demand and their distribution pattern among major occupations. The larger the wage demand for the class of occupation for which the greater idle status prevails, the greater will be the EGB.

As the Table shows, EGB for white-collar workers are insignificant. The largest percentage share of EGB from this class of workers is two percent maximum in the case of levee and powerhouse construction. The main reason for this, of course, is that the demand for these workers is significantly less[14] than demand for other classes of workers, and unemployment rates for these workers in the Impact Area are not high compared to national rates. No service and farm workers are required for on-site demand. Major demand for on-site labor is for blue-collar workers, and unemployment rates for these workers are significantly higher than the national average. About 60 percent of EGB is expected from the craftsmen, foremen and kindred worker class. Since the region is abundant in idle unskilled labor, greater benefits from the use of this type of labor are desired and have been expected as the effect on on-site demand resulting from water project construction. However, the maximum benefits from the use of unskilled labor shows only $43 per $1,000 of project cost or the proportion of EGB from unskilled labor to total EGB from on-site demand for labor would be: 17 percent from ULP and 14 percent for both levee and powerhouse.

Employment Generation Benefits from Off-Site Labor Demand

Table 39 shows EGB resulting from Appalachian off-site demand for labor and its distribution per $1,000 expenditure by occupation and type of measure, including private investment and personal consumption spendings. EGB from off-site demand for labor resulting from the three alternative project regions are: $40 from Region 1, $51 from Region 2 and $21 from Region 3. The range of difference is $30 per $1,000 outlay. EGB from levee and powerhouse construction are $45 and $28 respectively, and the range of difference in EGB from alternative public water projects in the same location is only $17. EGB from

[14]Demand for on-site white-collar workers as a proportion of total on-site demand for labor is: eight percent for the ULP and 14 percent for both levee and powerhouse construction.

TABLE 39

EMPLOYMENT GENERATION BENEFITS RESULTING FROM OFF-SITE DEMAND FOR LABOR AND ITS DISTRIBUTION PER $1,000 EXPENDITURES, BY OCCUPATION AND MEASURE USED BASED ON LINEAR RESPONSE FUNCTION

Unit: 1958 dollars

Occupation	Upper Licking Project (U.L.P.)	U.L.P. in Region 1	U.L.P. in Region 3	Levee	Powerhouse	Private Investment	Consumption Expenditures
Professional, Technical and kindred workers	$ 23,750 (1)[a]	$ 32,210 (1)	$ 15,881 (-)[b]	$ 29,223 (1)	$ 16,580 (1)	$ 20,003 (1)	$ 33,048 (1)
Managers, officials and proprietors, except farmers	76,176 (2)	80,082 (2)	13,584 (-)	81,360 (2)	51,175 (2)	79,718 (2)	91,564 (3)
Clerical and kindred workers	104,317 (3)	132,700 (4)	68,740 (2)	116,148 (4)	72,057 (2)	88,723 (3)	133,508 (4)
Sales workers	91,516 (3)	98,117 (3)	44,250 (1)	92,322 (3)	62,729 (2)	67,509 (2)	110,477 (3)
Craftsmen, foremen and kindred workers	356,167 (11)	320,848 (10)	148,552 (5)	392,545 (12)	241,409 (7)	944,034 (29)	411,358 (13)
Operatives and kindred workers	358,449 (1)	366,491 (11)	163,622 (5)	413,371 (13)	262,493 (8)	420,328 (13)	386,917 (12)
Service workers	40,878 (1)	18,417 (1)	13,046 (-)	16,534 (1)	11,166 (-)	36,530 (1)	18,911 (1)
Laborers, except farm and mine	258,982 (8)	631,861 (19)	229,431 (7)	334,232 (10)	193,074 (6)	176,761 (5)	383,766 (2)
Farmers and farm laborers	4,250 (-)	1,384 (-)	1,946 (-)	5,281 (-)	2,495 (-)	5,065 (-)	9,448 (-)
All Occupations	$1,311,496 (40)	$1,682,110 (51)	$699,051 (21)	$1,481,017 (45)	$913,178 (28)	$1,618,031 (56)	$1,578,996 (48)

Note: [a]Figures in parentheses show dollars per $1,000 project cost.
[b](-) means less than $.5.
Columns may not add because of rounding.

private investment are $56 and are $48 from personal consumption expenditures. The variation in EGB appears to be more directly associated with changes in project location than in project type. However, this is not necessarily true in all cases, particularly if the distribution pattern of idle resources changes.

Sensitivity of Total Employment Generation Benefits

EGB from the use of idle capacity and mixed factors are also estimated according to the procedures laid out in Chapter III. Total EGB and their major sources under various expenditure conditions are shown in Table 40. As seen in Table 40, EGB per $1,000 cost resulting from different types of expenditures vary significantly. EGB per $1,000 project cost resulting from the ULP located in alternative Regions are: $325 from Region 2, $174 from Region 1 and $89 from Region 3. EGB from the construction of a levee or a powerhouse to replace the ULP were estimated to be $375 and $176 respectively. EGB from the assumed spendings for private business investment and consumption expenditures in the Upper Licking Area were estimated to be $76 and $92 respectively. Despite possible measurement errors, EGB from water resource investment expenditures in Region 2 are significant, while EGB from the alternative circumstances are not so impressive.

EGB from alternative project locations range from a low of $89 to a high of $325. The range of fluctuation is $236. The primary cause of this fluctuation is the uneven distribution of idle resources within and among different subregions, and especially the more significant differences between impact areas within subregions. The range of EGB from alternative types of water projects, on the other hand, is from $176 to $375 showing a fluctuation of about $200. This seems to result from differences in ability to retain final demand in the Appa-

TABLE 40

EMPLOYMENT GENERATION BENEFITS PER $1,000 EXPENDITURES

BY SOURCES, LOCATION AND MEASURE USED

Unit: 1958 dollars

Sources of Benefits	ULP R-2	ULP R-1	ULP R-3	Levee R-2	Powerhouse R-2	Private Investment R-2	Consumption Expenditures R-2
On-site labor	246	79	34	265	126	0	0
Off-site labor	40	51	31	45	28	56	48
Capital return	18	21	20	25	14	15	31
Mixed factors	22	23	14	40	8	8	13
TOTAL	325	174	89	375	176	79	92

lachian economy from different investment expenditures.

The fluctuation of EGB from alternative project locations slightly exceeds that from alternative types of water projects.[15] Previously, regional demands and gross outputs resulting from a change in project location have shown a greater variation than that from a change in project type. The change in the pattern of variation seems to be attributable to changes in the distribution patterns of idle resources in different project regions and project impact areas.

With regard to the composition of EGB from various sources, EGB attributable to idle labor are the largest single item. The labor share exceeds 70 percent of total EGB, except for 61 percent in the case of the ULP in Region 3 and 52 percent from private consumption spendings in Region 2. Low EGB attributable to idle labor in the case of the ULP in Region 3 were expected, because Region 3 as a whole has a lower average unemployment rate than the national average. Of total idle labor, the on-site labor share is the most significant factor influencing the level of total EGB. The share of on-site labor required for the alternative water projects in Region 2 accounts for over 70 percent of the total EGB, while the low EGB from the two private expenditures are associated with an absence of demand for idle on-site labor.

Sensitivity of EGB due to O & M and Economic Expansion

EGB from the O & M of water projects and economic expansions in-

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[15] This conclusion applies only to the Appalachian Region, and it applies only when we assume that the unemployment rate in the immediate project area is the same as the average unemployment rate in each project region except when the project location is in Region 2. Unemployment rates in the Impact Area in Region 2 are much higher than those of Region 2, and this would be true for the Impact Areas in Region 1 or 3. If the unemployment rates in alternative Impact Areas in each region did not vary widely, this conclusion might well be reversed.

duced by water resource investments should influence the ultimate level of EGB. The impacts of initial investment and O & M of water resource developments on the expansion of a local economy beyond normal multiplier effects involve a complicated analysis, for which no satisfactory techniques have been developed at this time.

Many depressed areas are undergoing structual economic changes which may prevent the alternation of current economic patterns by merely increasing effective demand through initial water resource investment expenditures. The success of a long-term study such as the ULP, therefore, depends on the prospect that the project can stimulate local economic development. Under such conditions, the magnitude of EGB expected from a developmental response to a change in the location and type of water resource investment project might be a more important planning element than that derived exclusively from the construction expenditures for a project.[16] An analysis of economic developmental potentials and associated EGB resulting from alternative locations and expenditure type was not undertaken, because it is beyond the scope of this study.

Sensitivity of Benefit Cost Ratio and Social Costs under Various Investment Conditions

Impact of EGB on the B/C ratio

In Chapter III, we measured the index of the B/C ratio which will be credited by the EGB from the ULP construction by dividing EGB by the actual cost (money cost) of the ULP. B/C ratios creditable to

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[16] It is conceivable that a project with less EGB during the construction phase of initial investment is associated with larger EGB during the O & M phase or even larger EGB from subsequent economic development compared to the project which might induce larger EGB during the construction phase.

EGB from a project under various investment conditions can be obtained by dividing the EGB shown in Table 40 by $1,000. The EGB from a hypothetical private business investment and private consumption expenditures were introduced primarily to compare the impacts of these expenditures on the patterns of sectoral demand with those from water projects. The Impacts of EGB on the B/C analysis, therefore, will be limited to water project investments.

Benefit-cost ratios attributable to EGB resulting from alternative ULP regions are estimated to be: .174 when the ULP shifted in Region 1, .324 in Region 2 (in the Upper Licking Area) and .089 in Region 3. The range of fluctuation is approximately .240. Estimated impacts of EGB on the B/C ratio from alternative types of water projects in the ULP area again will be: .325 for the ULP, .375 for a levee and .176 for powerhouse construction. The range of fluctuation due to alternative types of projects is about .2 which is slightly less than in the case of alternative project locations. The significance of these ratios, the primary reasons for fluctuations among different investment conditions and the major sources of these ratios have been explained in the discussion of total EGB in the preceding section.

Social Costs of the Project

The social cost of a public expenditure can be measured by deducting EGB attributable to the project from actual project cost (money cost), or money costs can be multiplied by their shadow factors, which is the fraction of money cost equivalent to true cost to the society and is derived by deducting the B/C ratio from unity. The shadow factors of project costs for the ULP in alternative locations are: .911 in Region 3, .826 in Region 1 and .675 in Region 2. This means that the social costs (opportunity costs) of each $1,000 project costs will become $911, $829 or $675 depending on the project region selected. The shadow factors for the alternative types of water resource investment expenditures in the same general area will become: .826 for a power-house, .675 for the ULP and .625 for a levee. If we assume that private consumption expenditures result from some form of federal welfare support, the estimated shadow factor for this type of expenditure will be .908.

Shadow factors may further decline, except those for personal consumption expenditures, if there are additional EGB from O & M expenditures or from induced area development. Although impacts from O & M and area development induced by the project are not considered, those shadow factors limited to the construction phase of the water project are significant, except in the case of the ULP in Region 3.

The range of fluctuation in shadow factors for alternative water project locations was .236, and that for alternative project types was .200. In either case, the variation in shadow factors due to a change in project location only, or due to a change in project type only, is significant. This judgment is applicable in the case of EGB and also their impacts on the B/C ratio.

Summary

The sensitivity of sectoral demand and EGB, and of the impacts resulting from these on the B/C ratio or on the social costs of a water resource investment project, to changes in the location and type of project, has been investigated. Two additional private expenditures were analyzed to compare the pattern of expenditure impact on sectoral demand with those from water resource investment.

Since the Appalachian economy is far from self-sufficient, leakages from inputs originally demanded for an investment in Appalachia are significant, and can range from $232 to $601 per $1,000 expenditure under various conditions. A capital intensive project requires more inputs from outside of Appalachia, while a labor intensive project retains the largest demand in Appalachia. A comparison of the retainability of regional final demand, between a public water project and other private expenditures in Appalachia, is not conclusive. This depends on the individual project or expenditures. However, water projects generally impose heavy demands on trade, transportation and service sectors. Private investment expenditures impose heavy demands on the service and nondurable goods sectors. The heaviest demand is imposed on the project region and the project impact area, in the form of on-site demand.

The pattern of gross output by industry and subregion of Appalachia, generally, follows the pattern of the final demand vector. However, gross output resulting from private expenditures has shown greater inter-industry demand. Selection of alternative regions and types of expenditures can both casue differences in final demand as well as gross output, but a change in the type of expenditure has the more significant effect.

EGB divided by project costs yields a measure of the impact of EGB on the B/C ratio, and the shadow factor is obtained by deducting this B/C ratio from unity. EGB and their impact on the B/C ratio and the social costs of the project have been investigated only for the construction period. EGB per $1,000 project costs and their impacts on the B/C ratio and social costs vary significantly under various expenditure conditions. EGB and their impacts on the B/C ratio are the joint functions of (1) project type (2) project location (3) project impact on local economic development, (4) distribution pattern of idle resources (5) demand pattern for the resources and (6) resource response to demand. Unlike the case of regional demand and associated gross output, variation in EGB was greater due to changes in the project location than that from changes in project type.

Although Appalachia as a whole is a depressed area, EGB resulting from investment expenditures are not always significant. These depend on investment conditions. EGB resulting from the ULP in Region 3 and private consumption expenditures in Region 2 are not impressive, especially when possible measurement error is considered. The significance of EGB from each investment circumstance may be more distinctive if possible EGB from O & M and subsequent economic development are counted.

A major source of EGB is the demand for labor, particularly demand for on-site labor. Projects associated with high demand for on-site labor and occupations with low skill along with a high unemployment rate in the project region and in the project impact area have potential for large EGB and associated impacts on the B/C ratio.

An efficient allocation of public expenditures in water resource development in the Appalachian Region, therefore, requires a comparative study between the investment impact on EGB resulting from a given type of water project and those of competing projects to the maximum extent possible. The competing projects should include other types of water projects which are associated with different project regions and also public works projects other than for water resource investment.

CONCLUSIONS

The traditional benefit-cost analysis, which is based on an implicit assumption of full employment and maximization of national income benefits, has recently been challenged with regard to its adequacy in evaluation of public expenditures under conditions of less than full employment. In the traditional approach, benefits are limited to the direct output of the project, defined as primary benefits and project costs are implicitly assumed to approximate opportunity costs of the project defined as social costs. In areas and/or periods of less than full employment, project investment may stimulate economic activity that may generate new employment benefits in addition to primary benefits, or conversely social costs of the project could be less than the market prices to the extent that otherwise idle resources are used for the project. Thus, application of the traditional B/C analysis in the evaluation of public expenditures during periods of less than full employment may fail to accurately indicate the economic efficiency of resource allocation. Therefore, some procedural revision may be warranted.

To improve the B/C analysis relative to periods of less than full employment, a model has been constructed for estimating EGB as the result of a federal water resource investment in chronically depressed Appalachian Regions by applying a technique of input-output analysis. The practical significance of these benefit impacts on the social costs of the project and on the B/C ratio were investigated. The report of the Upper Licking Project proposed for construction in Mogoffin County in the Appalachian portion of the Commonwealth of Kentucky was restudied for this purpose.

The model involves a projection of long-term rates of resource idleness and of the demand for resources resulting from the water resource investment expenditures, along with a measurement of the extent of the utilization of otherwise idle resources resulting from the project, treated as employment generation benefits.

Projected long-term unemployment rates in Appalachia over a 50-year period are expected to be much higher than the national average. The major demand from water resource investments is expected to be for blue-collar workers. The difference in unemployment rates for these workers, between the nation and Appalachia, far exceeds the corresponding difference in total unemployment rates. Total unemployment rates projected for the construction period are 4.6 percent for the U.S., 5.9 percent for all Appalachia and 15.2 percent for the Upper Licking Area. If underemployment is considered, the total projected unemployment rate in the Upper Licking Area would be 45.5 percent. It has been estimated that an increase of one percent in the national average unemployment rate would involve a two percent rise in Appalachian unemployment, with a 4.5 percent rise in the unemployment rate of blue-collar workers. The excess industrial capacity rate during the period under study was estimated to be 9.7 percent.

To estimate the direct and indirect demand for the factors of production resulting from the Upper Licking Project, project costs have been broken down into on-site demand (direct labor demand), off-site material demand and unallocated demand. To estimate the indirect demand for the factors of production (off-site factor demand), industrial outputs resulting from construction, O & M and the increased Appalachian export capacity induced by the project have been projected through the use of an existing input-output model of Appalachia. Industrial outputs have been further disaggregated into the demand for labor and the demand for capital and mixed factors by industry and by subregion of

Appalachia. The total demand for labor (on-side and off-site) has been broken down into nine major occupations. The estimated resource demand imposed on the subdivisions of Appalachia can be met adequately by the available supply of idle resources in these areas.

In terms of viable growth, the Appalachian Region is far from being a self-sufficient economy. Each subregion of Appalachia has a different production function and maintains varying trade relationships with other regions internal and external to Appalachia. The leakage from Appalachia due to the nature of inputs demanded for the water resource investments is very significant. The patterns of input demand and the associated industrial output imposed on the Appalachian economy vary significantly with changes in the type and location of projects. However, the variations in regional final demand and the associated gross output resulting from changes in project type are greater than those from the changes in project location. Generally, a labor intensive project has tended to impose greater regional demands than a capital intensive project. Whether the regional final demand imposed by water resource projects is larger than that from nonwater projects can not be verified. Water projects in general, however, show the greatest demand for industrial output in the trade, service, transportation and warehousing sectors, while private investments impose a heavy demand on construction and durable goods. Private consumption expenditures exert a heavy demand for consumer goods and services.

The demand for labor is the largest single factor of total demand. In no case is the demand for labor below 70 percent of the total demand for the factors of production. In the case of construction and O & M of the ULP, the off-site labor demand is as large as, or larger than the on-site labor demand. More than 90 percent of the on-site demand is for blue-collar workers, while the demand for white-collar and service workers is equal to, or greater than for blue-collar workers in the case of the off-site labor demand.

Estimated EGB resulting from the ULP would be substantial. Average annual EGB per $1,000 of Upper Licking Project costs are estimated to be $325 for the project construction, $360 when O & M expenditures are included and $927 when benefits resulting from area development stimulated by the project are added. The EGB from area development is the largest benefit source, which accounts for more than 60 percent of the total EGB.

The social costs per $1,000 of project cost, derived by deducting EGB from actual project costs, will decline from $675 ($1,000 - $325) for project construction to $640 and $73, respectively, when the collective impacts of O & M expenditures and area development are considered. Thus, the traditional national efficiency B/C ratio of .305 would be adjusted upward to .665 when project construction and O & M expenditures are included and to 1.197 for the total project when area development is added. Therefore, the traditional B/C analysis based on full-employment assumptions in this case will significantly mislead an efficient resource allocation by the society, and some type of corrective action is necessary.

As with the variation in the final demand and the industrial output resulting from changes in location and type of project investment;the EGB, social costs and their impacts on the B/C ratio will fluctuate substantially.

The EGB per $1,000 of Upper Licking Project construction costs range from $325 to $89 when the project is relocated to another subregion of Appalachia and from $362 to $178 when two additional types of water projects, levee and powerhouse, are introduced. Although Appalachia as a whole is depressed, the EGB resulting from a water project and from private expenditures are not always impressive. However, the variation in the EGB from changes in location and type of project is significant. Unlike the case of industrial output, the variation here is larger from changes in project location than from changes in project type.

So far, the EGB have been estimated by several methods based on assumptions that were supposed to reflect actual conditions. Some of the methods critical to the entire study are: (1) the use of regression and relative share methods in projecting unemployment rates in Appalachian regions and the substitution of national excess capacity rates for those in Appalachian regions, (2) the use of a static input-output model, and static labor and occupation coefficients to estimate the demand for industrial output and for major occupations resulting from O & M and area development induced by the project, (3) the justification and measurement of an assumed potential for the economic development induced by the project, which occupies a critically dominant role in the entire B/C analysis, and (4) the determination of resource response functions, based on a hypothetical rather than an empirical evidence. The classification of types of resources and the use of uniform maximum unemployment and excess capacity rates for each type of resource is somewhat arbitrary.

To improve the reliability of the estimated EGB, further efforts are necessary requiring additional information on those subjects listed above.

In spite of some weaknesses in the methodology, the following final conclusions are made:

(1) The evaluation of public water resource investments in a chronically depressed area requires a modification of the conventional B/C analysis to incorporate EGB or to discount project costs to equate with the social costs of the project,

(2) The investigation of the economic impact of a public project on the use of idle resources should not stop with the construction and O & M but should be extended to the phase of economic development induced by the project.

(3) The significance of EGB resulting directly from investments varies with the type and location of project, with the distribution pattern of idle resources, with the demand pattern for the factors of production, and with the response pattern of idle resources to incremental demand. The variation in EGB resulting from the area development will add further significance to the measurement of EGB.

(4) Public water resource investment decisions, therefore, should be more discriminating with regard to the type and location of investments. This requires investigations of foregone EGB from differing types of water projects and from competing public works projects.

APPENDIXES

APPENDIX A

NATIONAL FINAL DEMAND VECTOR

PER $1,000 PROJECT COSTS

FOR A CLOSED INPUT-OUTPUT MODEL

APPENDIX A

NATIONAL FINAL DEMAND VECTOR PER $1,000 COST FOR WATER RESOURCE INVESTMENT PROJECTS

Industry Number	Large Dam and Power	Dredging	Large Earth Fill Dam	Small Earth Fill Dam	Local Flood Protection	Pile Dikes	Levees	Revet-ments	Miscel-laneous	Power-house	Medium Concrete	Lock and Concrete
1	--	--	--	--	--	--	--	--	--	--	--	--
2	--	--	0.18	0.91	0.28	--	0.25	--	1.12	0.02	0.06	0.97
3	--	--	--	--	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	--	--
9	41.08	0.01	0.24	23.69	40.94	121.50	72.69	303.79	22.66	3.29	1.57	65.89
10	--	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	--	--	--	--	--	--
13	--	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	0.46	2.09	--
17	0.16	0.84	0.22	--	0.01	--	--	--	--	--	0.12	--
18	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	0.32	--	--	--	--	--	0.39	0.01
20	5.74	0.06	7.82	5.78	11.52	55.21	1.14	45.54	20.47	11.68	5.17	4.52
21	--	--	0.02	--	--	--	--	--	--	--	--	--
22	--	--	0.02	--	--	--	--	--	--	0.22	--	--
23	0.44	--	0	0	0.04	--	--	--	--	0.52	--	--
24	0.78	--	--	--	--	--	--	--	--	0.14	0.01	--
25	--	--	--	--	--	--	--	--	--	--	0.29	--
26	0.14	--	--	--	--	--	--	--	--	--	--	--
27	6.66	13.57	17.21	47.82	2.63	14,47	1.42	--	24.00	0.84	8.51	1.28
28	--	1.08	--	--	0.11	--	--	--	0.09	--	--	--

APPENDIX (cont.)

Industry Number	Large Dam and Power	Dredging	Large Earth Fill Dam	Small Earth Fill Dam	Local Flood Protection	Pile Dikes	Levees	Revet-ments	Miscel-laneous	Power-house	Medium Concrete	Lock and Concrete
29	--	--	0.17	--	0.57	--	--	--	0.03	--	--	0.65
30	0.06	--	0.19	0.09	0.08	--	0.02	--	0.11	1.69	1.23	1.08
31	11.15	87.11	69.87	56.34	24.31	28.49	77.42	41.81	84.15	2.09	4.94	13.47
32	6.97	--	10.09	7.41	7.27	3.96	11.14	3.18	12.22	1.91	1.97	3.97
33	--	--	--	--	--	--	--	--	--	--	--	--
34	--	--	--	--	--	--	--	--	--	--	--	0.01
35	--	--	0.01	--	--	--	--	--	--	0.13	--	--
36	59.87	--	14.10	9.77	68.53	--	0.61	0.23	54.16	13.81	94.42	120.13
37	31.51	44.14	1.19	3.27	4.64	4.15	1.44	1.75	36.18	5.49	27.85	65.33
38	3.26	0.68	0.46	0.23	0.31	--	0.03	1.76	--	7.62	4.94	1.52
39	--	--	--	--	--	--	--	--	--	--	--	--
40	70.82	0.56	51.04	26.42	112.91	--	5.33	0.20	0.28	27.90	77.70	43.98
41	0.15	--	--	0.18	0.09	--	--	--	--	1.22	--	2.53
42	6.18	20.69	5.35	4.66	12.63	16.27	5.10	8.65	5.00	12.44	4.82	5.51
43	33.15	--	--	--	--	--	--	--	0.09	216.72	1.17	4.80
44	--	--	0.12	0.02	--	--	0.26	--	0.01	0.15	0.08	0.05
45	44.35	31.93	103.61	150.87	41.00	60.18	71.66	19.75	107.28	24.34	83.59	109.06
46	2.42	--	3.84	2.25	--	--	--	--	--	30.07	24.40	29.82
47	2.43	0.09	0.38	0.51	0.20	--	--	--	--	1.30	2.30	0.18
48	0.14	--	-	0.45	0.07	--	0.02	--	0.16	--	0.01	0.40
49	2.12	0.50	9.53	10.15	2.84	6.32	0.59	0.05	9.21	6.42	9.06	9.60
50	--	--	0.08	0.25	--	--	--	--	--	0.02	0.51	11.66
51	0.80	--	--	--	--	0.56	0.06	--	0.97	--	--	0.78
52	2.43	--	0.60	--	--	--	--	--	--	0.12	8.84	--
53	45.22	--	1.24	1.05	0.54	--	0.23	--	--	288.90	2.77	6.05
54	--	--	--	--	0.54	--	--	--	--	--	--	--
55	--	0.47	0.70	0.79	0.13	--	0.02	--	0.27	3.28	--	12.93
56	0.85	--	0.26	--	--	--	--	--	--	0.44	--	--
57	--	--	--	--	--	--	--	--	--	--	--	--
58	--	--	--	--	0.05	--	--	--	--	0.03	--	--

APPENDIX A (cont.)

Industry Number	Large Dam and Power	Dredging	Large Earth Fill Dam	Small Earth Fill Dam	Local Flood Protection	Pile Dikes	Levees	Revetments	Miscellaneous	Powerhouse	Medium Concrete	Lock and Concrete
59	3.87	1.23	76.65	75.03	21.23	8.85	9.56	4.49	49.57	4.02	16.71	11.9[illegible]
60	--	--	--	--	--	--	--	--	--	--	--	--
61	1.63	149.76	--	--	0.01	37.99	13.03	15.52	0.81	0.01	3.81	9.22
62	1.72	0.19	0.02	0.02	0.15	--	--	--	0.16	1.01	0.27	--
63	--	--	--	--	--	--	--	--	--	--	--	--
64	0.01	--	0.01	0.01	0.09	--	0.05	--	0.27	1.84	0.02	--
65	39.20	16.89	15.52	31.28	38.33	88.20	53.75	193.26	34.72	22.70	18.86	61.13
66	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
67	--	--	--	--	--	--	--	--	--	--	--	--
68	2.79	3.00	2.79	2.79	2.79	2.79	2.79	2.79	1.85	1.43	16.64	1.13
69	61.47	55.71	114.30	116.46	81.74	69.15	55.67	72.81	106.16	90.37	83.63	99.04
70	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09
71	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90
72	--	--	--	--	--	--	--	--	--	--	--	--
73	--	--	--	--	--	--	--	--	--	--	--	--
74	--	--	--	--	--	--	--	--	--	--	--	--
75	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91
76	--	--	--	--	--	--	--	--	--	--	--	--
77	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
78	--	--	--	--	--	--	--	--	--	--	--	--
79	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
80	--	--	--	--	--	--	--	--	--	--	--	--
81	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
82	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
83	435.71	546.80	466.88	396.81	498.41	457.22	591.03	259.74	403.31	186.48	466.56	276.67
84[a]	514.26	453.20	533.12	603.19	501.59	542.78	408.97	740.26	596.69	813.52	533.44	723.33

-- represents less than .0005.

[a]Sum of sectors 1-82

APPENDIX B

PERCENTAGE DISTRIBUTION OF THE NATIONAL FINAL DEMAND VECTOR WITHIN, AND EXTERNAL TO APPALACHIA

APPENDIX B-1

PERCENTAGE DISTRIBUTION OF THE NATIONAL FINAL DEMAND VECTOR WITHIN, AND EXTERNAL APPALACHIA WHEN A PROJECT IS LOCATED IN REGION 1

Sector No.	Region 1	Region 2	Region 3	Outside Appalachia
1	36.4	0	0	63.6
2	17.2	0	.7	82.1
3	100.0	0	0	0
4	100.0	0	0	0
5	0	0	0	100.0
6	0	0	0	100.0
7	94.2	4.8	0	1.0
8	73.3	7.7	0	19.0
9	84.3	.1	0	15.6
10	7.8	0	0	92.2
11	100.0	0	0	0
12	100.0	0	0	0
13	5.5	3.0	2.2	89.3
14	24.5	1.4	1.6	72.5
15	45.2	0	9.2	45.6
16	6.3	1.1	18.4	74.2
17	9.2	6.9	4.2	79.7
18	5.7	2.0	5.2	87.1
19	3.3	.6	2.7	93.4
20	14.9	3.1	2.9	79.1
21	5.1	0	.2	94.7
22	10.1	3.1	7.6	79.2
23	31.9	.7	.7	66.7
24	40.4	1.3	1.9	56.4
25	35.6	1.5	1.3	61.6
26	37.1	2.2	1.5	59.2
27	19.9	10.5	2.3	67.3
28	27.7	8.7	5.7	57.9
29	7.9	.7	.6	90.8
30	13.5	0	.3	86.2
31	17.0	2.0	.4	80.6
32	10.8	.5	1.8	86.9
33	20.7	1.9	.6	76.8
34	19.0	1.1	.9	79.0
35	70.4	1.5	.6	27.5
36	52.7	1.9	.9	44.5
37	64.1	.8	.7	34.4
38	20.3	4.3	2.0	73.4
39	21.7	0	.2	78.1
40	29.0	.4	1.7	68.9
41	15.7	.3	.4	83.6
42	20.0	.8	.8	78.4
43	27.0	0	0	73.0
44	.4	.2	.6	98.8
45	7.4	.5	.2	91.9
46	7.9	.5	1.4	90.2
47	14.1	.0	.4	85.5
48	9.9	.1	3.1	86.9
49	22.4	.2	.5	76.9
50	3.7	.2	.6	95.5
51	19.3	0	.1	80.6
52	5.1	.1	.5	94.3
53	16.7	0	1.4	81.9
54	1.4	.1	3.3	95.2
55	17.2	1.0	1.1	84.7
56	5.9	1.2	2.4	90.5
57	17.5	.9	1.4	80.2
58	6.1	0	1.2	92.7
59	30.3	.3	.1	69.3
60	11.9	0	.8	87.3
61	29.4	.7	.6	69.3
62	12.1	1.2	.9	85.8
63	7.5	.4	1.0	91.1
64	7.6	.2	.5	91.7
65	63.7	0	0	36.3
66	100.0	0	0	0
67	100.0	0	0	0
68	100.0	0	0	0
69	97.0	.1	0	2.9
70	34.7	.3	.1	64.9
71	63.9	4.5	0	31.6
72	20.8	4.0	0	75.2
73	100.0	0	0	0
74	0	0	0	100.0
75	100.0	0	0	0
76	100.0	0	0	0
77	98.9	0	0	1.1
78	0	0	0	100.0
79	100.0	0	0	0
80	0	0	0	100.0
81	100.0	0	0	0
82	100.0	0	0	0
83	98.8	0	0	1.2

APPENDIX B-2

PERCENTAGE DISTRIBUTION OF THE NATIONAL FINAL DEMAND VECTOR WITHIN, AND EXTERNAL TO APPLACHIA WHEN A PROJECT IS LOCATED IN REGION 2

Sector No.	Region 1	Region 2	Region 3	Outside Appalachia	Sector No.	Region 1	Region 2	Region 3	Outside Appalachia
1	.7	57.9	5.9	35.5	43	16.7	0	0	83.3
2	0	30.1	.9	69.0	44	.2	.5	1.4	98.3
3	0	100.0	0	0	45	3.8	1.4	.4	94.4
4	0	100.0	0	0	46	4.3	2.0	2.9	90.8
5	0	0	0	100.0	47	7.0	.3	1.1	91.6
6	0	0	0	100.0	48	4.5	.8	9.3	85.4
7	0	100.0	0	0	49	11.4	1.0	1.4	86.2
8	0	10.0	0	90.0	50	1.9	.6	1.2	96.3
9	0	94.2	.7	5.1	51	7.9	0	.3	91.8
10	0	15.4	0	84.6	52	2.4	.3	1.2	96.1
11	0	100.0	0	0	53	10.1	.2	3.2	86.5
12	0	100.0	0	0	54	.6	.2	6.7	92.5
13	1.6	12.8	4.1	81.5	55	8.6	3.1	3.1	85.2
14	5.9	15.9	6.8	71.4	56	4.4	2.7	3.9	89.0
15	5.7	0	28.4	65.9	57	11.9	2.2	2.8	83.1
16	.7	4.6	38.4	56.3	58	2.4	0	2.2	95.4
17	1.4	43.0	8.6	47.0	59	5.5	6.3	.7	87.5
18	2.8	7.1	11.6	78.5	60	3.0	0	2.2	94.8
91	1.7	2.5	7.7	88.1	61	13.0	3.9	1.6	81.5
20	2.4	17.9	7.6	72.1	62	7.6	3.5	1.8	87.1
21	1.0	0	.5	98.5	63	4.8	1.2	2.5	91.5
22	2.3	13.7	15.6	68.4	64	3.7	1.6	2.0	92.7
23	13.8	5.7	2.6	77.9	65	.8	25.8	0	73.4
24	11.2	23.7	13.1	52.0	66	0	100.0	0	0
25	8.3	25.4	6.2	60.1	67	0	100.0	0	0
26	7.6	30.5	8.0	53.9	68	0	100.0	0	0
27	6.4	38.0	4.9	50.7	69	.1	96.3	0	3.6
28	9.2	35.5	16.5	38.8	70	4.6	25.0	.4	70.0
29	2.2	7.8	3.2	86.8	71	6.2	79.5	.1	14.2
30	4.9	0	1.7	93.4	72	2.0	33.6	0	64.4
31	5.3	11.6	1.0	82.1	73	0	100.0	0	0
32	5.5	2.4	5.5	86.6	74	0	0	0	100.0
33	6.0	15.9	2.7	75.4	75	0	100.0	0	0
34	8.4	5.4	2.9	83.3	76	0	100.0	0	0
35	21.0	32.9	8.6	37.5	77	0	97.1	.2	2.7
36	12.2	37.5	6.3	44.0	78	0	0	0	100.0
37	24.4	18.3	4.9	52.4	79	0	100.0	0	0
38	8.5	20.9	4.9	65.7	80	0	0	0	100.0
39	9.9	0	.9	89.2	81	0	100.0	0	0
40	10.4	4.7	7.3	77.6	82	0	100.0	0	0
41	6.2	1.3	1.8	90.7	83	0	98.5	0	1.5
42	7.6	6.9	3.3	82.2					

APPENDIX B-3

PERCENTAGE DISTRIBUTION OF THE NATIONAL FINAL DEMAND VECTOR WITHIN, AND EXTERNAL TO APPALACHIA WHEN A PROJECT IS LOCATED IN REGION 3

Sector No.	Region 1	Region 2	Region 3	Outside Appalachia
1	0	0	90.4	9.6
2	0	0	18.5	81.5
3	0	0	100.0	0
4	0	0	100.0	0
5	0	0	8.9	91.1
6	0	0	23.7	76.3
7	0	13.8	81.8	4.4
8	0	0	0	100.0
9	0	0	93.0	7.0
10	0	0	35.0	65.0
11	0	0	100.0	0
12	0	0	100.0	0
13	1.1	3.0	15.7	80.2
14	3.0	3.2	27.1	66.7
15	2.4	0	57.6	40.0
16	1.4	1.2	52.0	46.4
17	1.3	16.0	23.6	59.1
18	2.1	4.0	18.1	75.8
19	1.3	1.3	12.5	84.9
20	1.2	3.4	20.4	75.0
21	.5	0	2.3	97.2
22	1.6	6.4	23.8	68.2
23	10.6	2.5	7.0	79.9
24	4.6	4.3	39.4	51.7
25	4.6	5.5	25.4	64.5
26	4.0	5.4	36.5	54.1
27	4.7	17.2	15.7	62.4
28	7.1	16.4	33.0	43.5
29	1.6	4.0	10.8	83.6
30	3.1	0	8.1	88.8
31	3.6	2.2	4.9	89.3
32	4.2	1.3	13.4	81.1
33	5.6	6.3	9.3	78.8
34	6.2	1.6	7.8	84.4
35	14.4	5.8	32.6	47.2
36	5.0	5.3	46.7	43.0
37	10.8	1.7	55.0	32.5
38	6.9	8.3	16.7	68.1
39	6.6	0	3.0	90.4
40	5.2	1.0	31.3	62.5
41	4.5	.7	8.5	86.3
42	5.3	2.7	14.9	77.1
43	13.2	0	0	86.8
44	.1	.2	2.4	97.3
45	2.7	.4	1.1	95.8
46	3.6	1.1	7.3	88.0
47	5.6	.2	2.4	91.8
48	3.6	.4	18.3	77.7
49	9.3	.9	4.0	85.8
50	1.5	.3	2.2	96.0
51	7.8	0	.3	91.9
52	2.1	.2	2.0	95.7
53	8.0	.1	5.6	86.3
54	.5	.2	11.9	87.4
55	7.1	2.2	5.4	85.3
56	3.9	1.9	4.6	89.6
57	11.6	1.5	3.4	83.5
58	2.2	0	5.5	92.3
59	4.2	1.2	9.9	84.7
60	2.0	0	8.6	89.4
61	8.8	1.0	7.6	82.6
62	6.5	2.3	2.8	88.4
63	4.4	.6	2.9	92.1
64	2.8	.7	5.9	90.6
65	0	0	10.1	89.9
66	0	0	100.0	0
67	0	0	100.0	0
68	0	0	100.0	0
69	0	0	96.9	3.1
70	.1	.3	29.1	70.5
71	0	0	78.1	21.9
72	0	.5	23.4	76.1
73	0	0	100.0	0
74	0	0	0	100.0
75	0	0	100.0	0
76	0	0	100.0	0
77	0	0	97.6	2.4
78	0	0	0	100.0
79	0	0	100.0	0
80	0	0	0	100.0
81	0	0	100.0	0
82	0	0	100.0	0
83	.1	0	98.6	1.3

APPENDIX C

PROPORTION OF GROSS OUTPUT BY INDUSTRY ACCOUNTED FOR BY TOTAL VALUE ADDED AND THOSE PROPORTIONS OF TOTAL VALUE ADDED ACCOUNTED FOR BY EACH VALUE ADDED COMPONENT

APPENDIX C

PROPORTION OF GROSS OUTPUT BY INDUSTRY, ACCOUNTED FOR BY TOTAL VALUE ADDED: AND THOSE PROPORTIONS OF TOTAL VALUE ADDED, ACCOUNTED FOR BY EACH VALUE ADDED COMPONENT

Ind. Sec.	Total Value Added	Empl. Comp.	Net Intr.	Capital Cons. Allow.	Corp. Profit	Propr. Rental Income	Ind. Bus. Tax.
1	34.281	12.00	10.00	23.00	.13	45.87	8.00
2	50.533	"	"	"	"	"	"
3	38.995	41.00	3.00	14.00	.90	30.10	11.00
4	44.650	"	"	"	"	"	"
5	35.331	64.09	.85	7.35	.28	10.00	9.12
6	35.927	"	"	"	"	"	"
7	58.310	72.00	2.00	12.00	8.39	1.61	4.00
8	61.468	25.00	1.00	27.00	36.40	1.60	10.00
9	57.272	52.00	1.00	18.00	24.08	1.92	4.00
10	52.593	"	"	"	"	"	"
11	35.493	75.00	1.00	5.00	5.27	11.73	3.00
12	61.234	"	"	"	"	"	"
13	34.747	71.00	1.00	7.00	16.17	.83	3.00
14	25.520	56.00	1.00	7.00	13.36	.64	20.00
15	48.017	16.00	1.00	2.00	19.89	.11	59.00
16	25.511	77.00	2.00	6.00	12.61	.39	2.00
17	24.454	"	"	"	"	"	"
18	38.580	82.00	1.00	3.00	10.53	2.47	1.00
19	23.006	"	"	"	"	"	"
20	32.182	63.00	2.00	10.00	14.62	7.38	2.00
21	36.345	"	"	"	"	"	"
22	41.599	82.00	1.00	3.00	9.67	2.33	2.00
23	44.735	"	"	"	"	"	"
24	34.789	66.00	2.00	12.00	14.87	3.13	2.00
25	37.409	"	"	"	"	"	"
26	47.213	75.00	--	6.00	14.87	2.13	2.00
27	38.606	57.00	2.00	12.00	25.00	2.00	2.00
28	39.466	"	"	"	"	"	"
29	41.706	"	"	"	"	"	"
30	36.438	"	"	"	"	"	"
31	20.050	32.00	2.00	14.00	9.94	.06	42.00
32	45.535	68.00	1.00	7.00	13.61	.39	11.00
33	31.241	83.00	1.00	3.00	16.12	.88	2.00

APPENDIX C (cont.)

Ind. Sec.	Total Value Added	Empl. Comp.	Net Intr.	Capital Cons. Allow.	Corp. Profit	Propr. Rental Income	Ind. Bus. Tax.
34	43.866	83.00	1.00	3.00	16.12	.88	2.00
35	55.467	73.00	1.00	11.00	11.51	1.49	2.00
36	48.315	"	"	"	"	"	"
37	39.512	68.00	2.00	12.00	15.82	.18	2.00
38	28.204	"	"	"	"	"	"
39	33.554	75.00	1.00	6.00	15.74	1.26	2.00
40	38.382	"	"	"	"	"	"
41	43.937	"	"	"	"	"	"
42	42.832	"	"	"	"	"	"
43	42.258	"	"	"	"	"	"
44	35.815	"	"	"	"	"	"
45	44.130	"	"	"	"	"	"
46	36.648	"	"	"	"	"	"
47	50.627	"	"	"	"	"	"
48	43.998	"	"	"	"	"	"
49	43.496	"	"	"	"	"	"
50	53.093	"	"	"	"	"	"
51	56.304	"	"	"	"	"	"
52	34.132	"	"	"	"	"	"
53	49.202	77.00	2.00	6.00	13.87	.13	2.00
54	37.255	"	"	"	"	"	"
55	46.647	"	"	"	"	"	"
56	44.302	"	"	"	"	"	"
57	49.694	"	"	"	"	"	"
58	42.148	"	"	"	"	"	"
59	29.036	53.00	2.00	6.00	25.91	.09	13.00
60	47.004	83.00	1.00	6.00	8.87	.13	2.00
61	38.027	"	"	"	"	"	"
62	45.476	65.00	1.00	8.00	24.61	.39	1.00
63	52.011	"	"	"	"	"	"
64	40.126	82.00	1.00	3.00	10.98	2.02	2.00
65	60.378	68.00	3.00	14.00	3.18	3.82	8.00
66	85.153	41.00	4.00	15.00	25.94	.06	14.00

Ind. Sec.	Total Value Added	Empl. Comp.	Net Intr.	Capital Cons. Allow.	Corp. Profit	Propr. Rental Income	Ind. Bus. Tax.
67	57.268	66.00	2.00	12.00	16.61	.39	3.00
68	48.465	32.00	11.00	20.00	25.50	.50	11.00
69	72.446	57.00	1.00	5.00	8.12	8.88	20.00
70	56.018	72.00	-34.00	5.00	39.68	8.32	8.00
71	72.369	4.00	28.00	18.00	0	28.00	22.00
72	60.812	57.00	3.00	11.00	19.49	4.51	5.00
73	45.867	72.00	1.00	9.00	6.71	9.29	2.00
74	7.681	"	"	"	"	"	"
75	48.130	47.00	4.00	23.00	2.90	19.10	3.00
76	53.186	57.00	3.00	10.00	2.49	8.51	19.00
77	68.106	51.00	1.00	2.00	.37	44.63	1.00
78	43.562	107.00	0	0	-8.03	0	1.02
79	54.430	48.49	0	0	51.59	0	0
80	0	.94	15.20	0	83.86	0	0
81	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0
83	0	0	0	0	0	0	0

Sources: U.S. Department of Commerce, Office of Business Economics, "The Transactions Table of the 1958 Input-Output Study and Revised Direct and Total Requirements Data," Survey of Current Business, Vol. 45, September, 1965, pp. 40-44, and percentage distribution of each value added component by each industry sector in 1968, computed from unpublished data from the U.S. Department of Commerce.

APPENDIX D

LABOR AND OCCUPATIONAL COEFFICIENTS

APPENDIX D

LABOR AND OCCUPATIONAL COEFFICIENTS

Unit: percentage

Industry Sector	Labor	Prof.& Tech.	Mgrs. & Officials	Clerical Workers	Sales Wkrs.	Crafts-men	Opera-tives	Service Workers	Nonfarm Laborers	Farmers Farm Wkrs.
1	64,652	2.39	.98	.96	.25	1.35	3.15	.38	4.05	86.50
2	"	"	"	"	"	"	"	"	"	"
3	82,116	"	"	"	"	"	"	"	"	"
4	119,484	"	"	"	"	"	"	"	"	"
5	18,939	8.74	3.69	6.46	.04	33.5	45.12	2.92	0	0
6	29,512	"	"	"	"	"	"	"	"	"
7	34.850	3.24	4.54	4.41	.63	30.89	55.49	.90	0	0
8	16,820	18.37	12.89	15.48	.60	19.23	32.54	.88	0	0
9	42,697	4.87	11.60	7.89	.77	25.27	47.80	1.79	0	0
10	"	"	"	"	"	"	"	"	"	"
11	46,432	7.20	11.29	6.05	.37	48.96	11.78	.52	13.83	0
12	"	"	"	"	"	"	"	"	"	"
13	39,683	13.6	5.97	11.72	2.10	22.50	38.03	1.52	4.55	0
14	18,654	3.83	8.42	12.30	5.32	14.31	47.88	2.51	5.44	0
15	9,993	3.91	6.41	10.41	5.48	16.79	46.51	4.33	6.27	0
16	31,535	2.98	4.00	8.93	1.39	13.14	64.50	1.67	3.39	0
17	22,201	"	"	"	"	"	"	"	"	"

Industry Sector	Labor	Prof.& Tech.	Mgrs. & Officials	Clerical Workers	Sales Wkrs.	Crafts-men	Opera-tives	Service Workers	Nonfarm Laborers	Farmers & Farm Wkrs.
18	64,489	1.46	3.75	8.10	2.07	5.45	77.31	1.17	.71	0
19	44,188	2.98	4.00	8.93	1.39	13.14	64.50	1.67	3.39	0
20	53,724	2.41	7.15	5.80	1.56	15.74	41.40	1.39	24.55	0
21	75.294	"	"	"	"	"	"	"	"	"
22	65,640	2.65	6.90	9.88	3.69	20.95	51.02	1.54	3.37	0
23	51,918	"	"	"	"	"	"	"	"	"
24	27,953	7.33	4.78	8.10	2.07	5.45	46.89	2.00	3.76	0
25	34,320	6.06	4.34	12.07	3.35	17.50	51.08	1.74	3.86	0
26	55,652	10.50	9.87	19.04	19.42	25.55	13.23	1.30	1.11	0
27	18,097	25.30	7.00	14.07	3.28	16.20	30.01	1.96	2.18	0
28	20,685	21.41	1.55	6.72	.61	22.79	42.15	2.69	2.08	0
29	16,330	35.52	8.73	18.08	4.60	10.04	18.78	2.74	1.51	0
30	18,924	18.67	11.87	18.75	8.41	7.97	27.80	1.52	5.01	0
31	5,806	24.61	6.72	18.55	2.30	20.03	22.81	1.36	3.62	0
32	32,281	6.23	6.59	13.44	2.28	15.45	50.30	1.78	3.93	0
33	35,477	2.26	9.28	7.15	1.60	12.87	54.32	2.44	10.09	0
34	93,010	.82	3.63	11.25	1.61	7.89	71.60	1.22	1.98	0
35	46,217	8.00	5.22	9.52	1.86	16.29	51.87	2.08	5.15	0
36	37,980	7.23	3.41	10.36	1.82	31.68	33.60	1.85	10.04	0

APPENDIX D (cont.)

Industry Sector	Labor	Prof.& Tech.	Mgrs. & Officials	Clerical Wkrs.	Sales Wkrs.	Crafts-men	Opera-tives	Service Workers	Nonfarm Laborers	Farmers Farm Wkrs.
37	29,784	8.36	4.97	10.69	3.00	24.25	47.74	1.60	5.38	0
38	21,988	6.13	8.53	10.29	3.66	15.99	45.40	1.55	8.44	0
39	24,280	5.95	3.75	9.27	1.59	34.21	35.88	1.80	7.55	0
40	37.588	12.48	7.31	13.11	2.35	23.57	36.53	1.45	3.20	0
41	56,674	"	"	"	"	"	"	"	"	"
42	39,550	"	"	"	"	"	"	"	"	"
43	27,359	12.63	8.05	12.24	2.09	27.14	35.06	1.59	2.91	0
44	40,686	"	"	"	"	"	"	"	"	"
45	34,926	"	"	"	"	"	"	"	"	"
46	36,778	"	"	"	"	"	"	"	"	"
47	49,475	"	"	"	"	"	"	"	"	"
48	43,539	"	"	"	"	"	"	"	"	"
49	38,467	"	"	"	"	"	"	"	"	"
50	78,465	"	"	"	"	"	"	"	"	"
51	33,070	"	"	"	"	"	"	"	"	"
52	20,431	"	"	"	"	"	"	"	"	"
53	38,912	24.05	4.11	12.14	1.68	16.95	38.32	1.48	1.27	0
54	23,405	"	"	"	"	"	"	"	"	"
55	44,794	"	"	"	"	"	"	"	"	"

APPENDIX D (cont.)

Industry Sector	Labor	Prof.& Tech.	Mgrs. & Officials	Clerical Workers	Sales Wkrs.	Crafts-men	Opera-tives	Service Wkrs.	Nonfarm Laborers	Farmers Farm Wkrs.
56	30,524	24.05	4.11	12.14	1.68	16.95	38.32	1.48	1.27	0
57	44,377	"	"	"	"	"	"	"	"	"
58	35,897	"	"	"	"	"	"	"	"	"
59	13,970	9.18	4.21	8.97	.75	19.45	51.87	1.81	3.76	0
60	39,214	28.04	3.96	15.82	.53	23.27	26.26	1.70	.42	0
61	43,758	7.16	5.91	11.03	1.82	26.03	41.52	2.24	4.29	0
62	39,839	25.33	5.86	15.46	1.97	17.46	31.87	1.22	.83	0
63	42,804	26.69	5.95	15.52	1.87	17.24	30.65	1.25	.84	0
64	46,822	4.05	8.60	13.61	4.74	16.59	48.94	1.39	2.08	0
65	50,072	3.50	9.35	19.71	1.07	15.33	38.39	3.80	8.85	0
66	33,130	13.50	6.34	46.62	2.04	27.76	1.04	2.12	.58	0
67	38,560	46.28	22.24	16.08	5.66	3.76	1.94	1.80	.54	0
68	13,363	12.78	6.28	21.21	1.23	41.78	10.40	7.10	4.37	0
69	105,231	2.16	19.72	17.12	22.42	8.20	12.55	13.81	4.02	0
70	65,417	3.97	23.50	50.03	18.27	.85	.25	3.50	.10	0
71	7,760	1.12	26.54	19.04	32.05	4.55	.75	10.03	5.93	0
72	159,453	2.75	3.33	9.32	5.54	3.60	13.83	15.84	1.00	0
73	55,011	17.86	15.70	28.58	4.07	8.68	9.08	14.48	1.55	0
74	"	66.20	4.25	21.98	.59	3.30	2.15	1.30	.24	0

APPENDIX D (cont.)

Industry Sector	Labor	Prof.& Tech.	Mgrs. & Officials	Clerical Workers	Sales Wkrs.	Crafts-men	Opera-tives	Service Workers	Nonfarm Laborers	Farmers Farm Wkrs.
75	37,490	.78	15.98	6.69	1.06	51.50	16.56	6.30	6.80	0
76	107,945	18.14	13.27	8.02	1.16	6.05	2.16	44.22	7.97	0
77	144,332	38.51	2.23	16.56	.01	2.02	1.84	48.59	.23	0
78	125,812	10.99	5.85	30.07	1.33	30.23	10.77	1.78	8.98	0
79	54,672	"	"	"	"	"	"	"	"	"
80	0	2.96	21.22	20.97	14.36	6.94	23.70	1.21	8.64	0
81	0	0	0	0	0	0	0	0	0	0
82	0	"	"	"	"	"	"	"	"	"
83	"	"	"	"	"	"	"	"	"	"
84[a]		14.58	10.19	16.65	6.60	12.84	16.70	12.52	5.50	8.09

Sources: Department of Labor, B.L.S. Direct Labor Coefficients per Billion Dollar Delivery to Final Demand by Industry, 1970, unpublished data.

U.S. Department of Labor, B.L.S., Occupational Employment Patterns for 1960 and 1965, Bulletin No. 1599, Dec., 1975. These coefficients are for 1975.

[a]Average of all industries.

APPENDIX E

ESTIMATED U.S. MEAN EARNINGS

(WAGES & SALARIES & SELF-EMPLOYED) IN 1970

AND

ANNUAL COMPOUND GROWTH RATE

APPENDIX E-I

ESTIMATED U.S. MEAN EARNINGS (WAGES & SALARIES & SELF-EMPLOYED) IN 1970 BY MAJOR OCCUPATION

Unit: 1958 dollars

Occupation	Mean Earning in 1968	Annual Growth Rate 1965-1968	Estimated Mean Earnings in 1970
Professional, technical and kindred workers	$6,791	6.0%	$7,630
Managers, officials and proprietors, except farmers	7,956	7.8	9,246
Clerical and kindred workers	3,372	4.3	3,668
Sales Workers	3,745	5.2	4,145
Craftsmen, foremen, and kindred workers	5,894	5.3	6,535
Operatives and kindred workers	3,961	6.0	4,451
Serivce Workers	1,942	5.9	2,178
Laborers, except farm and mine	2,706	6.3	3,058
Farmers and farm laborers	1,994	12.0	2,501

Note: Mean Earnings in 1970 are derived by applying the appropriate growth rate to mean earnings in 1968.

Sources: U.S. Dept. of Commerce, Bureau of Census, Consumer Income: Income in 1968 of Families and Persons in the United States, Series P-60, No. 66, Dec. 1969, Table 43, pp. 103-105 and Income Growth Rates in 1939 to 1968 for Persons by Occupation and Industrial Groups, for the United States, Series P-60, No. 69, Apr. 1970, Table 6, pp. 13-28, and unpublished data from the same office.

APPENDIX E-II

ANNUAL COMPOUND GROWTH RATE OF WAGE BILL, AND PRESENT WORTH FACTOR OF WAGE BILL FOR VARIOUS YEARS AT 4.875% DISCOUNT RATE (r)

(Base year 1970)

	Annual Growth Rate(r')	1975	1985	1995	2005	2015
Professional, Technical and kindred workers	.060	1.05779	1.18359	1.32434	1.48184	1.65806
Managers, officials and proprietors, except farmers	.078	1.15534	1.54216	2.05849	2.74770	3.66766
Clerical and kindred workers	.043	.97066	.90938	.8440	.77565	.70275
Sales Workers	.052	1.01661	1.05066	1.08585	1.12222	1.15981
Craftsmen, foremen, and kindred workers	.053	1.02169	1.06648	1.11323	1.16204	1.21299
Operatives and kindred workers	.060	1.05779	1.18359	1.32434	1.48184	1.65806
Service Workers	.059	1.05257	1.16615	1.29199	1.43140	1.58586
Laborers, except farm and mine	.063	1.07357	1.23736	1.42613	1.64371	1.89448
Farmers and farm laborers	.120	1.41109	2.80974	5.59471	11.14009	22.18195

Note: $P \cdot Wt = \frac{1 \text{ dollar} \times (1 + r')^m}{(1 + r)^m} = 1X\ 1 + (r'-r)^n$

$P \cdot Wt$ = present worth of wage bill at year t
n = number of years
r = discount rate used by the Army Corps of Engineers in the project report.

APPENDIX F

ESTIMATE OF INCREASE BY 2020 IN APPALACHIAN EXPORT CAPACITY, BY INDUSTRY, INDUCED BY UPPER LICKING WATER RESOURCE INVESTMENTS

APPENDIX F

ESTIMATE OF INCREASE BY 2020 IN APPALACHIAN EXPORT CAPACITY, BY INDUSTRY, INDUCED BY UPPER LICKING WATER RESOURCE INVESTMENTS

According to the original plan, the Upper Licking water resource investment is expected to induce further investments of $256,600,000 (July 1969 prices) in the project area. The original industrial location survey, in which market, resources, transportation, and labor cost have been studied for 4 digit SIC code for 63 water oriented industries, has concluded that certain manufacturing industries will enjoy comparative cost advantages over competing regions. Manufacturing capacity would eventually reach $309,270 (1960 prices) in shipment value by 2020. Expected manufacturing shipment value and number of employees by industry sector in 2020 are shown in Table 1 as extracted from Spindletop Research Center Study, Table 59.

In order to determine the level of export capacity in terms of yearly shipment values of manufacturing products by industry, the concept of basic and non-basic industry classification and location quotients[1] will be utilized. For this purpose, the ratio of employment for each manufacturing industry to total manufacturing employment in the Upper Licking Area was correlated with corresponding employment ratios of the U.S. manufacturing industry. The basic model used to determine export capacity of an industry sector, in terms of shipment value per year, from Appalachia to the rest of the world is as follows:

---

[1]For further discussion of the basic and nonbasic industry concept and various location quotient analysis see, Walter Isard, Method of Regional Analysis: An Introduction to Regional Science (New York: MIT Press John Wiley & Sons Inc., 1960), Chap. 7.

TABLE 1

(TABLE 58)
Forecast* of Employment and Annual Output
of Manufacturing Industries at Salyersville-Royalton Area 2020

SIC Number	Description of Industry	Value of Shipments** ($000's/yr.)	Value of Shipments/Employee*** ($000's/yr.)	Number of Employees
24-25	Lumber and Furniture	20,760	22.6	919
33	Primary metals	1,210	166.7	7
34	Fabricated metals	11,700	44.9	261
35-36	Machinery & elec. machinery	104,500	54.0	1,935
37	Transportation equipment	3,730	286.9	13
19,32,38,39	Other durables	11,920	57.3	208
20	Food	89,210	287.2	311
22	Textiles	70	64.3	1
23	Apparel	29,840	19.6	1,522
27	Printing	4,250	52.3	81
28	Chemicals	2,500	325.0	8
26	Paper	630	136.1	5
29	Petroleum refining	--	--	--
30	Rubber and plastics	8,860	150.0	59
21,31	Tobacco and leather	20,090	138.8	145
	Totals	309,270	56.5	5,475

*Forecasts are based on projections for growth in eastern Kentucky regional areas shown in Economic Base Study Information, Exhibit 19 To Plan of Survey for Development of Water Resources in Appalachia, Office of Business Economics, U.S. Department of Commerce, 9 January 1967, and Ohio River Basin Comprehensive Survey, Arthur D. Little, Inc., August 1964. Spindletop forecasts reflect envisioned conditions at Salyersville following completion of a reservoir.

**Values are given in terms of 1960 dollars.

***Source: Arthur D. Little, Inc., Ohio River Basin Comprehensive Survey, Vol. III, Table XIII.

$$X_i^A = (N_i^I / N_m^I - N_i^U / N_m^U) / (N_i^U / N_m^U) \times (N_i^I \times \alpha_i) \qquad (I)$$

Where

X_i^A = Export capacity of ith industry of Appalachia

N = Number of manufacturing employees

Subscript i = ith industry
m = all industry

Superscript I = The Upper Licking Area, project impact area

U = all U.S.

α_i = Productivity of ith industry per employee in terms of shipment value

The 1st term, $(N_i^I/N_m^I - N_i^U/N_m^U)$, gives the magnitude and direction of the divergence of the ratio of ith industry employees to total manufacturing employees in the Upper Licking Area, from the national standard. Assuming the same productivity of employees in each industry in the impact area and the U.S., the positive sign of the 1st term suggests that the ith industry in the Upper Licking Area has a comparative advantage over the average performance of the U.S. in the same industry. The positive sign suggests export and the negative sign suggests import.[2] The 2nd term $(N_i^I/N_m^I - N_i^U/N_m^U)/N_i^U/N_m^U$ measures the proportion of ith industry employees which is over or below the national standard in the same industry. The 3rd term $(N_i^I \times \alpha_i)$ gives total shipment value in ith industry produced in the impact area. The 2nd and 3rd term together provide the value of exports from or imports to the impact area. This could be understood more easily by looking at equation (II) which ia

[2]The location quotient itself does not satisfy the direction of export and import and has to have supplementary justifications. The ratio may involve many weaknesses, according to which base will be selected. See *ibid*.

simply a mathematical manipulation of equation (I).

Equation II:

$$X_i^A = (N_i^I - N_i^U \times N_i^I/N_m^U) \times \alpha_i \qquad \text{(II)}$$

In this model, we calculated the X_i^A only for the industry which had shown positive value in the first term of equation (I). The term X_i^A was treated as the value of export from the Appalachian Region to the rest of the world. The estimated value of export capacity by industry is shown in Table 2.

TABLE 2

ESTIMATE OF INCREASE BY 2020, IN APPALACHIAN EXPORT CAPACITY, BY INDUSTRY, INDUCED BY UPPER LICKING WATER RESOURCE INVESTMENTS

Unit: 1958 dollars

SIC Code	Description	Value of Export
15	Tobacco manufacturing	3,433,498
18	Apparel	22,102,267
20	Lumber & wood products	5,450,267
23	Other furniture & fixtures	3,449,881
34	Footwear & other leather products	2,091,933
43	Engines & turbines	7,218,641
47	Metal working machine & equipment	7,196,975
49	Gen. Ind. Mach. & Equip.	6,344,106
54	Household Appliances	1,122,209
55	Elec. Lighting & wiring equipment	2,492,878
57	Electric components & accessories	10,461,106
58	Misc. elec. mach. equip. and supplies	2,953,856
TOTAL		74,317,617

Note: To derive export capacity, 1965 employment figures for the Upper Licking Area and 1969 for the nation were used.

APPENDIX G

INDUSTRIAL DEMAND RESULTING FROM

THE UPPER LICKING PROJECT

BY REGION AND INDUSTRY

APPENDIX G-I

INDUSTRIAL DEMAND RESULTING FROM THE CONSTRUCTION OF THE UPPER LICKING PROJECT BY REGION AND INDUSTRY (Per $1,000 Project Cost)

Unit: 1958 dollars

Section No.	Region 1	Region 2	Region 3	Appalachia	Section No.	Region 1	Region 2	Region 3	Appalachia
1	1	4	1	6	43	0	0	0	0
2	0	2	0	3	44	0	0	0	0
3	0	1	0	1	45	5	2	1	8
4	0	1	0	1	46	0	0	0	0
5	0	0	0	0	47	0	0	0	0
6	0	0	0	0	48	0	0	0	0
7	0	2	0	3	49	1	0	0	2
8	2	1	0	3	50	0	0	0	1
9	0	25	0	26	51	0	0	0	0
10	0	0	0	0	52	0	0	0	0
11	0	0	0	0	53	1	0	0	1
12	2	19	0	21	54	0	0	0	0
13	0	0	0	0	55	0	0	0	0
14	4	9	4	17	56	0	0	0	1
15	0	0	2	2	57	0	0	0	0
16	0	0	3	3	58	0	0	0	1
17	0	2	0	2	59	7	7	1	15
81	1	3	5	9	60	0	0	0	1
91	0	0	0	1	61	1	0	0	1
20	0	2	1	3	62	0	0	0	1
21	0	0	0	0	63	0	0	0	0
22	0	1	1	2	64	0	0	0	1
23	0	0	0	0	65	3	18	0	21
24	1	2	1	4	66	1	18	0	20
25	0	0	0	1	67	0	2	0	2
26	2	6	2	9	68	2	43	1	46
27	3	18	3	24	69	8	257	4	269
28	1	0	0	1	70	4	15	1	19
29	0	1	0	1	71	13	116	2	132
30	0	0	0	0	72	1	12	0	13
31	4	9	1	14	73	3	31	1	35
32	1	0	1	2	74	0	0	0	0
33	0	0	0	0	75	1	22	0	24
34	1	0	0	1	76	1	19	0	21
35	1	1	0	1	77	3	75	2	80
36	3	9	2	14	78	0	0	0	0
37	5	1	1	7	79	1	9	0	9
38	0	0	0	1	80	0	0	0	0
39	0	0	0	0	81	1	12	0	14
40	4	2	3	9	82	0	1	0	2
41	0	0	0	0	83	28	703	13	745
42	1	1	0	2	84[a]	98	782	51	931

Note: [a]Sum of Sectors 1-82. Columns and rows may not add because of rounding.

APPENDIX G-II

ANNUAL INDUSTRIAL DEMAND RESULTING FROM THE O & M OF THE UPPER LICKING PROJECT BY REGION AND INDUSTRY
(Per $1,000 O & M Costs)

Unit: 1958 dollars

Sector No.	Region 1	Region 2	Region 3	Appa-lachia	Sector No.	Region 1	Region 2	Region 3	Appa-lachia
1	1	5	2	8	43	1	0	0	1
2	0	3	1	4	44	0	0	0	0
3	0	1	0	1	45	3	1	0	4
4	0	1	0	1	46	0	0	0	0
5	0	0	0	0	47	0	0	0	0
6	0	0	0	0	48	0	0	0	0
7	0	3	0	3	49	1	0	0	1
8	1	1	0	2	50	0	0	0	0
9	0	12	0	12	51	0	0	0	0
10	0	0	0	0	52	0	0	0	0
11	0	0	0	0	53	0	0	0	1
12	2	25	1	28	54	0	0	0	0
13	0	0	0	0	55	0	0	0	0
14	6	13	6	24	56	0	0	0	1
15	1	0	2	3	57	0	0	0	0
16	0	0	4	5	58	0	0	0	0
17	0	2	1	3	59	6	6	1	13
18	2	4	7	13	60	0	0	0	0
19	0	0	1	1	61	1	0	0	1
20	0	1	1	2	62	0	0	0	1
21	0	0	0	0	63	0	0	0	0
22	0	1	2	3	64	1	0	0	1
23	0	0	0	1	65	2	16	0	19
24	1	2	1	5	66	1	23	1	24
25	0	1	0	1	67	0	2	0	3
26	2	8	2	12	68	2	54	1	57
27	2	11	2	15	69	8	270	4	283
28	0	1	0	1	70	5	19	1	24
29	0	1	0	2	71	17	163	3	183
30	0	0	0	0	72	1	17	0	18
31	3	7	1	11	73	3	38	1	42
32	1	0	1	2	74	0	0	0	0
33	0	0	0	0	75	1	27	0	28
34	1	1	0	2	76	1	28	0	30
35	1	1	0	2	77	3	110	2	115
36	1	2	1	4	78	0	0	0	0
37	3	1	1	4	79	1	11	0	11
38	0	0	0	1	80	0	0	0	0
39	0	0	0	0	81	1	11	0	13
40	2	1	1	4	82	0	2	0	2
41	0	0	0	0	83	28	1047	14	1090
42	1	0	0	1	84[a]	94	908	56	1058

Note: [a]Sum of Sectors 1-82. Columns and rows may not add because of rounding.

APPENDIX G-III

INDUSTRIAL DEMAND IN 2020 INDUCED THROUGH INCREASED EXPORT CAPACITY RESULTING FROM THE UPPER LICKING PROJECT BY REGION AND INDUSTRY

(Per $1,000 increase in export capacity) Unit: 1958 dollars

Section No.	Region 1	Region 2	Region 3	Appalachia	Section No.	Region 1	Region 2	Region 3	Appalachia
1	0	3	2	5	43	2	97	0	99
2	0	5	1	6	44	0	0	0	0
3	0	10	0	11	45	0	0	0	0
4	0	0	0	1	46	0	0	0	0
5	0	0	0	0	47	1	97	0	98
6	0	0	0	0	48	0	0	0	1
7	0	1	0	3	49	2	86	0	88
8	1	0	0	1	50	0	0	0	0
9	0	1	0	1	51	0	0	0	0
10	0	0	0	0	52	0	0	0	0
11	0	0	0	0	53	2	0	0	3
12	2	13	1	16	54	0	15	0	15
13	0	0	0	0	55	0	34	0	34
14	3	6	3	10	56	0	0	0	0
15	1	46	4	51	57	0	141	0	143
16	1	4	43	48	58	0	40	0	40
17	0	3	1	4	59	3	2	0	5
18	3	303	10	315	60	0	0	0	0
19	0	0	1	1	61	0	0	0	1
20	1	78	2	81	62	0	0	0	0
21	0	0	0	0	63	0	0	0	0
22	0	1	1	2	64	0	0	0	0
23	0	47	0	47	65	2	10	0	13
24	2	2	2	6	66	1	15	1	17
25	1	2	1	4	67	0	2	0	2
26	2	5	2	9	68	3	31	3	36
27	1	4	1	6	69	8	133	9	150
28	1	4	3	9	70	3	10	1	13
29	0	0	0	1	71	10	80	5	95
30	0	0	0	0	72	1	8	0	10
31	1	2	0	3	73	2	35	3	39
32	1	0	1	2	74	0	0	0	0
33	0	1	0	3	75	1	12	1	13
34	0	29	0	29	76	1	13	1	14
35	0	3	1	5	77	3	47	3	54
36	1	2	0	4	78	0	0	0	0
37	13	7	3	22	79	1	1	0	1
38	2	5	1	9	80	0	0	0	0
39	0	0	0	0	81	1	15	1	17
40	1	0	0	1	82	0	2	0	2
41	1	0	0	1	83	28	442	28	499
42	1	1	0	2	84[a]	95	1523	119	1737

Note: [a]Sum of Sectors 1-82. Columns and rows may not add because of rounding.

APPENDIX H

PERCENTAGE DISTRIBUTION OF GROSS DOMESTIC INVESTMENT

AND

PERSONAL CONSUMPTION EXPENDITURES BY INDUSTRY SECTOR

APPENDIX H

PERCENTAGE DISTRIBUTION OF GROSS PRIVATE DOMESTIC INVESTMENT AND PERSONAL CONSUMPTION EXPENDITURES BY INDUSTRY SECTOR

Industry Sector No.	Gross Private Investment	Personal Consumption Expenditures	Industry Sector No.	Gross Private Investment	Personal Consumption Expenditures
1	.33	.34	42	.33	.16
2	.20	.54	43	.52	.06
3	.03	.08	44	1.98	-
4	.03	-	45	2.15	-
5	-	-	46	.61	-
6	.01	-	47	1.90	.01
7	.02	.04	48	2.43	.01
8	.03	-	49	1.52	-
9	.01	.01	50	.03	-
10	-	-	51	3.20	.03
11	46.94	-	52	2.09	.10
12	-	-	53	2.87	.01
13	.02	.07	54	.25	.11
14	.39	13.19	55	.07	.13
15	-	1.33	56	2.34	.91
16	.10	.25	57	.17	.01
17	.12	.30	58	.21	.11
18	.52	3.64	59	9.03	4.31
19	.02	.41	60	1.29	.01
20	.06	.06	61	2.34	.34
21	.01	-	62	1.02	.15
22	.23	.88	63	.51	.22
23	1.38	.05	64	.60	1.09
24	.06	.32	65	1.08	2.87
25	.02	.01	66	.60	1.75
26	.07	.84	67	-	-
27	.06	.08	68	-	3.22
28	.08	-	69	7.50	20.83
29	.13	1.75	70	1.15	4.25
30	-	.01	71	-	14.84
31	.10	2.39	72	-	3.05
32	.08	.54	73	-	.57
33	-	-	74	-	-
34	.02	.60	75	-	1.48
35	.01	.04	76	.04	.96
36	.04	.07	77	-	7.53
37	.09	.01	78	-	.23
38	.09	-	79	-	.16
39	.02	-	80	-	1.51
40	.87	.03	81	-	-
41	.01	.08	82	-	-

Source: U.S. Department of Labor, BLS, Projections 1970: Interindustry Relationships, Potential Demand and Employment, Bulletin No. 1536 (Washington: Government Printing Office, 1966), Table IV-8 & IV-II, pp. 71-77.
(-) means less than .005.

APPENDIX I

COMPUTER PROGRAM FOR DERIVING EMPLOYMENT GENERATION BENEFITS

```
@FOR,IS MAIN,MAIN
CYCLE 000 COMPILED BY 1201 0057E ON 27 OCT 71 AT 09:34:00.
```

MAIN PROGRAM

STORAGE USED: CODE(1) 003250; DATA(0) 000603; BLANK COMMON(2) 152463

EXTERNAL REFERENCES (BLOCK, NAME)

```
 0003   NINTR$
 0004   NSTOP$
 0005   NRDU$
 0006   NIO1$
 0007   NIO2$
 0010   NERR3$
 0011   NWDU$
 0012   SIN
 0013   COS
```

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 000166 1F	0000 000152 1F	0000 000315 1F	0000 000276 10F	0001 001460 1011G
0001 001462 1014G	0001 001520 1032G	0001 001523 1035G	0000 000303 11F	0001 001714 1107G
0001 001744 1120G	0001 002045 1144G	0000 000310 12F	0001 002207 1210G	0001 002222 1213G
0001 002254 1222G	0001 002305 1236G	0001 002306 1241G	0001 002307 1244G	0001 002343 1255G
0001 002352 1250G	0001 002355 1263G	0001 002474 1303G	0001 002552 1324G	0001 002636 1340G
0001 002640 1343G	0001 002717 1361G	0001 002742 1372G	0001 002771 1403G	0001 003020 1412G
0001 003026 1417G	0001 003056 1427G	0001 003062 1433G	0001 003105 1442G	0001 003134 1451G
0001 003142 1455G	0001 003147 1462G	0001 003153 1466G	0001 000076 153G	0001 000103 157G
0001 000110 164G	0001 000134 175G	0000 000167 2F	0000 000153 2F	0000 000325 2F
0001 000141 201G	0001 000146 206G	0001 000176 220G	0001 000203 224G	0001 000216 233G
0001 000234 241G	0001 000241 245G	0001 000246 252G	0001 000272 263G	0001 000277 267G
0000 000170 3F	0000 000154 3F	0000 000355 3F	0001 002130 30L	0001 002510 30L
0001 000326 302G	0001 000334 307G	0001 000354 320G	0001 000362 325G	0001 000402 336G
0001 000410 343G	0001 000430 354G	0001 000436 361G	0001 000456 372G	0001 000464 377G
0000 000156 4F	0000 000172 4F	0001 002512 40L	0001 002272 41L	0001 000504 41[illegible]
0001 000512 415G	0001 000527 425G	0001 000534 431G	0001 000541 436G	0001 000546 442G
0001 000573 452G	0001 000601 457G	0001 000606 463G	0001 000624 472G	0001 000632 477G
0000 000150 5F	0000 000203 5F	0001 000637 503G	0001 000651 511G	0001 000651 514G
0001 000656 520G	0001 000724 551G	0001 000740 560G	0001 000771 573G	0000 000163 6F
0000 000220 6F	0001 001004 600G	0001 001043 620G	0001 001055 623G	0001 001062 627G
0001 001067 633G	0001 001100 641G	0001 001102 645G	0001 001146 663G	0001 001150 666G
0000 000237 7F	0001 001214 712G	0001 001257 732G	0001 001272 740G	0001 001310 750G
0001 001342 765G	0000 000256 8F	0000 000274 9F	0000 R 000022 A	0000 R 000011 A
0000 R 000134 ALPHA	0002 R 102170 AMTRX	0000 R 000013 B	0000 R 000023 B	0000 R 000135 BETA
0000 R 000030 B1	0000 R 000041 B10	0000 R 000031 B2	0000 R 000032 B3	0000 R 000033 B4
0000 R 000034 B5	0000 R 000035 B6	0000 R 000036 B7	0000 R 000037 B8	0000 R 000040 B9
0000 R 000024 C	0000 R 000014 C	0000 R 000025 D	0000 R 000026 E	0000 R 000027 F
0002 R 017061 FILE	0000 I 000142 I	0000 I 000006 I	0000 I 000001 I	0000 I 000131 I
0000 I 000140 I	0000 I 000020 I	0000 I 000132 II	0000 I 000046 II	0000 I 000045 III
0000 I 000044 IIII	0002 I 000000 INCARD	0000 000456 INJP$	0000 000403 INJP$	0000 000433 INJP$
0000 000445 INJP$	0000 000422 INJP$	0000 000441 INJP$	0002 I 000001 INTAPE	0002 I 000002 IOTAPF
0002 I 000005 IOUNIT	0000 I 000007 IR	0002 I 102167 IREG	0000 I 000143 J	0000 I 000021 J
0000 I 000002 J	0000 I 000136 J	0000 I 000141 J	0000 I 000012 J	0000 I 000017 JJ

```
0000 I 000144 J1      0000 I 000145 J2      0000 I 000146 J3      0000 I 000147 J4      0000 I 000047 K
0000 I 000005 K       0000 I 000133 K       0000 I 000150 K       0000 I 000010 K       0000 I 000015 L
0000 I 000054 L       0000 I 000151 L       0000 I 000003 L       0000 I 000000 LPROJ   0000 I 000055 M
0000 I 000016 M       0000 I 000004 MPROJ   0000 I 000062 N       0002 I 102166 NPROJ   0002 R 102165 PCOST
0000 R 000042 PI      0000 R 000127 PI      0000 R 000043 PI2     0000 R 000130 PI2     0000 R 000056 S
0002 R 067561 SFILE   0002 R 101345 STITLE  0000 R 000057 T       0002 R 000004 TFILE   0002 R 057721 TITLE
0002 R 014125 TTITLE  0000 R 000060 U       0000 R 000137 UACOST  0000 R 000061 V       0000 R 000050 W
0000 R 000051 X       0000 R 000052 Y       0000 R 000063 Y       0000 R 000053 Z
```

```
00100    C       MAIN PROGRAM
00101            COMMON INCARD,INTAPE,IOTAPE,IOUNIT
00103            COMMON TFILE(75,83),TTITLE(75,20)
00104            COMMON FILE(4,50,84),TITLE(4,50,20)
00105            COMMON SFILE(20,83,3),STITLE(20,20)
00106            COMMON PCOST,NPROJ,IREG,AMTRX(3,83,83)
00107            DATA   INCARD/5/
00107    C
00111            CALL INPUT
00112            CALL IMPACT
00113            CALL COMP
00114            CALL OSLABR
00115            CALL MXFCTR
00116            CALL OUTPUT
00116    C
00117            STOP
00120            SUBROUTINE INPUT
00123          1 FORMAT (3I5)
00124          2 FORMAT (20A4)
00125          3 FORMAT (3F10.0)
00126          4 FORMAT (10F12.0)
00127          5 FORMAT (I3,7X,F10.0)
00130          6 FORMAT (I3,7X,10F5.0)
00131            READ (INCARD,4) PCOST
00134            READ (INCARD,1) NPROJ
00137            READ (INCARD,1) IREG
00142            READ (INCARD,1) INTAPE,IOTAPE,IOUNIT
00147            READ (INCARD,1) LPROJ
00152            DO 10 I=1,LPROJ
00155            READ (INCARD,2) (TTITLE(I,J),J=1,20)
00163            DO 10 J=1,83
00166         10 READ (INCARD,5) L,TFILE(I,J)
00174            DO 20 I=21,29
00177            READ (INCARD,2) (TTITLE(I,J),J=1,20)
00205            DO 20 J=1,83
00210         20 READ (INCARD,5) L,TFILE(I,J)
00216            MPROJ = LPROJ+29
00217            DO 30 I=30,MPROJ
00222            READ (INCARD,2) (TTITLE(I,J),J=1,20)
00230         30 READ (INCARD,6) L,(TFILE(I,J),J=1,9)
00240            DO 40 I=50,59
00243            READ (INCARD,2) (TTITLE(I,J),J=1,20)
00251            DO 40 J=1,83
00254         40 READ (INCARD,5) L,TFILE(I,J)
00262            DO 50 I=60,63
```

```
00265          READ (INCARD,2) (TTITLE(I,J),J=1,20)
00273       50 READ (INCARD,5) L,TFILE(I,1)
00300          READ (INCARD,2) (TTITLE(69,J),J=1,20)
00306          DO 60 J=1,83
00311       60 READ (INCARD,5) L,TFILE(69,J)
00316          READ (INCARD,2) (TTITLE(70,J),J=1,20)
00324          DO 70 J=1,83
00327       70 READ (INCARD,5) L,TFILE(70,J)
00334          READ (INCARD,2) (TTITLE(71,J),J=1,20)
00342          DO 80 J=1,83
00345       80 READ (INCARD,5) L,TFILE(71,J)
00352          READ (INCARD,2) (TTITLE(72,J),J=1,20)
00360          DO 90 J=1,83
00363       90 READ (INCARD,5) L,TFILE(72,J)
00370          READ (INCARD,2) (TTITLE(73,J),J=1,20)
00376          DO 100 J=1,83
00401      100 READ (INCARD,5) L,TFILE(73,J)
00406          READ (INCARD,2) (TTITLE(74,J),J=1,20)
00414          DO 110 J=1,83
00417      110 READ (INCARD,5) L,TFILE(74,J)
00424          DO 120 I=1,9
00427          READ (INCARD,2) (STITLE(I,J),J=1,20)
00435          DO 120 J=1,4
00440      120 READ (INCARD,3) (SFILE(I,J,K),K=1,3)
00450          READ (INCARD,2) (STITLE(10,J),J=1,20)
00456          DO 130 I=1,83
00461      130 READ (INCARD,3) (SFILE(10,I,J),J=1,3)
00470          READ (INCARD,2) (TITLE(1,1,I),I=1,20)
00476          DO 140 I=1,4
00501      140 READ (INCARD,2) (TITLE(I,8,J),J=1,20)
00510          DO 150 I=25,32
00513          DO 150 J=1,4
00516      150 READ (INCARD,2) (TITLE(J,I,K),K=1,20)
00526      151 CONTINUE
00527          RETURN
00530          SUBROUTINE IMPACT
00533        1 FORMAT (1H1)
00534        2 FORMAT (1H0)
00535        3 FORMAT (1H ,20A4)
00536        4 FORMAT (1H ,1X,I3,F11.1,F14.2,2X,
00536       *'**',         5X,I3,F11.1,F14.2)
00537        5 FORMAT (1H ,22X,'FINAL DEMAND VECTOR' /29X,
00537       *              'REGION'/30X,3A4/28X,'(DOLLARS)')
00540        6 FORMAT (1H ,'NUMBER   DEMAND',6X,'IMPACT',4X,
00540       *'**',   4X ,'NUMBER   DEMAND',6X,'IMPACT')
00541        7 FORMAT (1H ,'SECTOR   FINAL ',5X,'ECONOMIC',3X,
00541       *'**',   4X ,'SECTOR   FINAL ',5X,'ECONOMIC')
00542        8 FORMAT (1H , 9X,'VECTOR',6X,'VECTOR',4X,'**',
00542       *              13X,'VECTOR',6X,'VECTOR'/32X,'**')
00543        9 FORMAT (10F12.0)
00544       10 FORMAT (1H0,'PROJECT COST $',F12.2)
00545       11 FORMAT (1H0,'IMPACT REGION ',I5)
00546       12 FORMAT (1H0,'PROJECT TYPE  ',I5)
00547          FILE(1,1,1) = PCOST
00550          DO 15 I=1,82
00553          FILE(1,2,I) = TFILE(NPROJ,I)*(PCOST/1000.0)
00554       15 FILE(1,2,84)= FILE(1,2,84)+FILE(1,2,I)
```

```
      FILE(1,2,83)= TFILE(NPROJ,83)*(PCOST/1000.0)
      DO 20 I=1,84
   20 FILE(1,3,I) = FILE(1,2,I)
      IF (IREG.EQ.1) IR=20
      IF (IREG.EQ.2) IR=23
      IF (IREG.EQ.3) IR=26
      DO 35 I=1,3
      K = I+IR
      A = 0.0
      DO 30 J=1,82
      A = FILE(1,3,J)*TFILE(K,J)
      FILE(I,5,J) = A
      FILE(4,5,J) = A+FILE(4,5,J)
      FILE(I,5,84)= A+FILE(I,5,84)
   30 FILE(4,5,84)= A+FILE(4,5,84)
      A = FILE(1,3,83)*TFILE(K,83)
      FILE(I,5,83)= A
   35 FILE(4,5,83)= A+FILE(4,5,83)
      A = 0.0
      B = 0.0
      C = 0.0
      DO 46 L=1,3
      DO 46 M=1,3
      K = M+(L-1)*3
      DO 40 I=1,83
   40 READ (INTAPE,9) (AMTRX(M,I,J),J=1,83)
      DO 45 I=1,83
      A = 0.0
      DO 44 J=1,83
      B = FILE(M,5,J)
   44 A = A+(B*AMTRX(M,I,J))
   45 FILE(L,8,I) = FILE(L,8,I)+A
   46 CONTINUE
      A = 0.0
      B = 0.0
      C = 0.0
      DO 51 I=1,3
      DO 50 J=1,82
      A = FILE(I,8,J)
      B = B+A
      C = C+A
   50 FILE(4,8,J) = FILE(4,8,J)+A
      A = FILE(I,8,83)
      FILE(I,8,83) = A
      FILE(I,8,84) = B
      FILE(4,8,83) = FILE(4,8,83)+A
      A = 0.0
   51 B = 0.0
      FILE(4,8,84) = C
      C = 0.0
      WRITE (IOUNIT,1)
      WRITE (IOUNIT,3) (TITLE(1,1,I),I=1,20)
      WRITE (IOUNIT,10) PCOST
      WRITE (IOUNIT,11) IREG
      WRITE (IOUNIT,12) NPROJ
      WRITE (IOUNIT,1)
      DO 61 I=1,4
```

```
00734         WRITE (IOUNIT,1)
00736         WRITE (IOUNIT,3) (TITLE(I,8,J),J=6,20)
00744         WRITE (IOUNIT,2)
00746         WRITE (IOUNIT,5) (TITLE(I,8,J),J=3,5)
00754         WRITE (IOUNIT,2)
00756         WRITE (IOUNIT,7)
00760         WRITE (IOUNIT,6)
00762         WRITE (IOUNIT,8)
00764         DO 60 J=1,42
00767         JJ = J+42
00770      60 WRITE (IOUNIT,4) J,FILE(I,5,J),FILE(I,8,J),
00770        *                      JJ,FILE(I,5,JJ),FILE(I,8,JJ)
01001      61 WRITE (IOUNIT,1)
01004         RETURN
01005         SUBROUTINE COMP
01010         DO 10 I=1,3
01013         DO 10 J=1,83
01016         A = FILE(I,8,J)
01017         B = A*TFILE(69,J)
01020         C = A*TFILE(70,J)
01021         D = A*TFILE(71,J)
01022         E = A*TFILE(72,J)
01023         F = A*TFILE(73,J)
01024         FILE(I,11,J) = B+C
01025         FILE(I,15,J) = E+F
01026      10 FILE(I,14,J) = D+E+F
01031         DO 20 I=1,3
01034         DO 20 J=1,83
01037         A  = FILE(I,8,J)*TFILE(50,J)
01040         B  = FILE(I,11,J)
01041         IF (J.GT.80) A=0.0
01043         B1 = A*TFILE(51,J)*TFILE(60,1)
01044         B2 = A*TFILE(52,J)*TFILE(61,1)
01045         B3 = A*TFILE(53,J)*TFILE(62,1)
01046         B4 = A*TFILE(54,J)*TFILE(63,1)
01047         B5 = A*TFILE(55,J)*TFILE(64,1)
01050         B6 = A*TFILE(56,J)*TFILE(65,1)
01051         B7 = A*TFILE(57,J)*TFILE(66,1)
01052         B8 = A*TFILE(58,J)*TFILE(67,1)
01053         B9 = A*TFILE(59,J)*TFILE(68,1)
01054         B10= B1+B2+B3+B4+B5+B6+B7+B8+B9
01055         C  = B/B10
01056         B1 = B1*C
01057         B2 = B2*C
01060         B3 = B3*C
01061         B4 = B4*C
01062         B5 = B5*C
01063         B6 = B6*C
01064         B7 = B7*C
01065         B8 = B8*C
01066         B9 = B9*C
01067         FILE(I,20,J) = C
01070         FILE(I,42,J) = B1
01071         FILE(I,43,J) = B2
01072         FILE(I,44,J) = B3
01073         FILE(I,45,J) = B4
01074         FILE(I,46,J) = B5
```

```
01075         FILE(I,47,J) = B6
01076         FILE(I,48,J) = B7
01077         FILE(I,49,J) = B8
01100         FILE(I,50,J) = B9
01101      20 FILE(I,10,J) = B10
01104         PI = 3.1415926536
01105         PI2= PI/2.0
01106         DO 35 IIII=1,12
01111         I = IIII
01112         III = 3
01113         IF (I.GT.9) I=10
01115         IF (I.EQ.10) III=83
01117         DO 35 II=1,III
01122         K = II
01123         A = SFILE(I,K,1)
01124         B = SFILE(I,K,2)
01125         C = SFILE(I,K,3)
01126         IF (A.LT.B) A=B
01130         IF (A.GT.C) A=C
01132         W = (A-B)/(C-B)
01133         D = PI*W-PI2
01134         E = W*PI2
01135         X = 0.5*(SIN(D)+1.0)
01136         Y = 1.0-COS(E)
01137         Z = SIN(E)
01140         J = I+41
01141         IF (I.EQ.10) J=15
01143         DO 30 L=1,83
01146         M = L
01147         K = II
01150         IF (I.EQ.10) M=II
01152         IF (I.EQ.10) K=IIII-9
01154         IF (I.EQ.10.AND.L.GT.1) GO TO 30
01156         F = FILE(K,J,M)
01157         S = S+F*W
01160         T = T+F*X
01161         U = U+F*Y
01162         V = V+F*Z
01163      30 CONTINUE
01165         M = II+24
01166         N = I-1
01167         IF (I.EQ.10) M=K+37
01171         IF (I.EQ.10) N=II-1
01173         N = N+1
01174         FILE(1,M,N) = S
01175         FILE(2,M,N) = T
01176         FILE(3,M,N) = U
01177         FILE(4,M,N) = V
01200         S = 0.0
01201         T = 0.0
01202         U = 0.0
01203         V = 0.0
01204      35 CONTINUE
01207         DO 41 I=1,3
01212         DO 41 J=1,20
01215         IF (J.EQ. 6) GO TO 41
01217         IF (J.EQ. 7) GO TO 41
```

```
      DO 40 K=1,82
      FILE(I,18,K) = TFILE(74,K)
      FILE(4,J,K)  = FILE(4,J,K)+FILE(I,J,K)
      FILE(4,J,84) = FILE(4,J,84)+FILE(I,J,K)
   40 FILE(1,J,84) = FILE(1,J,84)+FILE(I,J,K)
      FILE(I,18,83)= TFILE(74,83)
   41 CONTINUE
      DO 50 I=1,4
      DO 50 J=25,27
      DO 50 K=1,9
      FILE(I,28,K)  = FILE(I,28,K)+FILE(I,J,K)
      FILE(I,28,10) = FILE(I,28,10)+FILE(I,J,K)
   50 FILE(I,J,10)  = FILE(I,J,10)+FILE(I,J,K)
      DO 60 I=1,3
      DO 60 J=1,4
      DO 60 K=1,83
      L = I+37
      FILE(I,30,J) = FILE(I,30,J)+FILE(J,L,K)
   60 FILE(4,30,J) = FILE(4,30,J)+FILE(J,L,K)
      RETURN
      SUBROUTINE OSLABR
      DIMENSION Y(4,9)
      PI = 3.1415926536
      PI2 = PI / 2.
      DO 10 I = 1,9
      FILE(1,41,I) = TFILE(NPROJ+29,I) * (PCOST/1000.)
      II = I
      IF(IREG-2)30,20,30
   20 K=4
      GO TO 40
   30 K=IREG
   40 Y(1,I)=(SFILE(II,K,1)-SFILE(II,K,2))/(SFILE(II,K,3)-SFILE(II,K,2))
      ALPHA = ( PI * Y(1,I)) - PI2
      BETA = PI2 * Y(1,I)
      Y(2,I) = .5 * ( SIN(ALPHA) + 1. )
      Y(3,I) = 1. - COS(BETA)
      Y(4,I) = SIN(BETA)
      DO 10 J = I,4
      FILE(J,29,I) = Y(J,I) * FILE(1,41,I)
   10 FILE(J,29,10) = FILE(J,29,10) + FILE(J,29,I)
      RETURN
      SUBROUTINE MXFCTR
      UACOST = TFILE(NPROJ+29,1) * (PCOST/1000.0)
      DO 10 I = 1,3
      DO 10 J = 1,4
      FILE(I,31,J) = (UACOST + FILE(I,18,84) ) * (FILE(J,I+24,10) +
     *                          FILE(I,30,J)) / (FILE(I,11,84) + FILE(I,14,84))
   10 FILE(4,31,J) = FILE(4,31,J)+FILE(I,31,J)
      RETURN
      SUBROUTINE OUTPUT
    1 FORMAT ( 1H1,51X,30HEMPLOYMENT GENERATION BENEFITS )
    2 FORMAT ( 1H0,46X,10A4 // 74X,25HTYPE OF RESPONSE FUNCTION / 19X,
     * 19HREGION / OCCUPATION,24X,6HLINEAR,6X,12HINTERMEDIATE,4X,
     * 11HLOWER-BOUND,4X,11HUPPER-BOUND )
    3 FORMAT ( 16X,10A4,4F15.2 )
      DO 10 I=1,4
      FILE(1,32,I) = FILE(1,32,I)+FILE(I,25,10)
```

```
01364          FILE(2,32,I) = FILE(2,32,I)+FILE(I,26,10)
01365          FILE(3,32,I) = FILE(3,32,I)+FILE(I,27,10)
01366          FILE(4,32,I) = FILE(4,32,I)+FILE(I,28,10)
01367          FILE(IREG,32,I) = FILE(IREG,32,I)+FILE(I,29,10)
01370          FILE(4,32,I) = FILE(4,32,I)+FILE(I,29,10)
01371          DO 10 J=1,3
01374          FILE(J,32,I) = FILE(J,32,I)+FILE(J,30,I)
01375          FILE(4,32,I) = FILE(4,32,I)+FILE(J,30,I)
01376          FILE(J,32,I) = FILE(J,32,I)+FILE(J,31,I)
01377       10 FILE(4,32,I) = FILE(4,32,I)+FILE(J,31,I)
01402          DO 20 I = 25,29
01405          IF ((I .EQ. 25) .OR. (I .EQ. 28)) WRITE(IOUNIT,1)
01410          WRITE(IOUNIT,2) (TITLE(1,I,J),J=1,10)
01416          DO 20 J = 1,10
01421          J1 = MOD(J,3)
01422          J2 = MOD(J,4)
01423          J3 = J1 + 2
01424          J4 = J2 + 25
01425       20 WRITE(IOUNIT,3) (TITLE(J3,J4,K),K=1,10),(FILE(L,I,J),L=1,4)
01441          DO 30 I=30,32
01444          IF ((I .EQ. 30) .OR. (I .EQ. 32)) WRITE(IOUNIT,1)
01447          WRITE(IOUNIT,2) (TITLE(1,I,J),J=1,10)
01455          DO 30 J = 1,4
01460       30 WRITE(IOUNIT,3) (TITLE(2,J+28,L),L=1,10),(FILE(J,I,K),K=1,4)
01474          RETURN
01475          END

END OF COMPILATION:        NO  DIAGNOSTICS.
```

```
@MAP
MAP 0017-10/27-09:34
START=007676, PROG SIZE(I/D)=5206/56815


@COPY TPF$.,APPPROG.
FURPUR 0017-10/27-09:34
   6 BLOCKS COPIED
```

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13. ABSTRACT

The study seeks (1) to develop a method of measuring the employment generation benefits from a federal water resource investment in a depressed area, (2) to relate such benefits to the social cost and economic benefit-cost ratio, and (3) to analyze the sensitivity of employment generation benefits to various types and locations of water project investment within areas designated as depressed regions. The Upper Licking River project in the Appalachian portion of Kentucky was chosen as the study area.

The study carefully examines the sensitivity of a variety of assumptions about the character of the location in which projects are constructed, the composition of the demands for labor and materials in various types of engineering alternatives and various patterns of response by otherwise unemployed factors of production.

The report concludes that conventional B/C analysis should encompass the utilization of otherwise unemployed resources, that those impacts should extend to the analysis of economic development induced by the project, that those benefits from utilization vary greatly with the type and location of the project with respect to the distribution of idle resources, with demand functions of production and the response pattern of idle resources to incremental demand. Finally and most importantly, the report concludes that public water resource investment decisions should be more discriminating to the type and location of investments. This requires investigation of the foregone benefits from alternative types and location of water projects and from competing public works projects.

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Interindustry Coefficients						
Resource Response Functions						
Benefit-Cost Analysis						

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