ABSTRACT

APPRAISAL OF ALTERNATIVE MODELS FOR ESTIMATION OF INDIRECT EMPLOYMENT AND PROFIT GAINS RESULTING FROM PUBLIC WATER PROJECT INVESTMENT

By

William Augustus Ward

In June of 1969 the United States Water Resources Council issued a revised statement of policies and procedures for evaluating Federal water resource projects. The primary effect of the new procedures was to greatly broaden the concept of project benefits. In particular, the benefits previously defined as "primary" and "secondary" or "indirect" were both lumped together into categories called "contributions to national income" and "regional development." The research reported herein dealt with the appraisal of secondary or indirect benefits.

The literature review revealed three categories of secondary benefits: 1) The customary variety consisting of the multiplier impacts "induced-by" and "stemming-from" output changes; 2) externalities such as economies of scale and technological spillovers; and 3) dynamic secondary benefits such as socially engineering the human inputs. The latter two categories have been the least widely used and seemingly the most difficult to appraise.

It was decided to focus upon the appraisal of the "customary" variety which applied the aggregate demand multiplier concept.

The literature review also revealed that most indirect benefit analyses violate both the compensation principle and the opportunity cost concept. The multiplier analyses surveyed showed a marked tendency to under-value the opportunity cost of labor and to over-estimate the real income changes. In most cases the benefits estimated exceeded the change in the recipients ability to pay.

In the study, arguments against placing a zero opportunity cost on human and capital resources were presented. It was argued that only the changes in quasi-rents to capital and the changes in labor wages stimulated by the project are benefits to people in the project region. An attempt was made to develop an indirect benefit appraisal model which reflected these concepts. The model used national input-output coeficients and secondary data regarding wages and profits by sector and region.

The conditions and assumptions under which the proposed model would be operable were spelled out. A total of nineteen conditions and assumptions were identified. Key among these were: 1) the opportunity costs of the factors involved, 2) the state of the national and local economies, 3) the source and alternative allocation of the Federal funds expended, and 4) the inter-regional and inter-job mobility of labor. Five of the nineteen assumptions were not specific to the proposed model, but were applicable to indirect benefit analysis in general. Two more related to input-output approaches in general. Several had the effect of pre-specifying parts of the result.

The model was applied to four different water resource projects. The results were compared with the indirect benefits estimated for the same projects by eight other teams of analysts. The teams represented three major water resource agencies and four universities. Numerical estimates of indirect benefits differed widely between the teams of analysts. These differences were found to be largely attributable to: 1) differing concepts of what constituted indirect benefits, and 2) differing assumptions regarding the macro-economic framework within which the projects were being appraised. Some of the indirect benefit categories applied by the teams of analysts were: 1) opening up new farming opportunities in the Western United States so as to re-distribute population, 2) raising per capita incomes in the regions effected (intensive growth), 3) increasing the total income of the region even if the increase occurred without increasing the incomes of individuals already in the region, and 4) increasing the stability of income. Some key implicit assumptions regarding the macro-economic policy framework related to: 1) other programs to deal with income and employment maintenance, and 2) the sources of the Federal funds spent and the methods used to collect those funds.

The study indicates that great difficulty will be had in applying the expanded benefit categories to Federal water project appraisal. The difficulty boils down to four key tasks:

1. Making the indirect income concepts and methods of estimation fit into the display framework selected by the Water Resources Council:

    a. The accounts display income changes for the project region and for the nation as a whole and do not facilitate the display of changes in income to individuals, within or without the region,
    b. The accounts do not facilitate the display of income losses to other regions;

2. Choosing the effects to display — e.g., regional employment, regional income, new farming opportunities, net national income, and income stability — and selecting the weights to be assigned to each for project-by-project comparisons. This is a value judgement which must be made either by the analyst or by the political process;

3. Finding the data to apply existent methods and developing improved methods for estimating the indirect impacts;

4. Developing the skills within the field staffs of the water resource agencies to handle the complex concepts and estimation procedures involved in estimating indirect effects.

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By

William Augustus Ward

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CHAPTER I

INTRODUCTION

In its report[1] to the Water Resources Council in June of 1969, the Special Task Force on Evaluation Procedures presented a greatly expanded concept of benefits to be considered in the evaluation of Federal water projects. The motivation for the report and the revision of benefit concepts was reportedly the passage in recent years of several laws relating to the Federal water program.[2] As a result of these new laws, it was felt that the general guidelines presented in Senate Document 97[3] (the currently-governing policies and procedures document) would need to be updated to encompass the "broadened" national objectives signalled by Congressional enactment of the new laws.

The broadened national objectives which were to be fostered by the Federal water program were classified as 1) national income objectives, 2) regional development objectives, 3) environmental objectives, and 4) well-being objectives. It was proposed that each of these be made explicit considerations in water project evaluations, and that the value of each project be judged on the basis of its contribution to one or more of these objectives. It was suggested that the old distinction between "primary" and "secondary" or "indirect" benefits be abandoned and that in their place the concept of "contributions to the national income objective" be adopted. This was felt to be "consistent with the evaluation principle requiring the identification and measurement of <u>all</u> beneficial effects . . ." It was proposed that those benefits formerly referred to as "secondary" and "indirect" now be discussed in terms of "production externalities" and "resource unemployment" benefits,[4] and that, rather than be treated only in side calculations, any contributions to national income from these sources should be accounted for in the national income objective account. Production externalities were considered to prevail when

> There exist economies of scale in production for industries affected by the project output when such economies do not exist in any activities which may contract. Under this condition production units may be operated at a more efficient level or interrelated processes may be better coordinated <u>including the elimination of bottlenecks to the efficient expansion of other activities</u>.[5]

Resource unemployment benefits could be expected to prevail when

> Otherwise unemployed or underemployed resources (labor, fixed capital and resource capital) may be used or better employed as a result of the developments occasioned by the project. This may come about as a direct result of project construction, operation, maintenance and replacement or as an indirect result of the use of project outputs. This latter effect occurs when the expansion of industries directly or indirectly using project outputs draw heavily upon similarly unemployed or underemployed resources.[6]

Though a potentially major addition to what was the old "national efficiency" or primary benefit account was being made, the national income objective account was still considered to be a principal objective measure of project value in light of which contributions to other objectives were to be considered. The addition of environmental consideration, regional development considerations, and considerations concerning the well being of people were added as additional objectives to be evaluated as competitors with national income objectives. However, the national income objective account was also greatly expanded by the addition of "secondary" impacts to that category of benefits.

The current status of theory, research methods and data sources concerning the evaluation of secondary effects was such that the Task Force acknowledged the difficulty surrounding the evaluation of these impacts, especially that of production externalities. Thus, while some general recommendations concerning the analysis of unemployed resource benefits were made, no attempt was made to present a format for the analysis of production externalities.

The "bottleneck" thesis forms the basis for much of the analysis of secondary impacts, since it allows the assignment of cause for secondary output expansion to the water project (which supposedly eliminates the bottleneck). While not all water resource agencies formerly included the evaluation of secondary benefits due to bottleneck elimination in their analyses, explicit consideration was often given to the elimination of production bottlenecks as a rationale for public investment. The proposed evaluation procedures would allow for the inclusion of the expansionary effects of such elimination as explicit project benefits.

By expanding the concept of income effects to include indirect or secondary impacts, the Task Force sought to comply with newly-enacted legislation which made regional development an explicit goal of the Appalachian water resource program. Unemployed resource benefits were expected to occur largely in the case of projects built in depressed regions. Benefits from scale economics would be expected to occur more readily in local economies which were operating at very low levels of output. The employment gains from breaking production bottlenecks would be greatest where large volumes of resources were unemployed.

The division of the income effects into a Regional Development Account and a National Income Account made the nation's regional development objectives explicit and made it possible to explicitly trade-off national income for regional income. However, it also made necessary techniques for estimating both regional and national impacts of water resource projects. In the past, only the Bureau of Reclamation of the United States Department of the Interior (referred to hereinafter as the Bureau) had attempted to evaluate indirect income effects of water projects. In doing so, the Bureau considered that Congress had assigned it the mission of developing the arid regions of the Western United States; thus, regional development benefits were treated as synonomous with national benefits. Transfer of income to the region was a primary goal of the Bureau's program, and little attempt was made to estimate the net national impact or to determine the efficiency of the transfer.[7]

The Bureau developed a "model" for evaluating the indirect effects of its reclamation efforts. The model consisted of a set of coefficients intended to represent the value added in processing outputs and producing the purchased inputs for the major agricultural commodities grown in the region. These coefficients were used in estimating the indirect income generated by the increased agricultural output on farms using project-supplied water. The Bureau's approach to benefit evaluation has been widely criticized.[8] The Bureau's model would not appear to be a generally acceptable means for dealing with the expanded concept of benefits under the new proposed procedures.

Towards the Appraisal of Secondary Benefits

Many other "models" for appraising secondary benefits have been proposed in recent years. These models can generally be divided into three groups: 1) multiplier models, 2) externality models, and 3) dynamic models (these three groups will be discussed more fully in Chapter II). The most popular has been the multiplier model (these are discussed in Chapter IV). The Bureau's approach has been classified as a multiplier model.

Perhaps the most misused concept in economics has been that of the multiplier. As a result, many prominent economists view with disdain the proposals to use multiplier concepts in the appraisal of Federal water projects. This is unfortunate since some aspects of multiplier analysis offer great promise in appraising one kind of secondary benefit which most economists would agree needs to be better appraised: the real economic costs of factors used and of factors directly stimulated to use by Federal water projects. The problem of appropriately shadow-pricing resources is closely tied to the basic static multiplier concept. A major purpose of this study is to demonstrate the link between the very simple economic concepts of 1) opportunity costs, 2) economic rent, and 3) multiplier analysis, and to develop a model which utilizes these concepts in appraising static indirect benefits.

Objectives

The objectives of the present study are

1. To survey, evaluate, and synthesize the current status of theory regarding secondary or indirect benefits;
2. To identify the elements in objective one above which can be forged into a generally applicable model which
   a) can be applied to all or most Federal water projects,
   b) uses generally available secondary data,
   c) makes explicit the assumptions and conditions under which it is operable;

3. To demonstrate and test the model by applying it to four test case projects;
4. To compare the model test results with the results obtained by other test teams and to identify the reasons for differing test results from the several analyses;
5. To evaluate the applicability of the model in light of the results obtained in meeting objective four.

Footnotes

1. Procedures for Evaluation of Water and Related Land Resource Projects: Report of the Special Task Force on Evaluation Procedures to the Water Resource Council. (Washington: June 1969).

2. Ibid., pp. 6-10.

3. United States Senate, 87th Congress, 2nd Session, Policies, Standards and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, (Washington: 1962).

4. Procedures for Evaluation . . . , op cit, 39-41.

5. Ibid., 42.

6. Ibid., 43.

7. George S. Tolley, "Impact of Public Resource Development on Agricultural Production and Income," Proceedings of the Agricultural Economics and Rural Sociology Section, Association of Southern Agricultural Workers, 1959.

8. See especially Tolley, op cit.

CHAPTER II

SECONDARY BENEFITS DEFINED: A REVIEW

The term "secondary benefits" as generally used in the water resources field refers to "The increase in the value of goods and services which indirectly result from the project under conditions expected with the project as compared to those without the project."[1] While primary benefits include only the value of outputs which are produced directly by the project, secondary benefits include the increased outputs (values) which result from the repercussions of the project outputs upon the rest of the economy. Thus, while the analysis of primary benefits is by nature micro-economic, the analysis of secondary benefits has been considered macro-economic in approach.[2]

The concept of secondary benefits found in the literature is not monolithic. Much controversy persists among economists regarding the nature, existence and means of evaluation. A large part of the disagreement stems from the existence of more than one type of secondary benefit. Most authors have not satisfactorily delimited the category of benefits they were discussing nor the assumptions under which the subject was being treated. Often authors have mixed into their discussion more than one type of benefit. The resulting confusion and disagreement between authors has been extensive.

Basically, one can divide secondary benefits into three different kinds: 1) the "customary" variety relating largely to multiplier effects, 2) the "externality" variety which relate mostly to economies of scale and the effects of "spillovers", and 3) "dynamic" secondary benefits which relate to changes in the shape of production functions, changes in "the human factor" and basic institutional effects. These three categories are not clearly defined and adhered to, as the following sections will show. For example, it is not clear whether "technological externalities" should go into the second or the third category. Further, the treatment of aggregate demand multiplication could be also viewed as a pecuniary spillover, which could place it in the second category. Nevertheless, the tripartite division is helpful in interpreting the literature regarding secondary benefits. It is especially helpful in understanding the basis of the disagreements between different authors.

The Customary View - The Multiplier

The customary approach to secondary benefits has generally divided them into two classes, following largely the convention of the Bureau of Reclamation: 1) those "induced-by" the increased factor requirements occasioned by the project, and 2) those "stemming-from" the added processing, etc., of the direct project outputs.[3] The first class can be sub-divided into a) those "induced-by" factor requirements for constructing, operating and maintaining the project, and b) those "induced-by" the complementary relationship between the water-based goods and other factors in the production of the direct benefits. An example of the latter is the induced sales of fertilizer as a result of increased water availability due to an irrigation project. The "induced-by" and "stemming-from" effects can be classified as demand effects and supply effects, respectively.[4] The former occur through the transmission of (derived) demand from the project outputs through the producers of the factors which go into intermediate products to meet those demands. The latter occur through the increased availability of factors to later stages in the marketing process. Ostensibly, since the supply of factors at the project-level stage has increased, the supplies of outputs at successive stages will increase. Both of these effects generate household income at each stage in the form of wages and profits. The indirect benefit is the change in real income realized as a result of the project.

Clark, Grant and Kelso (referred to hereafter as the Panel) in their report[5] to the Bureau of Reclamation advise that, since supply and demand act jointly to determine income, stemming-from effects and induced-by effects should not be added in estimating the value of secondary benefits from the national viewpoint. They argue that stemming-from effects are a special form of supply effect which presupposes a demand for the increased output. Further, the impetus of the two effects occur at different times in the life of the project. Part of the aggregate demand effect (induced) occurs as a result of construction expenditures, while the supply effect (stemming) occurs after project operation has begun and project outputs are forthcoming, often with somewhat of a lagged response.[6] Also, since the factors demanded by the project differ from the factors produced by it, traditional macro-economic aggregate supply and demand analysis tends to obscure the multitude of interactions and transactions necessary to establish a new equilibrium. The resource movements involved in those pecuniary interactions make the determination of net income effects very difficult to get at.

Indirect Benefits as a Pecuniary Externality

McKean[7] discusses indirect benefits as a form of pecuniary spillover or externality. He concludes that, in the presence of full employment, the net national benefits from such spillovers will be zero; the incidence of rents will shift so that some individuals benefit and some lose, but the net change in income in the absence of technological spillovers or economies of scale will be zero. However, if resources are unemployed or under-employed, there exist possibilities for indirect benefits to occur. He does not view such existence as a sufficient cause for a project to create indirect benefits, however. Neither does their existence solve the problem of separating out the net changes in real income due to employment of previously unemployed factors from shifts in the incidence of scarcity rents, where such changes may be widespread and individually very small.

McKean argues that, generally, the project analyst should include, in the national account, only technological spillovers, and should only consider pecuniary spillovers (to McKean, indirect benefits) if involuntary unemployment of a very long range nature is expected to exist in the absence of the project. He argues that in most situations the time lag between project analysis and construction is such that unemployment which existed at the analysis stage might well have disappeared by the time construction begins.[8]

The McKean definition of indirect benefits appears to only include aggregate demand effects and pecuniary externalities. He treats technological externalities and economies of scale under a second group of effects. "The position taken [by McKean] . . . is that the two general types of spillover -- technological and pecuniary -- are, in principle distinguishable and mutually exclusive."[10] He does not believe that secondary benefits generally prevail for the nation as a whole after all project effects are netted between all resource owners and all regions. Only under very special conditions of severe unemployment and factor immobility will any net positive effects occur for the nation as a whole, and those will be much smaller than traditionally claimed.[11]

The Secondary Benefit Controversy

There is some disagreement among economists concerning the question of the existence of secondary or indirect benefits. While that portion of economic theory is so underdeveloped as to allow for much controversy,[12] perhaps some part of that disagreement revolves around the confusion surrounding the inclusiveness of the term "secondary benefits." As pointed out above, McKean and others[13] take a very restrictive view of the term. The tendency among this group is to think only in terms of aggregate demand analysis which, under certain conditions, can lead to an increase in national income. Another group, to which the Water Resource Council Task Force seems to belong,[14] view secondary benefits as inclusive of all possible economic effects beyond the valuation of the direct project outputs, including scale economies, technological externalities, aggregate demand effects, aggregate supply effects, etc. Thus, the latter group tend to look more favorably upon the possibility of secondary benefits in water resource projects.

Primary and Secondary Benefits: Mutually Exclusive?

While the difference in inclusiveness of the definition of secondary benefits contributes to the controversy over real net national effects, it is not the only factor. An additional element is the disagreement over the sort of assumptions one should make about the future. Some analysts assume that general fiscal policy and public programs will be managed so as to promote steady growth, full employment, and factor mobility. Under these assumptions, long range resource unemployment problems disappear (or are obfuscated). Thus, only the demand multiplier effects of the construction expenditures are perhaps relevant; and the length of the planning period is such that fiscal management might have already eliminated that source of unemployment benefits.[15] The necessity for these assumptions is seen as the realization that, in the absence of steady growth and "adequate" levels of aggregate demand, the direct project outputs will constitute excess supply; thus, the assumptions which give value to the primary benefits are interpreted as negating the possibility of indirect benefits.

The difficulties of the unemployment-adequate demand dichotomy which plague the analyst under the growth-employment-mobility assumption can be handled through a minor alteration in that assumption. The difficulty lies in the all-or-nothing interpretation of the assumption--i.e., that one can not have both a growth in demand and unemployment or immobility. Such a situation can exist, however. Since the growth in demand is the principal factor upon which the valuation of primary outputs is based, then one can have both primary and secondary benefits prevailing, if there is unemployment, as a result of factor immobility. Thus, the assumption of factor immobility has come to play a large role in the justification for and evaluation of net secondary benefits. Some discussion has developed over the extent to which factor immobility should serve as a basis for secondary benefit analysis. On the one hand, it is realized that less than perfect mobility contributes to market imperfections which can allow unemployment in some areas or markets to coexist with inflationary demand in other areas or markets. Practically all analysts agree that unemployed or underemployed factors constitute a waste of resources. However, the disagreement comes from the interpretations concerning the temporal nature of the unemployment. Some argue that, if the unemployment and market imperfections are short-run in nature, then the creation of indirect impacts in those areas via public investment would thwart the operation of the incentive system upon which the market system operates.[16] The effects of such a policy in the long run would be to undermine the market system. Others interpret many of the market imperfections as long run imperfections. Thus, the policy prescription is to pinpoint such areas and dose in public investments designed to create indirect employment of the otherwise long-range unemployed.

Secondary Benefits - The "Externality" Approach

Margolis argues that the Bureau of Reclamation program cannot be justified on the basis of primary benefits alone. Further, the traditional "stemming-from" and "induced-by" sort of approach, when properly done, would not in most cases lead to a justification of most irrigation projects. However, when one considers the possible external economies due to denser settlement, economies of scale due to larger local markets, improvements in transportation, etc., the program of the Bureau becomes more justifiable. Thus, Margolis concludes, "The proper framework within which to discuss secondary benefits is the theory of external economies."[17] He would not limit the discussion to pecuniary externalities but would include other forms of externalities as well.

The Water Resource Council Task Force, in effect, institutionalizes the inclusion of externalities in the definition of secondary benefits.[18] They apparently accept the judgement that net national secondary benefits do not occur from project investments in the absence of unemployment or external economies. Thus, "secondary benefits will result in contributions to national income when either of the two general conditions are expected to prevail." These general conditions are:

> 1. Externalities--There exist economies of scale in production for industries affected by the project output when such economies do not exist in any activities which may contract. Under this condition

production units may be operated at a more efficient level or interrelated processes may be better coordinated including the elimination of bottlenecks to the efficient expansion of other activities.

2. Resource unemployment--Otherwise unemployed or underemployed resources (labor, fixed capital and resource capital) may be used or better employed as a result of the developments occasioned by the project. This may come about as a direct result of project construction, operation, maintenance, and replacement or as an indirect result of the use of project outputs. This latter effect occurs when the expansion of industries directly or indirectly using project outputs drawn upon similarly unemployed or underemployed resources."[19]

Under the "Externalities" heading the Task Force lists two general conditions under which the public investments may generate net secondary benefits. The first is that of different economies of scale between contracting and expanding industries. In terms of benefits, the real difference between the net values of the outputs would appear the relevant concept. The Task Force realized the difficulty of determining and measuring benefits due to scale economies and did not present a format for evaluating them.[20]

The second category of externalities relates to the elimination of bottlenecks. Secondary benefits would exist if the project directly or indirectly stimulated the expansion of output of some factor which had effectively limited the expansion of other activities. Such a situation might occur in a water supply project in which the water was a critical input into one product which was a critical input into a second product. In this case, the provision of water might stimulate the expansion of both activities, given the existence of effective demand for the outputs of both. The degree to which the water-related product contributed to such expansion and the extent to which one might credit the added income to the project would depend not only upon the marginal rates of substitution between the "critical" factors and other inputs but also upon the assumptions made regarding alternative means of providing those factors, and the development of substitutes (including a substitute technology), etc. All of the expansion would be creditable only under the very restrictive assumptions of 1) zero substitutability between factors provided at all levels of expansion, 2) no alternative means of providing the initial critical factors, and 3) no new technology which would effectively substitute for the critical factors would develop during the life of the project. In addition, since the bottleneck elimination is largely a supply effect, it is assumed that effective demand will exist for the outputs over the relevant period.

In actuality, the bottleneck elimination benefits are very much akin to the traditional "stemming-from" benefits in the Bureau of Reclamation procedures. For the stemming benefits to be valid, the same process of reasoning and assumptions outlined above would be necessary.

In the case of the Bureau, the basic project output is irrigation. The principal direct benefits come from increased agricultural output. There is little doubt that agricultural outputs are the basic factor in a food processing operation and that little factor substitution is possible, except between agricultural commodities. The same is true for succeeding operations to the final market. Thus, the Bureau procedure has been largely in keeping with that part of the requirements. However, a basic issue has been overlooked. That is, does a shortage of agricultural outputs exist which serves as a bottleneck to the expansion of food processing and succeeding activities? The apparent answer in light of the agricultural surpluses is that, in terms of national agricultural output, such a bottleneck does not exist. Whether or not such a bottleneck exists in terms of regional expansion is perhaps another issue, however -- an issue which belongs in the discussion of the regional development effects of indirect benefits, since such expansion in the project region would be expected to be offset by a contraction in some other farming region.[21] On the other hand, if there did exist a shortage of agricultural products, nationwide and if that shortage did force the operation of food processing plants at inefficient levels, then net national indirect benefits could be realized as a result of such irrigation projects. Thus, the validity of the principle stands, in spite of the improper manner in which it has been applied on occasion.

The Resource Unemployment benefits rightly belong under the customary variety of secondary benefits discussed above which view secondary impacts as largely a phenomenon of changes in the level and structure of aggregate demand. While the externality benefits largely presuppose an adequate level of effective demand for the final outputs, resource unemployment benefits assume a deficiency in demand. As discussed above, the assumption is not necessarily that the overall level of demand is deficient. Rather, the deficiency might be the inability of the market to transmit those demands to the unemployed factors, or in the structure of those demands relative to the structure of productive capacity. However, the benefits from changing the structure of aggregate demand to ease the unemployment problems would possibly be traded for some decrease in incentives to resource mobility.[22] It would also alter the structure and incidence of income flows. Indirect benefits from "resource unemployment" would occur only if the resources would not otherwise have found employment. While the restructuring of aggregate demand via Federal expenditure policy can lead to an acceleration of economic growth, Eckstein urges resistence to "pressure group expenditures" which would reduce factor mobility and reduce the long run rate of real growth.[23] To guard against the possibility of such long-run negative effects, many economists argue that only resource unemployment of a very long run nature should be considered.

Secondary benefits due to resource unemployment apply not only to those arising from the employment of otherwise unemployed labor but also from the employment of otherwise unemployed plant capacity (capital), as well as under-employed labor and capital. Under-employment occurs when a factor is employed, but not in its highest-valued use. If the project directly or indirectly leads to full employment (or less under-employment) of such factors, then the change in returns to those factors would constitute a secondary benefit (if, in the process, a decline in the employment of other factors is not caused). Secondary benefits might result from fuller utilization of otherwise unemployed fixed assets,[24] in which case the benefits would consist of the returns above variable and user costs stimulated by the project.

"Dynamic" or Developmental Secondary Benefits

A third class of secondary benefits has developed in recent years, though it has not joined the current controversy regarding the other two varieties. "Dynamic Secondary Benefits" is the title which has been bestowed upon them. This variety of benefits has to do with the "dynamic social engineering aspects of resource development."[25] It finds its basis in such things as the improvement in the labor force and in technological advance. Thus, it is much more difficult to conceptualize than the customary variety.

Also falling under this third heading is the socio-economic effects of moving the center of population in the United States westward.[26] The Bureau of Reclamation considers such a movement to be a part of the public mandate under which it operates.[27] Thus, the Bureau has had as a part of its "established procedures" in project evaluation a policy of crediting a given dollar value to each new farming opportunity created by its projects. Ostensibly, the Western United States constitutes a more "desirable" area in which to live than other sections of the country. Thus, real welfare of the populace can be improved by creating income-earning opportunities in the West allowing people to move to more "desirable" residential areas.

Another category of benefits sometimes placed under this class of secondary benefits is that relating to resource conservation. It is argued that Federal natural resource projects,by providing more and longer duration additions to capital stock than the market would demand, creates secondary additions to the real welfare of those who favor such policies and also, ostensibly, to future generations who would choose a higher rate of long term investment and a lower rate of consumption by previous generations, if such a choice were available.[28] Such benefits are not easily analyzed and, consequently, are not normally included in primary benefit calculations, though some have argued in the past that the discount rate used in Federal water project evaluations constitutes just such a consideration. While this rate has been much lower than the market rate in the past, the discount rate used for water project evaluation in the future will be much closer to the market rate of interest.

The "dynamic" secondary benefit category has tended to be a catch-all for the multifarious benefit categories which were difficult to evaluate. The fact that conservation and population dispersion are not necessarily "primary" goals of the Federal water program has created the impression that they are "secondary" benefits. Only in so far as they contribute to changing the long-run aggregate production function or to "socially engineering" the human factor should they be considered "dynamic" secondary aspects of project development. Thus, only remotely do many of these factors fit into the dynamic secondary benefit category.

Summary of Secondary Benefit Classifications

The literature on secondary benefits discussed above demonstrates substantial controversy regarding the concept. The greatest controversy surrounds the customary variety of benefits. Most authors believe the existence of unemployed factors to be necessary for net national secondary benefits to occur. Unemployment could result from either a deficiency of the overall level of aggregate demand or from resource immobilities. Some authors believe that only the former factor should be dealt with in public projects, since interference with the latter would lead to a distortion of the incentive system. They believe that in the long run the factors would reallocate to accomodate the changed structure of prices, if an adequate level of overall demand were maintained. Others believe that public interference should depend upon the length of time required to reallocate the factors, especially the human ones. They are willing to forego some of the incentive effects to relieve unemployment and resultant human suffering. All of these deal with secondary benefits from changing the level or the structure of aggregate demand, and they tend to view secondary benefits as arising primarily from this source.

The "externality" approach includes both supply and demand aspects, though most authors do not make this explicit. The "bottleneck" thesis is a good example of the case in which both derived supply and derived demand are thwarted by the shortage of a commodity. The case of scale economies is largely a supply effect which presumes a demand for the marginal output from the scale effects. Scale economies represent the point at which the externalities approach begins to blend into the "dynamic" secondary benefit category.

"Dynamic" secondary benefits are viewed largely as a supply effect. They operate through changes in the quality of resources and through changing the institutional and/or technological milieu in which the resources are operative. Frustration with past "theories" of growth and with aggregate demand multiplication as a means of economic development has led to increasing attention being given to the "dynamic" factcrs.

The interaction of long-run supply and demand under conditions of changing technology and institutions has created problems in dealing conceptually with secondary benefits. The domination of economic growth theory by Keynesian analysis in recent years has led to confusion as to what constitutes real growth and how it should be fostered. Many secondary benefit discussants have dealt largely with aggregate demand effects while making differing assumptions about aggregate supply and its responsiveness. This factor alone has led to substantial confusion and controversy. Others dealt with nebulous concepts regarding changes in productive capacity while assuming adequate administration of aggregate demand effects of public projects without adequately specifying their assumptions regarding the method of financing by the public sector. This has contributed to further disagreement as to the "net" secondary effect of public projects. The following section deals with the effects of differing assumptions regarding the means of financing public projects.

Secondary Benefits: The Budget and the Economy

Much of the discussion of the "netness" of secondary benefits has centered around the relationship of the project to the overall Federal budget. Quite obviously, the aggregate demand multiplier effects of the construction, operation and maintenance expenditures will depend greatly upon the method used to finance them. Keynesian multiplier theory makes it very clear that the multiplier effects of a tax-financed public investment are smaller than those of a deficit-financed public investment.[29] If the project is assumed to be tax-financed, then it appears reasonable that the funds taxed away would also have had multiplier effects associated with them in the private sector which should be subtracted from the multiplier effects of the government investment to determine the net multiplier effects of the tax-financed expenditure. However, it can be demonstrated that the multiplier effects of tax-financed public investment in the aggregate exceed those of the private sector (in the absence of a budget surplus policy). The systematic difference between the two multipliers has led to the "Balanced Budget Theorem" which states, in effect, that government expenditures financed wholly by taxes will have a net multiplier effect upon the level of aggregate demand. The difficulty, however, is that under a very complicated taxing structure (including built-in stabilization mechanisms) such as that of the United States the exact size of that net multiplier at the margin of expenditures is somewhat difficult to determine.[30]

Many economists have argued that the secondary benefits (especially those induced-by the construction, and operation and maintenance expenditures) created by the project are at least partially offset by 1) the contractions in the private sector caused by the taxing, or 2) secondary impacts which would have resulted from any other expenditure of those fiscal dollars. Thus, it is argued that secondary impacts should not be included in project analysis. Underlying such an argument is either 1) an implicit assumption that the secondary impacts of all of the alternatives are equal to those of the project, or 2) a belief that the effects of each are so difficult of determination and estimation that their inclusion would invalidate the analysis. (A third argument for not including them relates to the negative effects of distorting incentives, discussed above.)

Eckstein argues that net national indirect benefits result only under very limited circumstances. Those circumstances relate basically to the state of the economy at the time. Induced-by benefits would be expected "In a time of depression, when national output is far below capacity and there are idle resources diffused through the economy . . ."[31] These would come largely through the multiplier effects of the construction expenditure, since "Induced effects from the operation of the project are likely to be either very small or non-existent during a depression."[32] Because commodities are already in oversupply, the increased output from the project will offset the induced effects of the project, since the income payments to the project-related producers will replace income payments to the project-related producers will replace income payments to other producers. However, if the products produced are surplus agricultural commodities which will be absorbed by the Federal Budget, then there will be an additional induced benefit from operation of the project, but it will be due to the increase in the government deficit resulting from the price support program. Thus, Eckstein concludes," . . . the operation of projects does not create induced benefits in depression other than the effect of the price-support program, but . . . the construction of projects does induce substantial amounts."[33] While Eckstein does not make the distinction between tax-financed and deficit-financed projects in his discussion, the application of his analysis of induced effects can be made to both alternatives, the difference being in the magnitudes of the net multiplier effects at the construction stage. In his discussion of secondary benefits during periods of economic balance, Eckstein does distinguish between the two means of finance but concludes that the net effects would be to stimulate an acceleration of prices, thus worsening the situation.

If one accepts the counsel of the Panel of Consultants to the Bureau of Reclamation that stemming benefits are supply effects while induced benefits are demand effects,[34] then one should expect the benefits from the two categories to occur in obverse fashion over the business cycle. That is, it would appear that stemming (supply) effects would contribute to real income during inflation, while induced (demand) effects would contribute to real income during recession. Eckstein agrees that ". . .

stemming benefits are very unlikely in depression, are a possibility during inflation if the specific commodities are in short supply, and can only be granted for periods of economic balance in those instances where the premises of mobility can be denied because of extraordinary circumstances. The routine calculation of stemming benefits, therefore, is not warranted."[35]

Eckstein does not make explicit his assumptions concerning the state of the budget in each of the cases discussed. He largely ignores any off-setting effects from private sector contractions due to taxing or bond sales. Thus, it is not clear in his treatment of induced benefits from project operation during depression, for instance, as to why there will be no positive real income effects. If the operation and maintenance costs are tax-financed (financed from the budget rather than from project benefits, which will not be recaptured by the relevant agency), there appears to be no reason for assuming that the project output will merely replace non-project outputs in the market. In this case, the balanced budget multiplier should have raised the level of aggregate demand so that at least part of the new output could be purchased without reducing the demand for non-project outputs. That is, the overall level of demand should have increased rather than merely shifted in incidence. Thus, the real income effects of operation and maintenance expenditures for most Federal water projects should be to raise the level of aggregate demand. In times of recession, this would appear to have real welfare implications.

McKean points out that a difficulty in predicting the secondary effects of a project upon unemployment lies in the fact that the analyst has no foreknowledge of the rest of the Federal Budget. It is important to consider what would have happened to taxes and expenditures in the absence of the project.[36] Thus, the problem of piece meal sub-optimization in terms of secondary benefits is no less substantial than that in terms of primary benefits.[37] He notes elsewhere, however, that "In many problems of choice, the size of the budget or the scale of the mission is fixed by higher authority."[38] Thus, the question of secondary alternatives forgone is obviated, at best. On the other hand, Buchanan counsels that the expenditure-taxing decisions <u>must</u> be considered to be made simultaneously," . . . the overall size of the budget cannot be separated from its composition. The two decisions are interdependent."[39] Thus, the question of secondary benefits is not independent of the taxing process nor of the overall composition of the budget, including other mutually-exclusive alternatives. The determination of the real net changes in the welfare of the people involved cannot be made in isolation from these considerations. The "involved" people include both those paying for and receiving the benefits from the public projects.

Footnotes

1. *Procedures for Evaluation* --, op cit, p. 40.

2. *Development of Water Resources in Appalachia*, Main Report - Part IV (draft). United States Army Corps of Engineers, Office of Appalachian Studies, December 1968.

3. Julius Margolis, "Secondary Benefits, External Economies, and the Justification of Public Investment," *The Review of Economics and Statistics*, Volume 39 (1957), pp. 284-291.

4. John M. Clark, *et al*, *Report of Panel of Consultants on Secondary or Indirect Benefits of Water-Use Projects to Michael W. Straus, Commissioner Bureau of Reclamation*, June 26, 1952.

5. *Ibid*.

6. *Ibid*., pp. 20-21.

7. Roland McKean, *Efficiency in Government Through Systems Analysis: With Emphasis on Water Resources Development*. (New York: 1966)

8. *Ibid*., p. 161.

9. *Ibid*., pp. 154-55.

10. *Ibid*., p. 143.

11. *Ibid*., p. 159.

12. See, Julius Margolis, "Secondary Benefits, External Economics, and the Justification of Public Investment," *The Review of Economics and Statistics*, *XXXIX* (1957), 284-91.

13. See Roland McKean, "Criteria of Efficiency in Government Expenditures," *Federal Expenditures Policies for Economic Growth and Stabilization*, U. S. Congress (Washington: 1957); reprinted in *Public Finance and Fiscal Policy: Selected Readings*, ed. by J. Scherer and J. A. Papke (Boston: 1966), 98-104; John F. Due, *Government Finance: Economics of the Public Sector* (Homewood: 1968);
H. H. Stoenever and E. N. Castle, "Input-Output Models in Water Resources Research," *Journal of Farm Economics*, (Nov. 1965), 1572-79;
U. S. Congress, *Economic Analysis and the Efficiency of Government*, Report of the Sub-committee on Economy in

Government of the Joint Economic Committee, 91st Cong., 1st Session, (Washington: 1970), 25-28.

14. See Procedures for Evaluation---, op cit;
Margolis, op cit;
Allen V. Kneese, Water Resources . . . Development and Use, (Kansas City: 1959).

15. See particularly McKean, op cit; and Margolis, op cit, and

16. Otto Eckstein, "Federal Expenditure Policy for Economic Growth," Public Finance and Fiscal Policy: Selected Readings, ed by J. Scherer and J. A. Papke, op cit, 574-81.

17. Margolis, op cit, 284.

18. Procedures for Evaluation ---, 42-43.

19. Ibid.

20. Ibid., p. 101.

21. For example, Tolley, op cit, concludes that the effect of the Bureau program has been to transfer income from Southeastern farming regions to Southwestern farming regions.

22. Otto Eckstein, "Federal Expenditure Policy for Economic Growth," Public Finance and Fiscal Policy: Selected Readings, edited by J. Scherer and J. A. Papke (Boston: 1966), 574-81.

23. Ibid., 578.

24. See Clark Edwards, "Resource Fixity, Credit Availability and Agricultural Organization," unpublished PhD. thesis, Michigan State University, 1958.

25. Kneese, op cit, 27.

26. Ibid.

27. Margolis, op cit, 284-91.

28. Kneese, op cit.

29. J. M. Keynes, The General Theory of Employment, Interest and Money (London: 1964), 125-28.

30. E. Cary Brown, "The Personal Income Tax as an Automatic Stabilizer," Tax Revision Compendium, Hearings

before the Committee on Ways and Means of the U. S. Congress (Washington: 1959), 2357-62.

31. Eckstein, Water Resource Development: The Economics of Project Evaluation (Cambridge: 1965), 206.

32. Ibid., 207.

33. Ibid., 207-8.

34. J. M. Clark, et al, "Report of Panel of Consultants on Secondary or Indirect Benefits of Water-Use Projects to Michael W. Straus, Commissioner, Bureau of Reclamation," June 26, 1962.

35. Eckstein, loc cit, 211.

36. McKean, Efficiency in Government . . . , 161.

37. McKean, "Criteria of Efficiency . . .", 99.

38. Ibid., 101.

39. James M. Buchanan, The Public Finances (Homewood: 1965), 232-3.

CHAPTER III

SECONDARY BENEFITS, ECONOMIC RENT, AND THE COMPENSATION ABILITY PRINCIPLE

The basic issue in the discourse concerning secondary benefits is dual in nature: first, are there income gains to some parties which in total exceed the losses to other parties? And, secondly, are those estimated changes in the income of the gaining parties net, such that they would be able to pay for the privilege of receiving them? The first aspect of the issue relates to the reality of net national secondary benefits, while the second relates to that of net local (or to the individual) secondary benefits. The implications of the latter should make it apparent that, while much attention has been given to the existence of offsetting income declines in other regions, there is a very strong possibility that the generally-cited gains might not represent even net local gains. This is true because of a common failure to include all of the relevant opportunity costs which exist at the local level. Agreement between most parties to the discourse concerning indirect benefits has been accomplished in only the very special circumstance of substantial factor unemployment. Where substantial unemployment of a long-run nature has been evident, most authorities have agreed that indirect benefits should be considered. The common practice has been to treat the entire payment to the otherwise unemployed factor as a benefit (or, inversely, to subtract it from costs). There are two difficulties with this approach, however. First, it is very restrictive and only admits of the existence of indirect benefits in one special case. Secondly, the benefit gains cited in such cases are probably overvalued because of the implicit zero-valuing of the opportunity cost to those factors realizing the gains. In the case of labor, for example, it is doubtful that one could ever logically expect a zero opportunity cost to exist for two reasons: first, in terms of true welfare effects, such a procedure imputes a zero value to leisure;[1] secondly, as Joan Robinson points out, labor cannot survive in the alternative in the long run if "transference earnings" are zero.[2] Thus, even in the restrictive case upon which agreement has been achieved, the question of adequately handling the problem of the opportunity costs in terms of real welfare changes has not been resolved. The obvious existence of some degree of indirect benefits in those circumstances has led protagonists to allow the consideration of indirect benefits in the extreme case, even though many have felt that the true opportunity costs were something greater than the zero value conventionally imputed to them.

For indirect benefits to be relevant and helpful in comparing projects for investment decision purposes, it is important that some consistency in treatment be incorporated into project analyses. All public projects produce some kind of indirect economic effects. In many cases, the indirect effects merely take the form of transfers in which one party benefits at the expense of another. From a national viewpoint, perhaps no new net income results. From a regional viewpoint, net changes might well occur, however. In other cases, the incomes of certain individuals or regions might change in form without changing in total. For example, an individual who had previously managed a bowling alley might change to marina management as a result of the public water resource investment. Whether or not he benefited from the shift would depend upon the changes in his net returns. If he realized \$10,000 net income per year in the bowling alley business and \$12,000 in the marina business, the net benefit would be \$2,000 per year (not \$12,000). By the same token, he (or one of his employees) might have realized a decline in income from the shift. Such would have been the case had the project caused a shift in recreation consumption away from bowling and into boating. His shift into marina management might have still been his best alternative, even though a lower income alternative than his pre-project bowling enterprise. In this case, the relevant benefit to the individual would be negative. In either case, a benefit evaluation procedure which did not deduct the income from the pre-project bowling alley would greatly over-value the positive income effects. In each case, the key to coming up with the appropriate benefit figure lies in determining the relevant opportunity costs of the factors involved in the shifts. As discussed above, the implicit assumption in much of the discourse concerning the evaluation of indirect benefits has been that the opportunity costs are equal to the new income earned in all cases except that of substantial long-run factor unemployment. This convention ignores the possibility of major net benefits occurring in the case of factor under-employment. The fact that a secondary impact of a public project which moves a previously employed laborer from a job paying $3,000 per year into one paying $9,000 per year is excluded in some computations, while the employment at $3,000 per year of a previously unemployed worker is included, points up the difficulty in such a procedure.

While one might well argue that the marginal utility of $3,000 at zero income is very high, one could also make a very plausible argument that the marginal utility of $6,000 at a $3,000 income is relatively high. Thus, at least in the range of such figures as those used above, it would appear that the marginal utility of income argument would not constitute a sufficient case for the method in which all adjustments except that made by the unemployed are ignored.

Wage Changes and Economic Rent

When a worker moves from one job to another, it is usually a result of a perceived opportunity to increase the "net utility" derived from the work experience. In the simplest case, a worker might shift from one job with a relatively low wage to an identical job which yielded a higher wage. Presuming that the "disutility" of work was the same between the two jobs, the worker would view the change in wages as an "unearned increment" to his income. Economists generally refer to such unearned increments as "economic rent."[3] There is general agreement among economists that changes in economic rent are largely a result of demand changes. Demand is viewed as the "active determinant" of rent, while supply is viewed as the passive determinant. Such analysis is based upon the assumption that the supply of the factor under consideration is perfectly inelastic -- that is, regardless of the price offered for the factor, the same quantity would be offered for sale by factor suppliers. Any price above zero would yield a "rent" to the factor supplier. The higher the price, the greater the rent.

In Figure 1, the demand and supply of labor for an individual worker is depicted under the assumptions of perfectly inelastic supply and three different demand conditions. The vertical supply of labor curve (S_L) indicates that the laborer would work the same number of hours per year whether his annual salary were zero, $2,000

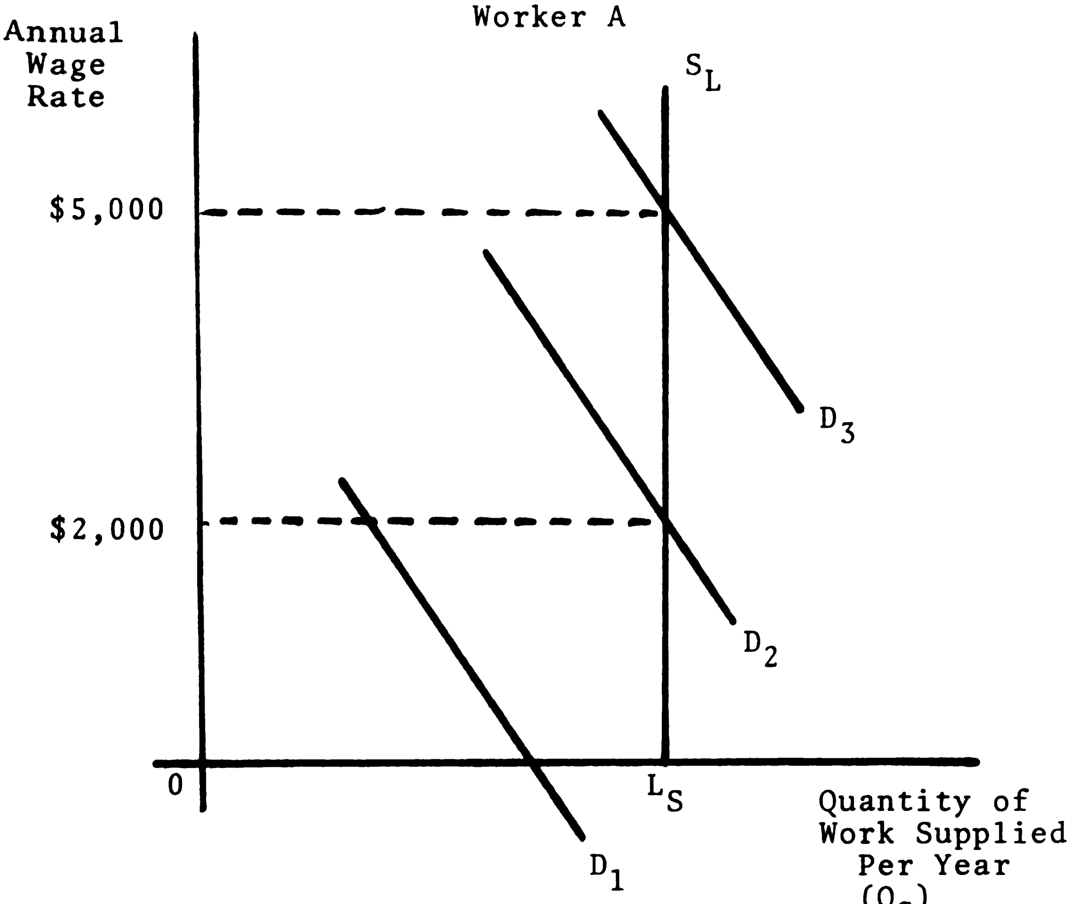

Figure 1. Wage Determination and Rent Accrual Where the Elasticity of Supply Equals Zero ($E_s = 0$).

or $5,000. As the demand for the laborer's services shifts from the level at which an employer would be willing to pay zero or less for the laborer's full year of work (D_1) to a demand situation in which the employer would be willing to pay $2,000 for the number of hours of work which this laborer would supply, the quantity of labor supplied does not change. Assuming for the moment that there is neither a "like" nor a "dislike" for work on the part of the laborer, the depicted supply curve would indicate that the marginal value of leisure to this laborer is zero at all levels of leisure consumption. (A supply curve which sloped upward and to the right would indicate that the marginal utility of leisure diminished as more leisure was "consumed" -- or, alternatively, that the marginal utility of leisure increased as more hours of work were undertaken.)

The generally used method of multiplier analysis treats the benefits to labor in essentially the fashion depicted in Figure 1 -- in particular the demand change illustrated by the shift from D_1 to D_2. Prior to the increase in aggregate demand indicated by the multiplier impact, the demand for the services of worker A was D_1, which was insufficient to bring about his "full employment," even though he would have been willing to work for a zero wage. The aggregate demand change shifts the demand for the worker's services to D_2, which would be sufficient to bring about his "full-time" employment for $2,000 per year. The

$2,000 is treated as an economic rent to the laborer. The demand for a factor of production such as labor is determined by the marginal revenue product (MRP) of that factor. The MRP of a factor is the dollar value of the addition to total output which is brought about by an increase in factor employment. Under pure competition, and in the absence of technological externalities, the MRP of labor represents the addition to the value of the output of the economy resulting from the employment of one previously unemployed laborer. Thus, the "rent" realized by the laborer would also be viewed as a net addition to the value of the output of the whole economy and would be added to the "national" benefits of the project.

There are two basic problems with the assumptions which underlie the approach to multiplier analysis discussed above. First, it is probably incorrect to assume that workers neither like nor dislike their jobs. Some workers appear to enjoy their work a great deal. Many of these would perhaps perform the same job for less pay, without decreasing their productivity. Thus, for these workers, over a particular price range their labor supply functions might be close to perfectly inelastic. Other workers obviously dislike at least some aspects of their particular jobs. Many "tolerate" the work performed only because of the salary received. The supply function for the services of these latter workers probably exhibits a great deal of elasticity for that particular job over the prevailing price range. Those workers who enjoy their jobs might be said to be realizing a "surplus" or a "rent" equivalent to the difference between the wage they would accept for the same work and the wage which they are actually paid. The worker who was "tolerating" his work might be said to receive no rent, if he would take his services off the market at any perceivably lower wage rate.

A second factor assumed away in the analysis usually undertaken by multiplier analysts regards the marginal value of leisure. In few cases would the marginal value of leisure be zero at all levels of leisure consumption. Rather, one should expect the marginal value of leisure to increase as work time cuts deeper and deeper into leisure time. Thus, the supply function for labor would appear to slope upward _and_ to the right, with the slope increasing as hours worked increased. Such a situation is illustrated in Figure 2. The intercept of supply function S_L depends upon the marginal value of leisure to the totally unemployed worker. In the case illustrated, the marginal value of leisure is assumed to be zero for all levels of employment below "A" days per year. Because the marginal value of leisure increases as the quantity of leisure decreases, the worker must be paid higher and higher wages to induce him to increase the number of days worked per year. As the wage rate increases, the worker realizes a "surplus" for those days on which he would have supplied his services for a lower payment. Presumably, after some level of days

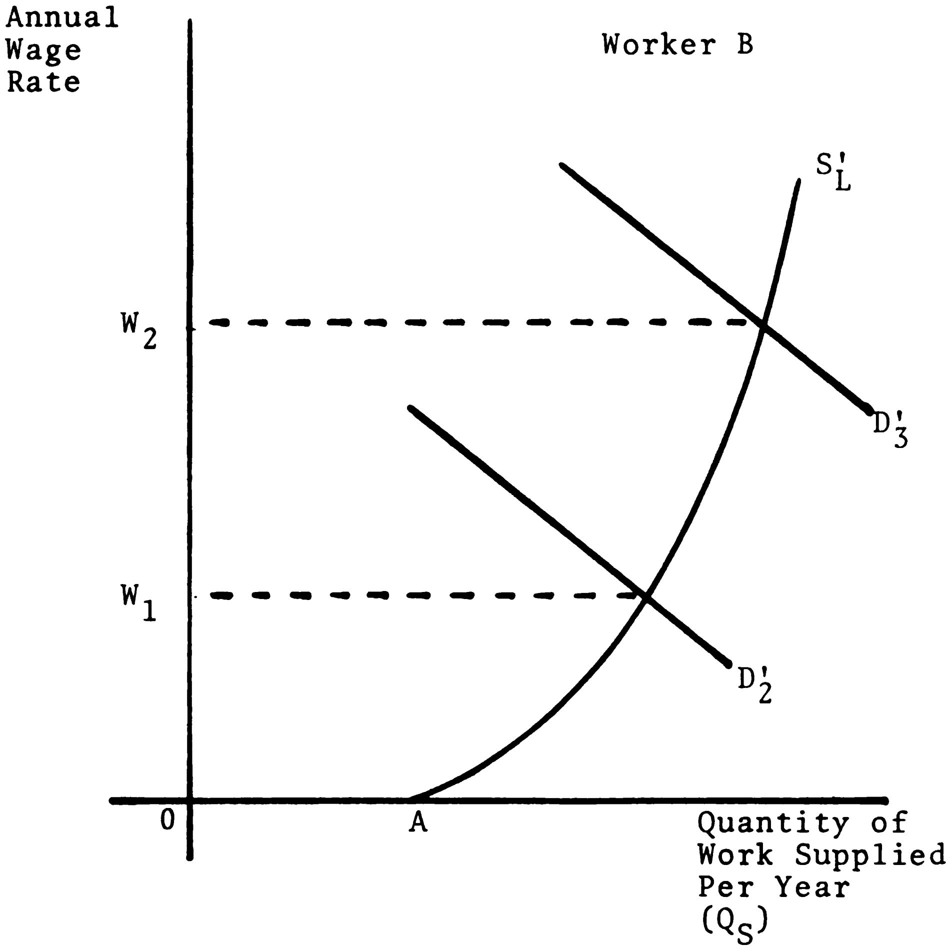

Figure 2. Wage Determination, Surplus and Rent Accrual Where the Elasticity of Supply is Variable [$E_s' = f(Q_S)$].

worked per year, the marginal value of leisure will become very great, and/or there will be no remaining leisure time. Additional increases in wages will not bring forth a greater quantity of labor. The increased wages will accrue to the laborer as "pure surplus" or "rent." Thus, only in the upper wage range would the depicted laborer realize the "pure rent" described by the multiplier. At lower income levels, only a "suppliers surplus" would be realized by the laborer. The extent of the surplus would depend upon the elasticity of supply of labor.

From the foregoing it would appear that the "pure rent" imputed to labor from the usual multiplier analysis should be expected to be more a phenomenon of fully employed labor, rather than unemployed labor. That is, when a change in aggregate demand leads to labor movement to higher paying jobs, the difference in wages accrues largely as "rent" to the worker. (The size of the rent component of the change in wages would depend upon the degree to which the wage differences resulted from differing psychic costs between the two jobs. If the psychic costs were equal, all of the wage difference would be rent.) Only in those cases in which the economic and psychic costs of the move were zero or very small would the worker be willing to pay a large part of the income difference for the opportunity to make the shift.

The occurrence of secondary benefits can relate to unemployed plant capacity as well as to unemployed labor.

If the plant has no alternative use, then the opportunity cost of the fixed factors would be zero. Thus, the relevant benefits from induced utilization of the plant would consist of gross revenues minus variable costs. In Marshallian terminology, this difference constitutes "quasi-rents."[4] For any such plant which was operating, but at less than "full capacity", benefits would accrue to any induced increases in output according to the changes in "quasi-rents" earned, including profits.

Secondary benefits from rents at the extensive margin for plant capacity could occur when the construction of a new plant was stimulated by the public investment. In this case, the rents would consist only of pure profits earned on the new plant investment, since the long-run concept of rents would be relevant here.[5] In the case of fixed plant employment as in the case of labor employment, however, consideration must be given to the decline in rents of other factors. Thus, if construction of the plant discussed above took place to the exclusion of the construction of some other plant, the net benefit would consist of the difference in profits (rents) between the two plants. If public investment stimulated a shift in investment from lower to higher profit plants, net economic welfare would presumably be enhanced. The enhancement would be by the amount of the difference in pure profits (rents), however, rather than by the full extent of the new plant profits.

Economic Rent and the Compensation Ability Principle

In the evaluation of secondary benefits, as in that of primary benefits, the "Compensation Principle" must hold. That is, the value of the benefits estimated should amount to no more than the recipients could and actually would pay for them. Thus, in terms of real welfare changes, the actual secondary benefits would be equal to the change in rents realized by factor owners, for that is all that they would be able to pay. Attempts to make them pay the "full value" of the new alternative rather than the differential would be confronted by an inability to do so. In many cases, it would appear, secondary benefits which had been thought to be net to the local area would not be opted for by the local populace, if the project cost were charged to them. This is true because of the methods by which secondary benefits have been evaluated, as discussed above.

In secondary benefit evaluation, the compensation principle can be applied at three different levels. The most widely discussed of these has been the national level. It has often been asked whether the nation should be willing to pay for the secondary benefits which have been claimed in some project analyses. This is, in effect, the same question as that of the "netness" of secondary benefits. A much less widely discussed level is that or regional or local ability to compensate. The question here is whether the secondary benefits are net locally. As discussed above, the changes might merely represent reallocations within the area so that some local people gain and some lose. Whether or not local governmental units (as representatives of the people) could pay for the changes is a basic question where measurement of regional development benefits are considered. The third level is that of individuals. There is a very complex problem involved at this level which also permeates the other two via the individuals involved there. That problem revolves around the real welfare effects of labor employment. Labor is dealt with both as the relevant welfare beneficiary and as a factor input. Supposedly, leisure is a consumption good just as the products of labor are. A rational laborer-consumer would be expected to allocate his time between leisure and labor until marginal values of the two were equal. One can logically assume that he would do so. However, it is difficult, if not impossible, to determine the real change in welfare of a previously unemployed individual who is employed as a result of a public project. He, in effect, exchanges a large volume of "leisure goods" for other kinds of goods. Ostensibly, the leisure goods had a zero value at the margin; thus, his welfare is enhanced by the exchange. To determine how much better off he would be, however, one would have to know the total difference in value. In application, this problem is generally ignored, and the benefits (welfare gains) are taken to be the whole of the wages paid. Unless the individual valued leisure at a zero rate at all levels of consumption, the real welfare gains are obviously over-valued. If asked to compensate by the amount of the entire wage (or slightly less) for the privilege of working, few workers would choose that alternative over leisure. The problem is not so complex when other individual factors are dealt with. The "consumption good" nature of leisure for idle plant capacity offers little problem. Most analysts have few qualms about valuing plant idleness at zero value. (Natural resources constitute another problem, however -- the problem of conservation or "option demand" value. This problem will not be dealt with herein.) In the case of labor underemployment, the leisure good problem is not so acute. If the individual were already working "full time" but at a lower wage, the wage improvement would not come at the expense of leisure good consumption. Thus, the welfare effects would be to increase the total volume of non-leisure goods while allowing continued consumption of the same volume of leisure (or more leisure and the same volume of non-leisure goods).

The invocation of the Compensation Ability Principle constitutes an attempt to ensure that changes in the real welfare of people actually occur as a result of a project in order for those changes to be included in the project analysis (if the given group is asserted to be all of the people of the region, then the internal transfers should be noted).

The important consideration is that people as laborers and as resource owners will be made better off by changes in resource productivity. Thus, in many respects, the analysis of secondary benefits from the employment of non-human resources conforms very closely to that of human resources. The major difference is that the non-human resources do not constitute the relevant consuming units. Thus, among other things, "leisure" is valued at zero for those units. (To the owner of an underutilized plant who must make amortized payments on the fixed assets, the value of such leisure is probably viewed as negative.)

In terms of real secondary benefits realized as a result of the utilization of unemployed plant capacity, the only changes for which one can find an ability to compensate are the changes in quasi-rents which result.[6]

A Working Definition of Secondary Benefits

Keynesian multiplier analysis demonstrates the real income changes which occur in an economy when an infusion of aggregate demand occurs. The economy to which it is most applicable is that of the United States in the 1930's in which economic stagnation had followed many decades of relative prosperity in which the basic investments had been made. The aggregate demand multiplier is an acceptable, and even fairly accurate, device for measuring aggregate demand-induced changes in income where the idle fixed capacity exists to employ idle workers; given a sufficient level of demand under these conditions, the real opportunity costs of both of these factors are probably close to zero, while (because of price rigidities) their market prices might be much higher.

The perfect competition model deals with factors which in equilibrium are allocated to their highest use. Under perfect competition, the opportunity costs of these factors are equal to their selling prices; factor owners, possessing perfect knowledge and foresight, undertake capital investments in the highest yielding industries, tending to force rates of return to equality; in equilibrium, rates of return on all investments equal the opportunity cost of capital and no pure profits exist.[7]

The perfect competition model in which both capital and labor are fully employed and are earning their opportunity costs is the antithesis of the Keynesian model in which labor and capital are unemployed and the factor prices do not equal their opportunity costs. Under the perfect competition model, the price of a good sold to final demand is exactly equal to the sum of the opportunity costs of all of the factors used to produce that good; thus, no "net" value (rent) is realized. In the Keynesian Model, all factor prices are over-valued relative to their opportunity costs; thus, the "net" value produced by a good sold to final demand exceeds the direct value added above factor cost and should include the rents realized by the owners of the factors indirectly used in meeting that final demand. That is, the "real" costs of a good sold to final demand is composed of the "real" cost of the factors used to produce that good; the "real" cost of the directly used factors is composed of the "real" cost of the factors used to produce them; and the same is true of all other "rounds" of production preceding these rounds. Thus, the cost of the final good is not equal to its market price to the extent that rents are realized in the production of all of the factors and sub-factors consumed in its production.

Some of the techniques used in traditional multiplier analysis allow the tracing of the factor rents realized from the most basic primary factor up to the good sold to final demand. Others include these rents but also superimpose the "induced" effects (see Chapter III) of the re-spending of these rents. Some techniques look at only the re-spending of the rents. In all cases, the rents are defined by an assumption of a zero opportunity cost for the factors used.

Secondary benefits (in the form of multiplier impacts) potentially exist where there are market imperfections which allow rents to be realized in the production of final goods or of factors. The traditional approaches to estimating these rents have used the Keynesian conventions of zero - costing the resources and/or adding an induced income component to them. The former is simply a special case solution, while the latter adds a dynamic component which damages the validity of what is basically a static

analysis. By leaving the induced component out and by appropriately shadow pricing the resources used in all rounds of production leading to final goods, it is possible to use some of the traditional multiplier techniques to estimate the degree to which market prices over-estimate the real cost of the goods produced; or, alternatively, it is possible to estimate the rents which are realized at all stages of production leading up to the provision of the final goods. The generation of such rents, it seems to this author, should form the basis for a workable concept of indirect income changes.

In Chapter IV, past approaches to secondary benefit estimation and multiplier analysis are surveyed and the conformity to above definition of secondary benefits discussed. The principal objective is the selection of a format which best allows the estimation of the above-defined secondary benefits. In Chapter V, an attempt is made to alter the selected format so that it will at least provide a conceptual basis for the estimation of the economic rents which are realized from the higher employment of previously under-employed factors.

Footnotes

1. Eckstein, Water Resource Development, 216.

2. Joan Robinson, The Economics of Imperfect Competition (London: 1965), 107-7.

3. David Ricardo, The Principles of Political Economy and Taxation (New York: 1965), 33-45.

4. Alfred Marshall, Principles of Economics (London: 1964), 349-50.

5. In the long-run all costs are variable; thus the only returns above variable costs would be profits. However, at long-run equilibrium, pure profits should be zero. See H. H. Liebhafsky, The Nature of Price Theory (Homewood 1963(, 353-61.

6. M. M. Huffschmidt, et al, "Standards and Criteria for Formulating and Evaluating Federal Water Resource Developments: Report of Panel of Consultants to the Bureau of the Budget" (June 30, 1961), 26.

7. Liebhafsky, op cit, 365-87.

CHAPTER IV

SOME APPROACHES TO SECONDARY BENEFIT EVALUATION: A REVIEW

Secondary Benefits and Economic Impact Analysis

In the past two decades there have been multifarious attempts at secondary benefit evaluation. Many (or perhaps most) of the attempts have been applied to other than natural resource investments. Some of these attempts were methodology oriented in that they sought to develop, test, or refine methods for dealing with the problems of secondary benefit evaluation. Others represented bonafide empirical attempts at determining the actual secondary benefits from certain economic impacts.

"Economic impact analysis" is the term used in the economics and Regional Science literature to describe many of the studies which have attempted to measure secondary benefits. Impact analysis represents an attempt to determine the macro-economic effects upon a regional or national economy of a given exogenous change in a variable affecting that economy. Several methods have been proposed for evaluating the economic repercussions of such changes. The more important of these will be presented and briefly discussed in this section.

Impact Analysis and "Customary" Secondary Benefits

Contemporary students of secondary benefits generally distinguish between three varieties of such benefits: First, the "customary" variety of "stemming from" and "induced by;" second, those due to scale economies; and, third, "dynamic secondary benefits" which actually change the form or productivity of the resources involved.[1] While it is probably true that-in terms of the economic development aspects of public investment-the latter two perhaps hold the greatest potential for large-scale impacts upon the economy, they are by nature so difficult of evaluation that few attempts have been made to deal with them empirically. The attempts which have been made have largely been of the theoretical type, as opposed to the methodological or empirical; and as yet little implementable theory appears to have been developed. While the concepts of "x-efficiency"[2] and "o-efficiency"[3] are perhaps valuable contributions to the growing body of theory of "non-marginal economics," one is hard-pressed at present to devise a means by which they might be operationalized. Furthermore, there exists a great and growing body of such literature relating to the growth and development of underdeveloped countries which have realized only very limited operationalization by economists working in that area.[4] The long-standing discourse concerning "infant industries" and "leading sectors" represents an overt attempt to deal with the problem of achieving scale economies. The discussion of investments in "human capital" constitutes a recognition of the existence of "dynamic secondary benefits." However, no generally acceptable methods for evaluating the impact of such policies have been developed.

The greatest difficulty posed by the third variety of secondary benefits is that they constitute not only movements up the aggregate production function but also changes in that function.[5] Thus, traditional production theory and analysis encounter great difficulty in coping with such changes. The second variety is perhaps not so difficult to handle conceptually; however, the prediction of scale economies is quite difficult when the relevant unit of production has never been operated at the scale necessary for their achievement. To date, the development of scale economies and other technological externalities has largely been incidental to project development. Analysts still do not have adequate information regarding this variety of secondary benefits to predict with any degree of accuracy their occurrence. As a result of these and other difficulties, secondary benefit analysts have spent most of their time in attempting to measure the first variety of secondary benefits. This emphasis has been a natural off-shoot of and has followed closely the "Keynesian revolution" in economic analysis. For the most part, it has constituted an attempt to bring macro-economic theory to bear upon the analysis of economic growth and development.

The application of Keynesian economics to the problems of growth and development which lie at the heart of the secondary benefit issue has resulted from the failure of economists to provide anything more closely resembling a theory of economic growth. Thus, attempts to deal with secondary benefits have tended for the most part to focus upon aggregate demand and "the multiplier" and have tended to ignore the problems of structural and institutional change involved in the development process.

Very early after its original statement, students of the General Theory deemphasized its aggregate supply aspects and began to work in earnest upon the aggregate demand aspects.[6] Comparatively little work has been done upon the aggregate production function and its determinants.[7] As a result, the most familiar and most widely applied component of the General Theory has been the aggregate demand multiplier. Economists became intrigued quite early with the multiplier; and during the ensuing decades the economics literature has been replete with theoretical and empirical treatments regarding it. While there have been some discussions regarding "shifting the aggregate production function," these discussions have gained nothing of the impetus granted to those concerning aggregate demand. Aggregate demand maintenance as a Federal function was given explicit recognition in the Employment Act of 1946; there is no such explicitly-stated policy at the Federal level regarding aggregate supply maintenance, though programs such as that in the water resources field constitute implicit policies of resource improvement.

Given the foregoing as a background from which to develop, it is understandable that secondary benefit evaluation would follow the lines it has followed. For the most part, "secondary benefits" has been synonymous, with "secondary impacts"; and "secondary impacts" has generally referred to aggregate demand multiplier effects. Thus, the approach most often taken in secondary benefit evaluation has utilized some form of multiplier analysis in which changes in regional or national demand via the multiplier effects of the project were taken as the secondary benefits. The major exception has been the approach used by the Bureau of Reclamation in which the aggregate supply effects ("stemming-from" benefits) were added to the aggregate demand effects ("induced-by" benefits) in estimating secondary benefits. The problems posed by this approach in estimating the net secondary benefits from the national viewpoint have been previously discussed (see Chapter II, above). While from a regional viewpoint one might wish to consider "stemming-from" effects in addition to "induced-by" effects because of the possibility of net regional gains via inter-regional pecuniary effects, most secondary impact analyses have dealt with only the aggregate demand (induced-by) effects. Thus, the discussion which follows will be couched basically in the aggregate demand

multiplier framework. Most of the approaches discussed below could be used in the estimation of "stemming-from" effects as well.

Multiplier Analysis

In very general terms, a "multiplier" constitutes an expression of the relationship between changes in one variable in association with a given change in another variable. Thus, one might view a multiplier as simply a "coefficient" in a functional equation which relates changes in the dependent variable to changes in the independent variable.

As used in economics, "multipliers" generally refer to the relationship between some welfare-related dependent variable and an independent "policy" variable which is subject to manipulation from without. The most common of the welfare-related variables have been those of employment and income. Their determinants have ranged from "government expenditures" to the "export base" of the relevant economic unit. There are many such relationships in economics, with several means for constructing multipliers to represent most of them. Thus, one should be wary of such terms as "*The* Multiplier," which is often encountered in Federal water resource project reports and, at times, in other economics literature.

A great part of the attraction which multiplier analysis seems to hold stems, no doubt, from the simplicity and

apparent logic of the process by which multipliers are generally derived. For most multipliers, a knowledge of simple algebra is sufficient for one to understand the mathematical relationships involved. By the same token, the same simple algebra is generally sufficient for the student to derive the expressed multiplier himself or derive another on his own. For example, the original Keynesian investment-income multiplier is sufficiently simple in concept that normal procedure in economics principles courses is to have students derive it for themselves. At the same time, the algebra involved lends to the derivation process an aura of mathematical logic which tends to create an illusion of a great revelation,[8] when, in fact, the "multiplier" might be nothing more than another way of stating a tautology.[9] Keynes, though himself accused of the same fault by Haberler and others, warns against the obfuscation of important relationships by "a maze of pretentious and unhelpful symbols."[10] One should interpret apparent mathematical relationships with some caution lest he interpret a snapshot specification of an existent situation as a fundamental long run identity or functional relationship. The warning concerning the regression fallacy is not new to economists; indeed, it is included in practically all introductory texts. Thus, whether one should interpret a "relationship" between farm income and non-farm income, for example, as a fundamental multiplier identity is a question which cannot be answered by simply stating that "total income = farm income + non-farm income."[11] The careful process by which causation is established is not present in this statement alone.

Keynesian Multipliers

Though the original presentation of the multiplier concept is generally credited to R. F. Kahn,[12] it was John Maynard Keynes who brought the concept to fruition in his General Theory of Employment, Interest and Money. In Chapter Ten Keynes presented his now famous investment-income multiplier which expressed a relationship between equilibrium income and investment. In a closed system in which investment constituted the only exogenously determined variable, changes in equilibrium income were given by the product of investment change and the multiplier, defined as the reciprocal of one minus the marginal propensity to consume, or $\frac{1}{1-MPC}$. Though Keynes discussed altering effects upon the multiplier by such factors as foreign trade payments (later called "leakages") and durable-nondurable goods composition of purchases, the basic Keynesian multiplier remains as originally stated.

Though the original, simplified derivation of the Keynesian multiplier stressed the effects of exogenous changes in investment upon the economy, the concept may be applied to any form of exogenous infusion of expenditures. Thus, it is particularly useful in looking at the effects upon regional income of a given level of expenditure in public works originating outside of the region, such as expenditures by the Federal government for construction of a water resource project.

To estimate the secondary changes in income using the Keynesian multiplier, one would first have to establish the marginal propensity to consume. If one were largely interested in regional income changes (as, for example, one might be in applying the considerations dictated by the Appalachian Development Act), one would need to know the regional MPC. Having determined that, the process of estimating the secondary income changes would be a fairly simple one. It should be emphasized, however, that the determination of the MPC is seldom a simple task and would require a large scale research effort in and of itself.

If the MPC of the region in which the expenditure occurred were different from that of the nation as a whole, the secondary income changes would not represent simply shifts in income between regions; there might also occur net increases or declines in national income as a result of those shifts. J. S. Chipman[13] has demonstrated that if the MPC for all regions were equal, the inter-regional multiplier would reduce to the national multiplier. Then there would be no problem of trading off relative changes in regional income with absolute changes in national income. If the MPC of the project region were greater than that of the nation as a whole, national income would be increased by virtue of the shift in expenditures. Richardson mot

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notes that, since most underdeveloped regions tend to have a very high MPC, national income would be maximized if the increase in government expenditures were concentrated in those regions.[14] While first round expenditures would perhaps be greater in such regions, "leakages" would also tend to be greater. Thus, while national income might be greater, the region in question would probably realize little of the gains in income beyond the first round of expenditures.

An obvious difficulty with the simple Keynesian multiplier is that it does not consider such factors as imports and other leakages which exist in open systems. Thus, there are serious limitations to its use in regional analysis. When other factors such as the industrial composition of the region, regional input-output relationships, and local purchasing propensities are considered, the marginal propensity to consume becomes only one of many factors operating upon the level of regional income. Indeed, if the MPC is related to the state of development while the volume of leakage is related in an inverse fashion, as would appear to be the case, the simple Keynesian multiplier could be quite misleading in terms of regional income effects of exogenous investment.

The degree of aggregation involved in the determination of a single marginal propensity to consume creates the kind of problems involved in all such aggregations. First, there is the problem of different consumption

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patterns between different groups of income recipients. As a result, it makes some difference as to what groups the initial income changes accrue. If there is a systematic bias towards skilled craftsmen, for example, whose incomes tend to be higher than average, then the relevant MPC might be quite different from the average propensity to consume. At least the first round of expenditures should take this fact into consideration. Secondly, it matters what the composition of purchases is for both the exogenous infusion and for the ensuing household purchases. Keynes realized the difficulties involved with durable goods purchases, for example, which are normally taken "on order." The lags involved at both the consumption and production stages for durable goods create difficulties. In the case of Federal water resource projects a large volume of the expenditures involved are directed towards durable goods industries.[15] The problems created by the differing "velocities of circulation" (or "duration of the rounds") are substantial in determining both the magnitude and duration of the significant multiplier effects.

As in interpreting all multipliers, one should ask the question of exactly what is being multiplied. In this case, the "welfare-related" variable that one is attempting to change is income. Whether or not those income changes represent commensurate changes in real welfare, however, is not answered by the analysis. This must be answered from without and in consideration of other factors. This

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is true because of the manner in which the multiplier operates. While one often hears the Keynesian multiplier described as an "income" multiplier, it multiplies income directly under only very special conditions. The Keynesian multiplier (and most other "income" multipliers) is an aggregate demand multiplier. Thus, for it to be effective, certain conditions relating to aggregate supply must be met. In short, aggregate supply must either be perfectly elastic or it must shift (as a result of the investment, ostensibly) by the same amount as does aggregate demand for the multiplier effects to be felt full force without being partially absorbed through inflation. For the full value of the income payments to represent real changes in welfare to the recipients, the opportunity costs of those factors must have been zero. Thus, the real welfare effects (secondary benefits) of public investments are consistently overstated by the Keynesian multiplier in all except this very special case.

While practically all secondary impact study reports begin with a discussion of the Keynesian multiplier concept, few of them utilize the pure Keynesian version in their analyses. The common disclaimer by which the analyst proceeds to another approach concerns the difficulty of obtaining data (especially at the local or regional level) on the marginal propensity to consume and the imprecision of such data, when available. As a result, most impact studies which purport to utilize the Keynesian multiplier

in fact only utilize the Keynesian method of derivation. That method has been discussed above and some of the pitfalls delineated. The following example should demonstrate some of these pitfalls.

In their article on farm-non-farm income linkages, Mirakhor and Orazem discuss the development of the multiplier concept. They quote a definition of the multiplier by Oskar Lange as ". . . the marginal effect of a change of one economic variable upon another economic variable, of which the first is a component." From this definition they conclude that ". . . if it is possible to divide an economic variable into its different components, it is permissable to determine the changes that take place in the original variable as a result of a change in one of its components."[16] The authors then proceed to set up an income identity similar to the Keynesian income identity. This, however, shows total income as composed of farm income and non-farm income. From this identity, "multipliers" are derived which show the relationship between "changes in farm income" and "changes in total income." In fact, the multipliers" are nothing more than the tautological statement which Haberler warned against in his discussion of the Keynesian derivation.

Though Mirakhor and Orazen use correlation analysis to demonstrate the implied relationship between farm income and non-farm income via their "multiplier," no where do they show the logical process by which farm income changes "cause" non-farm income changes. As discussed earlier in this chapter, correlation analysis does not establish causation between variables: it merely demonstrates the degree of similarity in the manner in which they change. Thus, the presentation of statistical analysis with their "farm-non-farm income multiplier" is not sufficient to rebut the Haberler criticism but rather further points up the danger of the regression fallacy.

An additional point concerning the pure Keynesian multiplier bears mentioning in closing this section. That point regards the part played by the marginal propensity to consume in determining the equilibrium level of income in the Keynesian system. If one forgets about the aggregate supply side of the Keynesian system (as too often multiplier analysts do), an apparent disagreement among growth theorists and Keynesianites developes. This apparent disagreement should serve to illustrate the problems posed by the uncritical acceptance of multiplier analysis in impact evaluation. The Keynesian multiplier holds that an inverse relationship exists between the marginal propensity to save and income growth in the system. That is, the less saving there is in the economy, the greater will be the level of equilibrium income. However, most of the growth models developed by international development economists made savings (rather than consumption) the prime mover of growth in the underdeveloped world. Thus, the policy prescription in the growth models is to somehow reduce the marginal propensity to consume and to raise savings out of current income. The similarity in this dichotemy to that between the Classicists and the Marginalists over the determinant of market prices is striking. To one group the supply problems are the perplexing ones, while to the other the demand issue is the important one. To all of those working upon the problems of income determination, the macro-economic equivalent of Marshall's two-edged shears analogy would appear instructive.

"Induced" and "Induced-by": A Note on Terminology. Often in reading the technical literature on multiplier analysis and on project appraisal, one encounters the terms "induced" multipliers and impacts "induced-by" purchases of inputs. One should note very carefully the context within which the terms are being used, for they refer to two vastly different concepts. "Induced-by" impacts are those which result from the purchase of inputs by producers who realize an increase in output due to a public project. The "induced-by" analysis traces the increased purchases of fertilizer and other inputs caused by the completion of an irrigation project, for example. "Induced" multiplier effects, on the otherhand, are those purchases which occur through re-spending of household incomes. The Keynesian multiplier is an induced multiplier. It includes only those spending effects which occur through the household sector. Some multipliers include both an "induced" component and an "induced-by" component. An example is the

Type II input-output multiplier discussed in a following section of this chapter. Henceforth in this study, when reference is made to the multiplier impacts of household re-spending, these effects will be referred to as Keynesian induced effects. The effects of input purchases will be referred to by the hyphenated term induced-by effects.

The Economic Base Multiplier

The economic base multiplier, or "export" base multiplier as it is sometimes called, is the most simple and straightforward of all the regional multipliers.[17] The simple economic base multiplier consists of nothing more than the ratio of total employment or income in the region to "basic" employment or income, where "basic" refers to those activities which serve export markets. This statement alone is sufficient to point up the implicit assumption in economic base analysis that exports constitute the prime mover of the local economy. Thus, changes in the "export base" are seen to have certain stimulating effects upon employment and income in secondary and tertiary activities; if the basic/non-basic ratio is stable over time and over stages of development, then the effects of changes in the export base upon the rest of the regional economy can be predicted using the economic base multiplier.[18]

The economic base multiplier has some real advantages over the Keynesian multiplier in regional analysis. Whereas the simple Keynesian multiplier makes no distinction between the propensity to consume locally-produced goods and services and the propensity to import out of local income, the economic base multiplier does. This relationship is implicit in the basic-non-basic distinction. Tiebout demonstrates this by showing that the propensity to consume locally, multiplied by the income created per dollar of local sales, yields a product equal to the ratio of non-basic/total income.[19]

The simple economic base multiplier discussed above has been described as a short run multiplier because of the absence of consideration of investment expenditures. The long run multiplier can be constructed by simply adding a local investment component to the short run multiplier. Thus, the long run multiplier becomes the reciprocal of one minus the sum of the products of the propensity to consume locally times the income created per dollar of local consumption sales, and the propensity to invest locally times the income created per dollar of local investment sales, or

$$\frac{1}{1-(PCL\,\frac{OY}{OS} + PIL\,\frac{OY}{OI})} .$$

As a result of the inclusion of local investment, the long run multiplier will always be greater than the short run multiplier. The extent to which it is greater will depend, of course, upon both the propensity to invest locally and the income created per dollar of local investment.

Tiebout defines the "long run" as greater than two years. While some might challenge the arbitrariness of this distinction, for purposes of evaluating the secondary impacts of long-range investments such as those of the Federal water resource program, the Tiebout definition of the long run creates no difficulties. Such investments so greatly exceed the time horizons discussed by Tiebout that one has few qualms about accepting the long run multiplier as the relevant one for water resource project evaluation. The problem, however, is that the data requirements increase greatly when the investment component is added. Thus, most use only the simple multiplier.

The economic base approach is basically a comparative statics approach, though (according to Isard)[20] Tiebout maintains that it is a dynamic technique. Thus, even though one might do a base study of the same community at two points in time, he would simply have two snapshots of the local economy rather than one. Therefore, it would appear, the greatest uses of the base study are for description.

The prediction component of the base study lies largely in the economic base multiplier. The normal procedure in predicting future changes in the local economy is to determine first the ratio of basic to non-basic employment and/or income. Secondly, the future growth in basic or export employment and/or income is somehow established. Then utilizing the multiplier developed from the current basic-non-basic economic components, the future changes in non-basic employment and/or income are predicted from the expected changes in the basic. It is a fairly simple and straightforward procedure.

In using the economic base approach for predictive purposes, as one would be doing if he used the multiplier in an attempt to estimate secondary benefits, the analyst should understand the weaknesses of the technique. Among these are the implicit assumptions that "export" (basic) activities are the prime mover of the local economy and that the relationship between the basic and non-basic sectors of the economy are stable over time. Isard,[21] Andrews[22] and others have pointed out that substantial evidence exists indicating the relationship is not stable; thus, the predictive powers of the technique are cast in doubt. Barkley and Allison classify economic base analysis as "a somewhat undisciplined body of economic theory" for its failure to satisfactorily interpret the meaning of the basic/non-basic ratio and establish logically the causation involved.[23] It has been widely argued that exports do not constitute the sole "basic" activity of an economy and that, as a result, the "export base" multiplier does not include all of the relevant components.[24] Whether this explains part of the observed instability in the multiplier over time has not been answered.

Another major consideration regarding the use of the economic base multiplier is the degree of aggregation involved. The economic base multiplier, like the Keynesian multiplier, is an "average" multiplier. That is, it averages together the separate multiplier effects of all "basic" industries into a single multiplier, while the multipliers relevant to the individual industries might vary widely. As a result, the multiplier when applied to any change in the basic sector other than one having an identical industrial mix to the current one, will be inappropriate.[25] In addition, the less diversified the mix of the change, the less appropriate the multiplier would be, in all probability. Thus, the changes in basic employment, such as that stimulated by a water resource project which attracted one firm or group of similar firms, would be amenable to analysis using the economic base multiplier only under very unusual circumstances.

Barkley and Allison interpret from a passage in Senate Document 97 a charge to the water resource agencies to do economic base analyses as a part of the project planning and evaluation process. They indicate a similar interpretation on the part of N. A. Back of the Corps of Engineers. Thus, they argue, there is a provision in the water resource development process for economic base studies.

Economic base analysis has been widely used as a technique for projecting future "demands" or "requirements" for economic goods. The initial presentation by Homer Hoyt cast base analysis in just such a role in estimating future demand for housing.[26] It has been picked up and used fairly extensively by the water resource agencies in projecting future "requirements" for water or for water related goods.[27] Normally, the procedure involved is to project the growth in non-basic activity, after making some assumptions about changes in basic activity, assuming that water or the water-related goods will be available.[28] Then, having established the "potential" growth with adequate supplies of water, the actual water requirements for such a level of output are estimated, over and above those which would actually be available in the absence of public provision of additional supplies. The excess then becomes the "requirements" to sustain the "anticipated" growth. Often the analyst credits the difference in regional income to the provision of that water. In effect, such a procedure constitutes a one-factor theory of economic growth.

The procedure described above is quite similar to "approach No. 1" to secondary benefit evaluation suggested in the June 1969 Report of the Special Task Force of the Water Resource Council. The suggested approach would have the analyst "Establish an achievable level of National income secondary benefits . . ." Then, a "general development plan" including the "required" public and private investments should be established. Lastly, the contributions of the "specific water resource projects" should be determined and allocated to each project according to relative investment costs.[29] The problem comes, of course, in determining the contribution (i.e., the marginal product) of the water service. However, any approach which did not credit all of the increase in income to the provision of the water service would constitute an improvement over the "one-factor theory."

The Bureau of Reclamation has used economic base analysis in a restrospective attempt to determine the secondary income producing effects of irrigation projects.[30] These attempts, however, were undertaken more in the spirit of the comparative projection approach (discussed below) than the traditional economic base multiplier approach in that they were directed largely at determining the secondary effects of previous projects as a guide in predicting the effects of future projects. In this case, not only the inter-temporal stability of the basic/non-basic ratio is subject to question but also the inter-area stability.[31] Thus, unless there is some universal, natural and immutable basic/non-basic ratio, such an approach has all of the pitfalls of the comparative projection approach.

In the study by Christensen and Matson,[33] which uses the economic base concept to modify a statewide multiplier for use in local impact analysis, an attempt was made to evaluate the secondary effects of irrigation development. The induced effects of an increase in irrigated agriculture were estimated based on the assumption that agriculture was a basic industry to the area. Changes in income in the "non-basic" sectors were estimated using the modified statewide multiplier. However, the estimates of the income

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changes were accepted as the relevant secondary benefits without any consideration being given to the supply conditions or the opportunity costs of the basic income receiving units in the analysis. The assumption was implicitly made that _intensive_ income growth would occur to owners of retail and service establishments due to the fuller utilization of underemployed facilities, while at the same time _extensive_ growth would occur through the development of other similar facilities. At no point was it established (even by explicit assumption) that such facilities were currently under-utilized. Neither was it established as to whether extensive employment growth would come from employment of previously unemployed local people or from immigration. (Neither was it established as to whether there were unemployed local people). Each of these are necessary for one to determine whether the estimated impacts are the real monetary changes in the welfare of the people involved.

In summary, though economic base studies have been used widely in the water resource development field, there is some question as to their applicability to secondary benefit evaluation. A most basic question is that regarding the stability of the multiplier, not to mention the lack of a theoretical basis for its importance. Though it deals with the problem of local versus non-local consumption which limits the Keynesian multiplier, it has all of the problems of the Keynesian multiplier in terms of aggregation. In addition, as in the case of the Keynesian multiplier, the economic base approach does not allow the analyst to determine the real net changes in welfare of the people involved. The units which are typically used in the economic base multiplier are employment, income, and/or value added, or some similar measure. The crude estimates of the changes does not give much insight into the basic question of "How much better off are the people involved?" (i.e., the people already in the region). If the changes in these measures occur through extensive growth (i.e., a change in the number of jobs without a change in the kinds of jobs or in average wages) rather than intensive growth in the region, it is quite possible that no one individual would be any better off, though both regional income and employment could have grown substantially.[32] In the case of under-employment, one is specifically interested in intensive growth (i.e., changes in the composition of employment and the level of average wages).

The Comparative Projection Approach

The comparative projection approach has been much more widely practiced than the discussions of it, per se, in the economics literature would indicate. The comparative projection concept is a fairly simple one, though the technique itself sometimes becomes a bit involved, and often even confused. As its title indicates, the approach utilizes comparative analyses of similar areas -- one

(group) having a public project, the other not -- in an attempt to estimate the differences in income which rebound to the advantage of the project region. The approach represents an attempt to apply the "controlled experiment" approach of scientific investigation, the "without-project" group in this case representing the "control group." The differences which exist in the parameters deemed to be important are noted. If a systematic pattern exists concerning the differences, and if that pattern can not be logically explained by some other "uncontrolled variable," the cause of the difference is assigned to the existence of the public projects. Usually the analyst computes a "multiplier" which consists of the ratio of the project area/non-project area income, employment or whatever parameter or index of parameters one desired to use.

Though not the first use of such an approach, the presentation of the formalized version of the comparative projection model can be attributed to John E. Pearson. Pearson attempted to develop and present "a theoretical model which would predict with reasonable accuracy the economic impact of water impoundment on the surrounding areas."[34] A simulation approach was used in which an attempt was made to simulate the economic growth process of two water impoundment areas, using a third area which did not have a water impoundment as a check on the model. Economic parameters felt to be of economic significance, and for which data were commonly obtainable, were selected for inclusion in the model. These included area population, area income, area agricultural income, and distance to a metropolitan area. Exogenous factors expected to impact on the local economy were project construction expenditures, project operation and maintenance expenditures, project-related associated investments, and visitor recreation expenditures. A model designed to simulate the economic growth generated by these exogenous factors and composed of the above economic parameters was described.

Pearson says that "The model en toto provides a transformation of valid macro-economic theory into a workable simulator of a micro-economic system."[35] However, he does not demonstrate this fact to the reader. Indeed, there is no theoretical foundation laid in either macro-economic or micro-economic terms, though there is implicit in his equations some basic "theory" about how income growth occurs (for instance, the exponential growth equations of pp. 34-42).

A similar criticism can be made for other comparative projection techniques. While one must admit that no readily acceptable theory of economic growth exists at present, this admission should not negate the importance of a theoretical basis for growth projection. Admittedly, one can learn a great deal about the process of growth by the case study approach. However, most comparative projection approachs do not "study" the process, but rather perform a multiplier or rate of growth "transplant" upon another case. At the least, such a process should be accompanied by a detailed explanation of the similarities between the areas and the reasons the analyst would expect the area in question to grow in a similar manner to the studied area.

A similar study to that performed by Pearson was undertaken by the Business Research Center of the Oklahoma City University. However, rather than attempting to simulate the growth process, the Oklahoma study simply used linear regression techniques to estimate growth rates in income, etc., from time series data. The rate of growth which had been realized by Oklahoma areas having impoundments was estimated from time series data and used as the "with-project" case in analyzing the economic impact of the Hugo Reservoir. The pre-project rate of growth of the Hugo Reservoir area was used as the "without-project" case. The difference was purportedly attributable to the presence of reservoirs.[36]

The Bureau of Reclamation has undertaken at least three such studies of their project areas in an attempt to estimate the secondary impact of irrigation projects. The studies by Marts, and Struthers were retrospective analyses of irrigation development projects, much in the spirit of the above-discussed studies. The objective in these studies was also to determine the relationship between water projects and economic growth.

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A common failure of all of the comparative projection techniques which have been discussed has been the failure to develop a proper thread of logic linking the availability of water or a water service to the process of economic growth. Perhaps the milieu in which the reports were written or the audience to which they were directed can explain this failure. It is understandable that the availability of water in a water deficit area such as the western United States might be accepted axiomatically as a (if not the) determinant of economic growth. Nevertheless, a great deal of credibility is lost on the uninitiated as result of the lack of an established link. Lacking a water-related growth theory, the advocate of such an approach should as a second-best alternative describe the similarities between the areas which might justify the comparative analysis. In the case of "multiplier transplants," which is a form of comparative analysis, the analyst should discuss in detail the factors which influence the level of the particular multiplier and should give his reasons for believing these factors -- and, thus, the level of the particular multiplier -- to be similar between the areas. The Corps of Engineers Test Team Study of the Mountain Home Project provides a case in point[37] (see Chapter VI). Considering the very great time limitation under which the Team worked, the "multiplier transplant was perhaps the only means by which regional development effects might be approximated. Nevertheless, under normal project ap

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appraisal circumstances, a great deal more evidence as to the applicability of that multiplier should be required of the analyst.

One should be quite wary of the comparative projection approach as a means of estimating secondary project impacts. The comparative growth rates are not developed from "controlled" experiments, though the analyst might strive very diligently to find comparable areas in which the lack of a project is the only difference. In reality, comparable areas can seldom be found. Thus, the analyst must accept some divergence for his desired control group. The sensitivity of the growth rates experienced under different industry mixes to certain kinds of public investments has not been established. The effects of different size communities and the resultant differences in scale economies might negate the supposed correction for population differences -- i.e., the use of per capita income, etc. Similar precautions apply to the use of "transplanted multipliers." Differences in industrial mix and structure and in local consumption and investment propensities can cause income multipliers from seemingly similar areas to differ considerably. The amount by which they might differ could be partially checked through the use of Bromley's index of internal purchases discussed below. However, where analytical alternatives are possible such "transplants" should be avoided.

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Index of Internal Purchases

Bromley argues that, when one considers the opportunity costs of the technical manpower involved, input-output analysis has been overdone in recent years. He maintains that, for most of the purposes for which local business income multipliers are used, acceptable local multipliers can be generated at a much lower cost than by constructing input-output models. Thus, he argues for the adoption of the "index of internal purchases" approach where the analyst-planner desires a ranking of relative multipliers between sectors rather than necessarily the absolute magnitude of those multipliers. He demonstrates that, in eight cases for which input-output multipliers could be compared, the relative rankings of sector multipliers yielded by the index of internal purchases are identical to those yielded by the input-output tables.[38]

Very simply stated, the Bromley approach would arrange the sectors into a four quandrant format according to the proportions of their purchases and sales which are local. Those sectors for which the proportions are high for both purchases and sales would be placed in quadrant I; in quadrant II would be those sectors which bought from sectors in quadrants IV and I and used them in producing items for export; the quadrant III sectors would be those which import much of their inputs and export most of their

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output; quadrant IV sectors would be those which bought little locally yet sold a great deal locally.[39]

Bromley maintains that such a breakdown is sufficient for most community development planners, since what they really need to know is for which sectors they should promote growth to achieve the greatest secondary effect upon local business. For their purposes, the actual size of those multipliers is only of secondary importance for internal planning purposes.

While the index of internal purchases might be sufficient for many local planning purposes, it constitutes a very imprecise means for estimating secondary benefits. The index yields an ordinal measure of sector impacts which can be useful to the local planner. However, for comparisons between localities or between projects justified largely by primary benefits and those seeking justification based upon their secondary impacts, the index is not quite so helpful. Thus, it is doubtful that the approach, as it now stands, could serve alone as a means for estimating secondary benefits. However, it is quite possible that the index could be of use as a check upon other approaches, such as the more aggregative multipliers discussed above, in estimating whether the actual sectors impacted might have multipliers greater than or less than the aggregate multiplier used. Such a procedure might, at best, allow for an adjustment upward or downward of the aggregate multiplier to reflect those differences.

From-to Analysis

From-to analysis is one approach in an increasingly popular area of economic analysis known as "inter-industry economics." From-to analysis differs only slightly from input-output analysis, the difference lying chiefly in the form and extent of data collection. Whereas in the typical regional input-output study data are collected regarding both purchases and sales by each sector, in the from-to study only sales by each sector are recorded. The result is a much less costly data collection process in the from-to study. However, a valuable means of cross-checking is lost in the from-to approach.

Kalter and others[40] have argued that for many problems in regional analysis, a model which followed output flows alone would be sufficient. For firms in the region selling to other firms in the region, the from-to approach would provide information on the internally produced (regionally) inputs for the latter and the internal sales of the former. Thus, for a completely closed region (i.e., a region doing no trading with the outside world), the from-to formulation would yield basically the same information as the input-output approach when all of the inter-firm purchase data were brought together.

Obviously, the from-to formulation ignores imports, since sales from extra-regional firms are not included in the data collection process. If one were interested only in the intra-regional effects of certain impacts, this

exclusion would be of little importance. A more important disadvantage for regional analysis purposes is the fact that such a data collection process does not allow one to estimate the value added coefficients for the producing sectors. Thus, what is actually developed, if no further additions are made to the basic data, is a matrix of intra-regional requirements for the production of the total sector outputs of the region.

The from-to approach is capable of most of the analytical uses to which input-output analysis can be put. The most obvious exceptions, of course, are those concerning inter-regional trade analysis, since the from-to formulation does not include imports from other regions. Most of the multipliers which can be derived from input-output studies and which are relevant to secondary benefit evaluation can be computed from the from-to study, if an additional data collection effort is undertaken to provide the value added components for each sector. Thus, the discussion of these will be saved for the section on input-output analysis. Additionally, many of the assumptions and limitations of from-to analysis are common to input-output analysis as well and will be reserved for discussion in that section.

Because from-to analysis includes only locally-purchased inputs, the analyst assumes implicitly when utilizing the model for projection that inter-regional trade patterns will remain stable over time and as regional output changes. Since multiplier analysis is inherently a projection technique, one should be aware of the trade stability assumption in evaluating secondary benefits utilizing multipliers derived from such studies. If a principal impact of the project under study were to stimulate import-substituting industries, the typical from-to formulation would not allow one to measure the local secondary effects.

Jansma and Back[41] used the from-to formulation in estimating the local secondary impacts of small watershed projects. The most unusual aspect of the study was the method used in acquiring sales data. Microfilmed records of checks which were cleared through the only bank in the community were the basic source of data. Since information was contained concerning both the payer and the payee, a matrix could be constructed which included not only internal transactions but also imports and exports. The difficulty, however, was that for small owner-operated businesses, for some professionals and for farms, information on household consumption were inseparable from business input purchases. Thus, only induced multipliers could be constructed, since some household sector expenditures were implicitly endogenous. As a result, information regarding input requirements and inter-industry linkages was somewhat obscured. In the previously mentioned studies by Kalter, on the other hand, such a problem was not encountered, since firm-by-firm surveys were taken. However, the

survey method used by Kalter would require a household survey, as well as the firm surveys, to provide the information implicit in the approach used by Jansma and Back.

Input-Output Analysis

In the input-output model has been called a static general equilibrium model which depicts the inter-industry and inter-market flows of goods and services at a given point in time.[42] Though some have questioned the "general equilibrium" aspects of the above characterization, there is general agreement that the input-output technique is a comparative statics analysis.[43] That is, the inter-industry transactions matrix which is basic to input-output analysis is analogous to a "snapshot" of the economy at a single point in time.

The basic unit of the input-output model is the transactions matrix or table. The rows of the table describe the sales by each industrial sector to other industrial sectors and to final demand; while the columns detail the purchases by each industrial sector from other industrial sectors (and from other regions, if the model is "open").

From the transactions matrix, two other matrices are generated in most input-output studies. The direct requirements matrix gives the breakdown of each dollar of gross output by each sector and describes its flows to other sectors for inputs and to value added. The procedure

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involved is to simply divide the elements in each column of the transactions matrix by the adjusted gross output for that industry.[44] The third matrix is the direct and indirect requirements matrix, which describes the input requirements, both direct and indirect, which result from each dollar of gross output by each sector. The direct and indirect requirements matrix considers the derived demands which result from a change in the final demand for the output of one sector and the second and ensuing rounds of demands which are derived from the demands for the inputs used to produce the output to meet that change in final demand. In most cases, when both the direct and indirect effects have worked themselves out, the output requirements imposed upon the sector experiencing the change in final demand will exceed that of the final demand change alone. This is due to the fact that additional outputs of that sector will be required as inputs into other sectors which supply inputs to the former sector (or perhaps to other sectors which do so). Thus, obviously, the coefficients in the cells of the direct and indirect requirements table will be larger than those of the direct requirements table.

The direct and indirect requirements matrix can be computed from the direct requirements matrix. One method of computation would be to simply multiply through the round after round effects of one sector on another. Since the round-by-round effects become successively smaller,

probably eight to ten such computations would yield a fairly close approximation to the "infinite series" sum. In some cases, such a round by round procedure is used -- generally because the analyst feels that the infinite series sum is inappropriate for some reason or another and that he should "truncate" the expansions after a few rounds.[45] However, in the general case, the full measure of the expansionary effects is computed in which case the round-by-round method would become a bit laborious, especially for some of the larger matrices. By inverting the "leontief Matrix," one can achieve the same results as by multiplying through all of the round effects. This was the basic eclectic contribution of Wassily Leontief,[46] the application of matrix techniques to the analysis of interindustry flows. The Leontief matrix is defined in matrix notation as [I-A], where A is the direct requirements matrix and I is an identity matrix of the same dimensions.

The input-output model is composed of a system of linear equations. As stated above, the equations depict in snapshot fashion the interindustry flows of goods and services at a particular point in time. Thus, while the input-output model provides a very detailed view of the current structure of inter-industry flows, when used for projection purposes it has all of the problems which attend the use of a static model for such purposes. For instance, the direct requirements coefficients reflect the average rather than marginal relationships between inputs and outp

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outputs. Thus, in using the model to project input requirements for higher levels of output one assumes implicitly that the marginal relationships are equal to the average. This amounts to imputing a linear homogeneity to the production functions involved. Further, since the proportions between the inputs used and the outputs of each sector are fixed in the model, it is implicitly assumed that no input substitution will occur in any of the production processes. Stated another way, if used for projecting, the model assumes that the supply functions for all factors are infinitely elastic at the prevailing prices. Thus, one of the "frictions" which the projection version assumes away is that of factor supply inelasticities, including any market imperfections which might contribute to those inelasticities. While a real descriptive strength of the model is its ability to show explicitly the interdependencies between industries, this same explicit statement of interdependence allows the following seemingly-logical interpretation of sectoral importance: Since the outputs of some sector (e.g., the paper clip industry) are used either directly or indirectly in fixed proportions with other inputs by all other sectors in the matrix, a shortage or a blockage in the supply of paper clips would force the halting of all industrial production. Of course, this is absurd. Nevertheless, a strictly-interpreted logical extreme is that such would be the case. Thus, the fundamental economic principle of input substitution is ignored by gross application of the input-output model.

While the input-output model obviously has its weaknesses, it is still the most powerful of the regional models. No other approach allows one to deal with regional economic impacts at such a disaggregated level. Though the literature on input-output analysis abounds with discussions of "the aggregation problem," the aggregation involved in input-output analysis is very slight in comparison to that of the economic base model or the Keynesian model. Thus, input-output analysis allows a great deal more specificity on the part of the analyst in estimating the extent and the incidence of secondary economic impacts on a local community. The disaggregation in the input-output model allows one to compute many multipliers rather than a single "average" multiplier. Multipliers for each industrial sector can be computed. Thus, if the incidence of the impact is known, the multiplier effects can be estimated with much more precision than is possible with the more aggregative (and, hence, much less costly to construct) multipliers such as those from the economic base model.

As pointed out above, the input-output model allows one to construct a number of multipliers. Thus, the term "the multiplier" is not even singularly applicable to input-output multipliers. Some of the most widely used input-output multipliers are discussed below and their advantages and disadvantages for secondary benefit estimation are noted.

Output Multipliers

The simplest of all input-output multipliers to compute are the "output multipliers." These simply show the direct and indirect changes in gross output stimulated by a $1.00 change in demand for each industrial sector. Thus, the output multiplier for a particular sector is merely the sum of the entries in the vector of "direct and indirect requirement per dollar of sales" for the industry in question.

Output multipliers can be instructive as to the "activity" stimulated by a particular policy, where activity refers to gross economic output. If one were interested, for some reason, in maximizing the level of economic activity generated by a given volume of exogenous impact, the output multipliers would serve as a useful guide to the choice of sectors towards which the emphasis should be directed. However, one is more often interested in the income-producing effects of a policy rather than the stimulation of gross activity. Thus, while output multipliers can yield valuable information as to relative sectoral interpedence, they can be misleading when used to estimate income effects.

In general, the larger the volume of input purchases from other sectors per dollar of sales, the larger will be the output multiplier for a particular sector. At the same time, however, the volume of such purchases is inversely related to the value added coefficient for the sector in question. Thus, the use of output multipliers as a guide in determining which industrial sectors to emphasize in a community development plan leads one to adopt a development strategy which is perhaps diametrically opposite to what many would consider the "proper" strategy, since the sectors having the lowest value added per dollar of sales tend to be those having the greatest sectoral interdependence. Unless the agglomerative attractions of the sector emphasized are great, such a policy can lead to a predominance of low-wage (or low employment) and perhaps low-profit industries in the area. Obviously, few local communities would desire to adopt such a strategy. Yet, in their input-output study of the Oklahoma economy, Doeksen and Little[47] advised that, since the output multipliers for "agricultural processing" and "livestock and livestock products" were relatively large, those sectors should be emphasized for development purposes.

While the relative size of the output multiplier is inversely related to the direct income (i.e., value added) of a sector, it is perhaps positively related to the indirect income produced by that sector. Since relatively larger volumes of activity are stimulated by sectors having large output multipliers, the possibility of secondary net income stimulation occurring is much greater for these sectors, also. However, the income secondarily stimulated also depends largely upon the income-producing capacity of the linked industries. Thus, the output multipliers can not be accepted as dependable guides to the secondary income-producing capacity of a sector, though there perhaps exists some degree of correlation between the two. For such purposes, one is best advised to use one of the income multipliers discussed below.

For secondary benefit evaluation purposes, one is more likely to be interested in income than in "activity generation." Thus, output multipliers are not likely to be particularly helpful. Additionally, since in secondary benefit evaluation one is likely to be dealing with economically-depressed localities, output multipliers can create a dangerous bias towards perpetuating a poor industrial mix for the locality. This is true because of the tendency for from-to models and regional input-output models to identify the strongest intra-regional linkage effects in the structural matrix. The problem comes in situations in which the regional industrial mix includes a predominance of slow-growing industries.[48] The regional interindustry model shows the greatest interdependence effects, obviously, for those industries which are "established" in the area. Thus, the output multipliers will be greater for those sectors which are linked to the (slow growing) sectors which are already there. At least when the income multiplier is used instead of the output

multiplier, those sectors which pay low wages (or employ few people) are penalized in the relative size of their interdependence effects. The output multiplier includes no such penalty.

Type I (direct-indirect) Income Multipliers

A better guide to the income-increasing effects of sectoral interdependence than that provided by output multipliers is that given by the direct-indirect income multipliers. The basic difference between the two is the emphasis of the latter upon income stimulation rather than activity generation. While the output multiplier shows the direct and indirect activity generated per dollar of sales for the sector, the direct-indirect income multiplier depicts the direct and indirect income changes in comparison to the direct income changes. The multiplier which results is the ratio of direct plus indirect income to direct income alone.[49]

The direct-indirect income multiplier was developed from an input-output study of the St. Louis Metropolitan area by Werner Hirsch.[50] In that same study, Hirsch presented a second income multiplier which included, in addition to the direct and indirect income changes, an "induced" component. The induced component incorporated the effects of re-spending by households into the multiplier effect, which the direct-indirect income multiplier excluded. Hirsch called these multipliers "Type I" and

Type II" multipliers, the Type II being the multiplier which included the induced income component. The Type II multipliers will be discussed later in a following section.

To derive the direct-indirect (Type I) multipliers two matrixes are needed: First, the direct requirements matrix with households included in the structural matrix is needed. In other words, a row must be added to the transactions matrix to show the wages, salaries and profits per dollar of direct sales, and a column must be added which shows the purchases by households from every other sector and from households (the sums of the column and the row entries must be equal). Secondly, the matrix of direct and indirect requirements per dollar of sales (with households outside of the structural matrix) is needed. To estimate the direct-indirect income multipliers for a sector (call it sector A), one would multiply the elements in the sector A column of the direct and indirect requirements matrix by the household row of the direct requirements matrix and sum the products (i.e., using matrix procedures, post-multiply the household row of the direct requirements matrix by the "A" column of the direct and indirect requirements matrix); then divide the sum of the products by the sector A entry in the household row.[51] The result is the Type I income multiplier for sector A. It expresses the relationship between direct and indirect income changes due to sectoral interdependence and direct changes in income in sector A.

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As stated above, if one desires a measure of the relative income-producing sector linkages, the direct-indirect income multipliers provide a much more reliable sector ranking device than do the output multipliers. However, like the output multipliers, the direct-indirect income multipliers do not include the feedback effect from household expenditures. Thus, these multipliers only show the buildup in household income which results from the direct and indirect requirements imposed upon other sectors (and itself) by changes in the output of sector A.

A point should be made in passing regarding the relevant change to which the direct-indirect income multiplier should be applied. While the input-output tables of requirements show the input required from other sectors to allow a one dollar change in <u>output</u> (sales) of sector A, the direct-indirect income multipliers show the change in both direct and indirect income which results from a one dollar change in direct <u>income</u>. Thus, in estimating the direct and indirect income effects of a one dollar change in the output of sector A, one should not simply multiply that one dollar change by the above multiplier. One would be applying the multiplier to the gross change in output of sector A rather than to the direct change in income. Thus, the direct-indirect income changes are much smaller than is sometimes erroneously estimated using such multipliers. For example, if the household coefficient in Column A were .20 and the sector A multiplier were 2.0, a one dollar change in export sales of sector A would not generate two dollars in income, but, rather, it would generate forty cents in income. The difference comes in how one defines the initial change in direct income. If the dollar initial change is, in fact, the direct income component, then the multiplier should properly be applied to that figure. However, if the dollar is instead an exogenous change in export demand, then for regional analysis purposes the "initial income" aspect of that dollar is realized in another region; and the initial region income is only twenty cents. This differs somewhat from the output multipliers, discussed above, because of the difference in the base. The base of the output multipliers is formed by the initial dollar change in demand for the output of that sector. Thus, the output multiplier should normally be applied to that figure. However, if the full income effect of that initial dollar expenditure is not realized in the region, then that dollar should be subtracted from the effects of the output multiplier. This differentiation between the initial income incidences was not considered by Doeksen and Little in their analysis, however, since they were dealing largely with gross activity generation instead of changes in local income, per se.

Since the Type I multiplier ignores the effects of the household re-spending (induced) component, it assumes, in effect, that the marginal propensity to consume locally (out of household income) is zero. Thus, if one derived a set of Type II multipliers and added an adjustment for the propensity to consume locally, the Type II multiplier would reduce to the Type I multiplier when the MPCL=0. Such a situation would only exist in the "real world" if the community in question had no retail sector nor other facilities for selling to households, so that all consumer spending occurred outside of the community. For all practical purposes, the only communities which would fit such a mold would be industrial parks or city sectors which were zoned for industrial development only. It is unlikely, however, that an analyst would define such a region as the relevant one for study -- especially in the evaluation of secondary benefits, which should have their basis in real changes in consumer welfare.

The process of multiplier analysis is a very precarious one wrought with some very great assumptions regarding economic behavior. The assumptions made in the calculation of the indirect requirements matrix provide a case in point: It is assumed in carrying out those calculations that all of the factors needed for the envisioned expansion (both directly and indirectly) will be available at current prices; further it is assumed that they will be used in the same proportions as depicted in the tables and that no thwarting of the derived demands for them will occur via market imperfections, etc. The net effects of these assumptions, in all probability, is to bias upwards the estimates of the real expansionary effects. If, at the same time, an induced component is added, the resulting projections can greatly exceed the actual multiplier effects. Thus, if one suspects that the "leakages" from the endogenous matrix are greater than those depicted, and he at the same time suspects that the induced effects are overstated (the reasons this might be so will be discussed in the sector on Type II multipliers which follows), then the rule-of-thumb correction provided by the Type I multiplier might, in fact, make it a better estimate of the actual multiplier effects than the Type II multiplier. Thus, one might choose to use the Type I multiplier as a "more reasonable" estimate of the true secondary impacts under such circumstances.

In secondary benefit evaluation, the analyst should attempt to identify the net secondary changes in real income which accrue to the relevant unit of analysis (i.e., to the nation or to the region, depending upon which "account" he is dealing with). The output multipliers are better in one respect than are the more aggregative approaches: They allow the analyst to identify the sectors experiencing the greatest gross activity changes and, thus, can help point out the sectors in which supply conditions can be most critical. However, they are weaker in two respects: First, they incorporate the gross output concept rather than income; and, second, they do not include the induced component of income growth. The Type I multipliers, on the other hand, go one step further than the output multiplier in that they utilize the income effects as the relevant multiplier effects rather than gross output. However, they do not include the induced income growth component. Thus, their applicability is limited largely to the three following uses: 1) determination of the sectors having the greatest inter-sectoral income linkages (excluding the household re-spending component) for purposes of sector emphasis; 2) situations in which the marginal propensity to consume locally is assumed to be very low; or 3) as a rule-of-thumb adjustment for "frictions" and leakages in the structural matrix and for leakages from the induced component.

Type II (direct-indirect-induced) Multipliers

The Type II multiplier differs from the Type I multiplier by the addition of the induced component only. The induced component incorporates into the multiplier the expansionary effects of the re-spending by households of incomes earned during the course of the initial and ensuing output expansions. Thus, the household sector is assumed to act in a fashion similar to the producing sectors in the structural matrix -- i.e., it increases its "requirements" as "sales" (household income) expand.

In recognition of this link between household expenditures and household income, Hirsch removed the household sector from the final demand category and placed it in the structural matrix in computing his Type II multipliers. To do so, he had to determine the distribution of expenditures by households to each sector in the structural matrix (including other households); and he had to determine the part of each sales dollar for each sector which went to households in the form of wages, salaries, profits, and interest. Having determined these, Hirsch re-inverted the Leontief matrix with households included in the endogenous matrix. Then, to estimate the multiplier for some sector (Sector A), he took the household coefficient for Sector A from this new matrix and divided it by the household coefficient for Sector A from the direct requirements matrix. The ratio which resulted was the Type II multiplier.

While, in concept, the addition of the induced component offers a more realistic approach to estimating multiplier effects, there are two new problems created by its addition. First, since most regional input-output studies do not include a household survey, the household column has to be estimated outside of the model. Typically, the coefficients from national input-output studies are used in regional studies. Thus, if no adjustments are made, one is forced to assume that inter-regional consumption patterns are invariant. To appreciate the compromise which such an assumption entails one must simply reflect upon the fact that national coefficients will include items consumed in one part of the nation which perhaps are not even marketed in the region for which the study is being made --

e.g., alcoholic beverages sales are illegal in many southern counties. The fact that homes in Maine incur very substantial heating costs while many Florida homes do not even have central heating can only be rationalized by assuming that the Florida air conditioning costs offset the difference. If air conditioning and heating implements are produced in the same industrial sector, then the problem is perhaps lessened. Nevertheless, regional coefficients would normally provide better measures of induced multiplier effects in the region than do those borrowed from national tables.

Secondly, the addition of the induced component also necessitates the additional assumption that the mix of household purchases remains the same as income increases. The implicit assumption is that the income elasticity of demand of all items in the household budget is equal to unity. Thus, as income increases by 1 per cent, expenditures for all items in the household "market basket" increase by 1 per cent. This is analogous to the assumptions made concerning the other "producing" sectors in the structural matrix regarding the linear homogeneity of the production functions involved. However, while there has been an unresolved controversy regarding the fixity of the input coefficients, the difficulty posed by the static consumption function can be resolved by making one rather palatable additional assumption. That assumption concerns the manner in which income grows as a result of the expansion. If output (and income) increase as a result of extensive growth rather than intensive growth, then the assumption can be made that the consumption patterns of the "new" money earners will be the same as those of the "old" money earners at the same level of income. Thus, if regional output increases as a result of bringing in new workers at approximately the same wages as the resident workers, it would appear reasonable that the "average" consumption patterns would not change very much. However, if income grew as a result of more intensive use of resident workers and average incomes increased as a result, then one should reasonably expect the pattern of consumption to change.[52]

While the Type II multiplier includes the induced multiplier effects of household spending, it does not allow for the effects of other income-related changes in expenditures which will have further expansionary effects upon income. Increases in investment and government expenditures which will occur as a long-run effect have been excluded. Thus, the Type II multiplier is only a short run multiplier. To adjust for the long-run induced effects of these two additional factors one would follow the same procedure as was followed in incorporating the household re-spending into the model. Column and row values for each would have to be estimated, adjusted and placed in the matrix of direct requirements. Then a new Leontief matrix would be computed and inverted with households, investment, and government all in the endogenous matrix with the producing sectors.[53] The long-run induced multipliers would be computed in the same manner as the short-run induced (Type II), the difference being that the household coefficients would be larger as a result of the effects of "capturing" the effects of investment and government spending in the structural matrix.

The difficulty with the long-run induced multiplier is that it compounds the already-unrealistic lack of consideration of leakages from the model. The problems posed by the assumptions made concerning the "frictions" and leakages in the input-output model have already been discussed. Isard[54] highlights the problem by pointing out that

> . . . an input-output model as such contains no restrictions on rates of expansion and contraction and on multiplier effects. The sophisticated analyst usually allows for such restrictions; typically, he establishes the final demand sectors at such magnitudes tha, being fixed, they automatically set reasonable restraints on rates of change and multiplier effects. When, however, the important households sector is removed from the final demand sectors, unrealistic rates of change and multiplier effects do result unless other modifications are made which introduce compensating restrictions or leakages.

Quite obviously, the removal of two more sectors from final demand multiplies the problem. The removal of all the final demand sectors would, obviously, lead to an underidentified system of equations.[55] The long-run induced multiplier comes very close to creating the latter problem, in that the only factors left to "explain" the level of the system are exports (and exogenous public and private investment in the case of regional analysis, where only local governments are made endogenous). As a result, the long-run induced multiplier is generally an unreliable estimator of the actual long-run multiplier effects.[56] Because of the problems caused by leakages, the (short-run) Type II multiplier might, in fact, provide a more reliable estimate of the long-run multiplier effects than does the long-run induced multiplier.

Input-Output and Secondary Benefits: An Overview

Because it allows the most detailed analysis of sectoral interdependence, input-output analysis constitutes the most effective tool the analyst possesses in evaluating secondary impacts. The biggest problem in applying the technique is the cost and the time required to construct the tables. Where input-output studies exist for the impacted region, however, the opportunities for detailed analysis of secondary benefits far exceed those offered by other techniques.

Input-output analysis is not without its problems as an analytic technique, though its problems are perhaps much less severe than many other regional analysis techniques. Its greatest weakensses are manifest when it is used for projection purposes; multiplier analysis is a form of projection.

Dorfman points out the problem of time involved in interpreting the matrix of requirements. Since the technological relationships in the matrix refer to the current level of output of each industry, the past level of output of its suppliers, and subsequent levels of output of its customers, input-output analysis" . . . abstracts from the time sequence of production and exchange . . ." and, thus, ". . . applies only to a stationary equilibrium, where time is of no consequence."[57] Since the multiplier techniques include the round-after-round expansions as well, the problem of time is compounded. Thus, the multiplier not only abstracts from time in dealing with the direct relationships, it also further abstracts from time in handling the "rounds" of expansions -- i.e., it does not deal with the problem of differing time periods required between sectors for a "round" of output to occur. Neither do input-output (or any other multipliers) differentiate between the present values of succeeding rounds of income.

Though input-output is the most disaggregative of the multiplier techniques, there are still some problems caused by sector aggregation. Thus, in projecting outputs from a sector, one makes the assumption that the outputs will be produced by the "average" firm or by a mix of firms perfectly representing the mix in the sector. The aggregation problem is two-fold: Not only is the average or the mix projected in terms of relative costs but also in terms of products. Thus, one also projects the current mix of products from that sector.

Dorfman feels that the neglect of substitution is the most striking divergence of the Leontief model from conventional economic assumptions. The fact that the coefficients are fixed and assumed to hold for all levels of output has led some economists to be very critical of the technique.

Another problem in projecting from input-output models concerns the handling of investment. It is questionable whether investment requirements should be included in both relatively small short-run changes in output and relatively large long-run changes. Dorfman argues that "The assumption of a unique relationship between the output of an industry and its purchases from other industries is plausible only with respect to purchases on current account."[58] Thus, projecting far beyond current outputs becomes increasingly precarious. Whether one should use the same matrix of technical relationships to estimate both short-run induced and long-run induced multipliers is questionable, since the long-run multipliers explicitly consider the induced effects of investment on income without considering the decrease in input requirements generally signalled by long-run investment changes.[59]

The greatest strength of the input-output model is its ability to depict in detail the structural interrelationships within an economy. As a projection tool, the least violence is done to the model when the same mix of outputs as is currently being produced is projected, and when the output being projected is not substantially different from the output depicted in the model. Thus, for secondary benefit evaluation purposes, the model is most applicable to the "conventional" category of secondary benefits in which changes in the level of aggregate demand are the principal actors. It is only in this group of secondary benefits that the economic structure and the productivity of the resources are treated as constants, while the exogenous forces presumed to move the economy to higher levels of output are changes in demand. Since the other two types of secondary benefits relate to changes in resource productivity and/or changes in economic structure, the input-output model can not be directly applied to their evaluation. Thus, the secondary benefits of induced change within the current industrial structure are the only kind evaluated by input-output multipliers.

Input-output analysis provides a very interesting picture of the interactions which occur in an economy as a result of an exogenous impact upon that economy. At the same time, there exists a tendency on the part of some to view the problems of under-developed areas as problems of inadequate "economic activity." Thus, they view the generation of "activity" in such economies as being generally beneficial. Since the input-output model provides a very good abstract view of economic activity, its

descriptions are often used in developing policy prescriptions regarding the generation of increased levels of such activity. In this regard, its descriptive powers have in some cases led to misguided policies, as discussed above in regard to output multipliers. That "economic activity" in a given area and income to people in a given area are not synonymous (or even very closely related) is a point which should be re-emphasized. The fact that direct and indirect activity in an input-output model is maximized when value added in all linked sectors is zero should serve to point up the fallacy involved in using "activity" as a guide for economic policy. When value added is zero, net welfare of society is not enhanced by changing the form of the resources, unless for some reason "activity" itself is inherently valued.

Whether the analytic tool used to evaluate secondary benefits is the input-output model or any of the other approaches discussed herein, the fact remains that the relevant unit to be measured is the change in the welfare of the people involved. Because input-output analysis allows the greatest degree of disaggregation, it allows the analyst to come closer to evaluating the real interpersonal changes than does any of the other techniques discussed. However, it also allows the analyst " . . . to lose sight of the complexities and interdependence of the real world in a maze of pretentious and unhelpful sumbols."[60] Too many users of the technique have perhaps been so enamored with the system of equations and the mathematical possibilities offered by them that their use of economic theory in applying the description provided by the equations has been neglected. It is in the application of this tool that theory plays its greatest role, not in the estimation of the structural relationships.[61] Thus, the economics involved in the estimation of secondary benefits using the input-output approach does not end with the inversion of the Leontief matrix, nor with the computation of the income multipliers; and it should begin long before the estimation of the structural equations.

Linear Programming

Linear programming is generally defined as a technique for maximizing some linear objective function, subject to a set of linear restraints. The technique can be used to either determine the allocation of a set of resources to achieve maximal returns or to determine the minimum cost set of resources needed to achieve a pre-specified output. It has been a widely used tool of firm-level analysis. Linear programming is being increasingly used in analyzing regional problems as well.

Regional Linear Programming. Linear programming can be used to estimate the optimum allocation of a regions resources to different products and processes. Just as the technique can be used to determine the optimum product mix for an individual firm, it can also be used in estimating the optimum degree of specialization for a particular region. The technique has been discussed as a tool of analysis in land use zoning and has been used for such purposes on some occasions. The data requirements for regional linear programming are, of course, very great.

Inter-regional Linear Programming. Regional linear programming, like regional input-output in a developed country, must deal with categories of inputs and outputs which are "exogenously defined." The smaller the region, the larger the number and the greater the importance of the exogenous variables.

Inter-regional linear programming attempts to make endogenous to the model the inter-regional effects of input and output decisions. For example, the optimum degree of specialization and trade for a particular region depends not only upon the endowment of resources of that region but also the regions with which its economy is linked. Thus, one use of inter-regional linear programming would be the allocation of production and trade between regions.

River Basin Planning Models. The widest use of linear programming in the water resource field has been in river basin planning. The greatest resemblance to an indrect benefit model has been achieved by the Economic Research Service group. The Economic Research Service model[62] uses a least-cost solution approach to estimate the benefits from flood control projects where an increase in agricultural output in the flood plain is involved. By using the projected demand for agricultural commodities during the project life as a guideline, the Economic Research Service analysts established regional output requirements by commodity. A share of the total "demand" was allocated to the Wabash River Basin and cropland adjustments were computed for basin lands under flood-prone and flood-free conditions. The implicit attempt at estimating income shifts between up-land and flood plain land owners holds valuable prospects in terms of determining who receives the benefits and who is indirectly hurt by flood control projects.

Input-Output as a Linear Program. The input-output model is very similar to the linear programming model. It is often described as a linear programming model. The similarities are basic: 1) The relationships between inputs and outputs are fixed or linear, and 2) the relationships between inputs are fixed or linear. When used for projection purposes, the input-output model is very similar to a linear program. If overt restraints are placed upon the projections, the input-output model becomes a form of linear programming. Linear programming solutions to multiplier problems are most applicable where unemployment exists in a regional economy, but in which the unemployment is not sufficient to meet the labor requirements indicated by the multipliers derived from input-output models. By placing labor restraints on the model, the round-by-round computation of income impacts can be stopped at the point at which the unemployed labor force has been used up.

Secondary Benefits and the Multiplier: A Summary

Of the three types of secondary benefits -- i.e., 1) conventional, 2) externalities, and 3) dynamic -- the most widely discussed and the one generally subjected to analysis has been the conventional variety of "stemming-from" and "induced-by" changes in economic activity. This has occurred largely because this type has been most amenable to macro-economic analysis. The latter two types -- while perhaps equally or more important in terms of economic growth inducement -- have been more difficult of analysis because they represent changes in the production functions and in the inherent productivity of the resources involved. Thus, they are not handled as easily by conventional economic theory. While changes in scale economies, for example, are a familiar part of micro-economic theory, the implementation of the concept and the measurement of the effects has not come easily. Neither has the measurement of output changes due to increasing productivity of labor. Thus, the basic approach to secondary benefit evaluation has revolved around the estimation of aggregate changes in output resulting from the secondary impacts of increased expenditures due to a public project. The typical approach has utilized the multiplier concept in some form to estimate these impacts.

"The multiplier" measures the lateral shift in aggregate demand which results from a unit change in exogenous expenditures. Thus, it does not measure secondary income changes directly, unless aggregate supply is perfectly elastic over the relevant range or makes an equivalent lateral shift. Unless one has reason to believe that one of these two aggregate supply conditions is being met, multiplier analysis should not be used to measure benefits in the absence of at least a cursory analysis of supply conditions.

The conditions under which the full multiplier effects of a public investment in a water resource project, as they are typically estimated, would constitute a real net change in welfare are fairly specific and very operationally limiting, though the general approach has been to include the full multiplier impact. The full value of the multiplier effects might be included where 1) the conditions of supply for all factors stimulated to employment by the investment are perfectly elastic at prevailing prices, 2) the opportunity costs of those factors in the absence of the investment are zero in all cases -- i.e., the full factor price consists of economic rent, and 3) the outputs which result do not simply substitute for other products in the market place; thus they do not unemploy other factors of production. Normally these conditions are not

present in the general case. Thus, multipliers in general (whether Keynesian multipliers or input-output multipliers) exhibit a consistent tendency to over-estimate the real welfare effects of secondary impacts. That any or all of the above conditions might partially hold in many cases is not questioned. However, the typical approach to multiplier analysis assumes that all of these conditions hold fully. Thus, the "secondary benefits" which are generally estimated using secondary impact analysis are not really net secondary benefits at all, even from the viewpoint of the factors being employed. Rather, they are gross changes (usually long run) in the demand for those factors.

Multiplier analysis is basically a projection technique. All of the uses of the multiplier which were discussed above deal with the multiplier as a tool for projecting the expansions in income, employment or economic activity resulting from certain exogenous changes.

In addition to projecting expansion, input-output multipliers can also be used to <u>trace</u> the incomes received from current or direct output, since the input-output model gives a detailed description of the factor payments involved in producing the outputs of a particular industry. The factor payments are based upon market prices which might or might not represent the real opportunity costs of those factors, nor of the resources which might have been used in producing the factors. In those cases in which the factor prices differ from the real opportunity cost, the real value added for that sector will be incorrectly stated. If one knew the real opportunity costs of all factors, the real economic value added by a particular sector could be more accurately estimated. That is, the real shadow price of each output could be estimated by repricing each factor entry at its real opportunity cost and recomputing and inverting the Leontieff matrix (with households outside of the endogenous matrix). The result could be used in either or both of two ways: 1) To project the real income from an expected expansion in output due to an expected change in final demand (the estimate would have all of the problems posed by projecting from input-output models discussed above), and/or 2) to estimate the total factor rents (i.e., factor prices minus real opportunity costs) earned by all of the factors and subfactors used in producing the current output. The latter use would simply constitute a full shadow pricing of the current outputs. The former would constitute a full shadow pricing of expected outputs.

Footnotes

1. Kneese, op cit, 24-9.

2. Harvey Leibenstein, "Allocative Efficiency vs. 'x-Efficiency'," The American Economic Review (June 1966), 392-415.

3. Peter Helmberger, "O-Efficiency and the Economic Organization of Agriculture," in Agricultural Organization in the Modern Industrial Economy (Columbus: 1969).

4. See Irma Adelman, Theories of Economic Growth and Development (Stanford: 1961).

5. Glenn L. Johnson, "A Note on Non-Conventional Inputs and Conventional Production Functions," in Agriculture in Economic Development, ed. by C. Eicher and L. Witt (New York: 1964).

6. Edwin Kuh, "Unemployment, Production Functions, and Effective Demand," Journal of Political Economy, LXXIV, No. 3, 238-48.

7. Notable exceptions are Ibid; Robert M. Solow, "Technical Change and the Aggregate Production Function," The Review of Economics and Statistics XXX, 312-20; and Lawrence H. Shaw and Robert S. Arden, "Output Effects of a Changing Composition of Industry, 1947-1965," The Review of Economics and Statistics XLX, 134-6.

8. Gardner Ackley, Macroeconomic Theory (New York: 1967), 309.

9. Gottfried Haberler, "Mr. Keynes' Theory of the 'Multiplier': A Methodological Criticism," Zeitschrift für National ökonomie (1963).

10. Keynes; op cit, 298.

11. See Abbas Mirokhor and Frank Orazen, "Importance of the Farm Sector to the Economy: A Multiplier Approach," American Journal of Agricultural Economics (November 1968).

12. "The Relation of Home Investment to Unemployment," Economic Journal (June 1931).

13. The Theory of Inter-sectoral Money Flows and Income Formation (Baltimore: 1950).

14. Harry W. Richardson, *Elements of Regional Economics* (Baltimore: 1969), 23.

15. Robert H. Haveman and John V. Krutilla, *Unemployment, Idle Capacity, and the Evaluation of Public Expenditures: National and Regional Analysis* (Baltimore: 1968), 28-33.

16. *op cit*, 914.

17. See Walter Isard, *Methods of Regional Analysis: An Introduction to Regional Science* (Cambridge: 1960), 189.

18. Charles M. Tiebout, *The Community Economic Base Study*, Supplementary Paper Number 16 (New York: December 1962).

19. *Ibid.*, 61-2.

20. *op cit*, 199.

21. *op cit*, 200-1.

22. Richard B. Andrews, "Comment re: Criticisms of the Economic Base Theory," *Journal of the American Institute of Planners* XX (1958).

23. Paul W. Barkley and Thaine H. Allison, Jr., "Economic Base Studies in Resource Administration," *Land Economics* XL: 470-9.

24. Hans Blumenfield, "The Economic Base of the Metropolis," *Journal of the American Institute of Planners* XXI (1955).

25. C. L. Leven, "Regional and Interregional Accounts in Perspective," *Regional Science Association Papers and Proceeding*, XIII: 127-44.

26. See "Homer Hoyt on Development of Economic Base Concept," *Land Economics* (May 1954).

27. See for example *Economic Base Survey of the Potomac River Service Area*, prepared by the Office of Business Economics of the U. S. Department of Commerce for the U. S. Army Corps of Engineers (Washington: 1969).

28. Barley and Allison, *op cit*.

29. *Procedures for Evaluation . . .* , 107-8.

30. See M. E. Marts, *An Experiment in the Measurement of the Indirect Benefits of Irrigation*, prepared for

the Bureau of Reclamation, U. S. Department of the Interior, Boise, Idaho (June 1950); and Robert E. Struthers, The Role of Irrigation Development in Community Economic Structure: Grand Valley Trade Area, Colorado (Washington: 1963).

31. Barkley and Allison, op cit.

32. For a more complete discussion of the "intensive" versus "extensive" growth problem, see C. M. Tiebout, "An Empirical Regional Input-Output Projection Model: The State of Washington," Review of Economics and Statistics (August 1969).

33. Impact of Irrigation Development on Income and Trade: Eastern and Central South Dakota (Brookings: February 1969).

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35. Ibid., 42.

36. A Study of the Economic Impact of the Hugo Reservoir on Choctaw and Pushmataha Counties (Oklahoma City: 1969).

37. A Test of Procedures Proposed by a Task Force of the Water Resource Council: Special Study of the Mountain Home Division, Southwest Idaho Water Development Project, U. S. Army Corps of Engineers, Walla Walla District (March 1970).

38. "On the Use and Overuse of Input-Output Models: A Methodological Hypothesis," unpublished paper, undated.

39. Ibid., 4-5.

40. R. J. Kalter, Estimating Local Secondary Impacts of Water-Based Recreation Investment Using Interindustry Analysis (Madison: 1967), and An Interindustry Analysis of the Central New York Region, Bulletin 1025 (Ithaca: 1969); Charles L. Leven, "Regional Income and Product Accounts: Construction and Applications," in Design of Regional Accounts (Baltimore: 1961), Chapter 6; and W. Lee Hansen and Charles M. Tiebout, "In Inter-sectoral Flows Analysis of the California Economy," The Review of Economics and Statistics, XLV, No. 4 (November 1963).

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42. William H. Miernyk, _The Elements of Input-Output Analysis_ (New York: 1967), 30.

43. H. H. Stoevener and E. N. Castle, "Input-Output Models and Benefit-Cost Analysis in Water Resources Re-Search," _Journal of Farm Economics_ (November 1965), 1572-9.

44. See Miernyk, _op cit_, 21.

45. For an example of such a truncation and a discussion of truncated multipliers, see Walter Isard and Robert Kuenne, "The Impact of Steel Upon the Greater New York-Philadelphia Industrial Region," _The Review of Economics and Statistics_ (November 1953).

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47. Gerald A. Doeksen and Charles H. Little, _An Analysis of the Structure of Oklahoma's Economy by Districts_ (Stillwater: 1969).

48. Which also tend to be low-wage, low-value added industries. See Harvey S. Perloff, _et al._, _Regions, Resources, and Economic Growth_ (Lincoln: 1960) 93-6.

49. Miernyk, _op cit_, 47.

50. "Interindustry Relations of a Metropolitan Area," _The Review of Economics and Statistics_ (November 1959).

51. See _Ibid._, and Miernyk, _op cit_, 42-9.

52. Charles M. Tiebout, "Regional and Interregional Input-Output Models: An Appraisal," _Southern Economic Journal_ XXIV (1957).

53. For a discussion of long-run versus short-run input-output multipliers, see Kalter, _Estimating Local Secondary Impacts_ . . ., _op cit_.

54. Isard, _Methods of Regional Analysis_ . . . , 35.

55. Mordecai Ezekial and Karl A. Fox, _Methods of Correlation and Regression Analysis: Linear and Curvilinear_ (New York: 1959), 415-33.

56. Kalter comes to a similar conclusion. See _loc cit_, 77.

57. "The Nature and Significance of Input-Output," Review of Economics and Statistics (May 1954), 121-33.

58. Ibid., 124.

59. For a discussion of this point, see H. B. Chenery, et al., The Structure and Growth of the Italian Economy (Rome: 1953), 17.

60. Keynes skepticism regarding the mathematical models of some of his colleagues is perhaps relevant to this discussion:

> "Too large a proportion of recent 'mathematical' economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious unhelpful symbols." The General Theory,

298.

61. Dorfman, op cit, 125.

62. Roger Strohbehn, et al., Analysis of Alternative Procedures for the Evaluation of Agricultural Flood Control Benefits (Washington: 1971).

CHAPTER V

ESTIMATING SECONDARY FACTOR INCOME CHANGES

Foreword

In Chapter II, the literature regarding secondary benefits was reviewed. The survey revealed three classifications of secondary benefits: 1) Customary induced-by and stemming-from effects, 2) externalities and economies of scale, and 3) dynamic secondary benefits. It was concluded that the latter two categories required a great deal of further study and that, at present, they must be approached on a case-by-case basis. Even more so than the customary variety of secondary benefits, the analysis of externalities and dynamic effects requires great perception and imagination on the part of the analyst. Only the customary variety of secondary benefits appeared amenable to analysis using currently available economic knowledge and currently available secondary data.

In Chapter III, methods of estimating secondary impacts were surveyed. The advantages, disadvantages, and assumptions of each were discussed. It was concluded that the major drawbacks to most approaches have been the assumptions of perfect supply elasticity and zero opportunity cost of the factors stimulated to employment and the tendency to credit all ensuing changes in the level of income or employment to the initial investment. The latter tendency gives no credit to the associated investments required. It was concluded that the detail provided by the input-output model allowed the analyst the greatest opportunity to adjust for the effects of these factors. It has been maintained throughout the preceding sections of this study that the analyst should apply imagination and reason to the analysis of customary secondary benefits rather than faithfully accepting an estimate of "The Multiplier" as an effective measure of real welfare changes. The purpose of this section is to demonstrate an alternative approach to such acceptance. The approach utilizes the input-output model as a starting point and incorporates opportunity cost and economic rent concepts in deriving a set of multipliers which it is believed will more closely represent the real changes in economic welfare which result from the operation of "The Multiplier."

The model presented herein is slightly revised from a version used by Schmid and Ward[1] in the Michigan State University Test Team report on the Water Resource Council's June 1969 proposed changes in water project evaluation procedures. The concepts and approaches are essentially the same. The version presented herein is different from the original in the following respects: 1) The earlier version used the coefficients from the 1958 input-output study of the United States, while the newer version uses the 1963 coefficients, 2) the assumptions regarding the treatment of profits are changed, 3) the approach to estimating "stemming-from" benefits is changed, and 4) a different procedure for estimating opportunity cost of labor, where the local wage rates are lower than the national wage rates, is used. In addition to demonstrating the application of the revisions in the earlier model, the application of the revised model to the Trenton Channel Project in this Chapter provides a third set of secondary benefit estimates for use in the comparative analysis of the Trenton Channel Project in Chapter VI, which evaluates the sensitivity of secondary benefit concepts to differences in analytical approaches.

Estimating Wage Changes

Input-output models allow the analyst to trace the impact of a change in final demand through the economy. Since "households" is normally one of the sectors included in the input-output tables, it is possible to estimate the total effects upon household income caused by these final demand changes. As discussed in Chapter III, income multipliers derived from input-output studies have generally presumed that all of the income flows to the household sector represent real secondary benefits. As discussed previously, this convention assumes that the opportunity costs of the household sector are zero - that is, that all of the wage, salary and profit earners have no valued alternatives. It assumes that all returns on capital in excess of recurrent costs are "pure" profits and ignores the concept of "normal" returns on investment. It undervalues leisure and assumes that labor earnings are zero in all possible alternative uses. While this latter assumption *might* be justified on some grounds in some underdeveloped countries, it is clearly inappropriate for recent conditions in the United States.

The Wage Component of Value Added

The input-output model provides the analyst with snapshot information relating to average relationships in the economy on a disaggregated basis. It provides much of the information needed to estimate the *real* changes in income which occur as an indirect result of water resource projects. However, the information in the input-output tables must be supplemented by additional information. Part of this information is currently available in secondary sources. For example, the household sector (or the value added sector, in some studies) can be disaggregated by using data on wages, profits and sales by industry which are contained in the "National Income Issues" of the *Survey of Current Business*, published by the Department of Commerce. ("The National Income Issue" is normally the July issue.) By dividing the wages and salaries data by the sales for the particular industry, one can obtain a "wages per dollar of sales" coefficient which can be substituted in the direct requirements table. The same is true for profits. Having done this, one could then use the input-output multipliers discussed in Chapter IV to estimate a "wage multiplier" or a "profit multiplier." However, both of these would still deal with the gross concepts of wages and profits discussed in the previous paragraph. Though both of these can be useful in their own right, they do not provide appropriate measures of real wage and profit changes (to even the local area) under normal United States conditions.

The "wages per dollar of sales" coefficient can further be disaggregated into an "opportunity cost" component and a "rent" component. The rent component could also be used to generate a "rent multiplier" using the input-output multipliers discussed in Chapter IV. These would show the total net changes in income to workers from a given change in final demand. In order to construct the "rent coefficients," however, one must have information regarding the alternatives available to the workers in each industry. Unfortunately, there is no generally available source of such information at present, though a slight revision in the application forms used by the State Employment Security Commissions could make such information available on a continuing basis. By requesting the industry of previous employment and the wage rate of each applicant, in addition to the job classification as is now

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done, these agencies could provide valuable data required in establishing the alternatives available to the labor force of each industrial sector. It would also improve the estimates of unemployment rates by industry groups. These rates would obviously be even less precise than the currently estimated rates by job classification. Nevertheless, they could be of substantial aid in determining which industries could best use an infusion of exogenous demand. More importantly for analytical purposes, this information would allow greater precision in dealing with the problem of supply elasticies, since one could better forecast the emergence of labor shortages for each industry.

Even in the absence of data sources regarding alternative earnings, some logical improvements can be made in the approaches discussed in preceeding chapters. Though it is unlikely that one could establish the precise level of real opportunity costs by logic alone, it is possible to reduce the range of error apparent in traditional approaches. For example, it is apparent that zero is too low an opportunity cost in practically all cases. Any estimate which is higher and can be logically shown to be lower than the actual opportunity cost will narrow the error. Thus, the process becomes one of determining the highest logically defensible estimate. Since "logically defensible" involves a subjective judgement, the estimate should be a conservative one.

The most plausible argument relating to alternative labor earnings looks at the bidding process for labor. As the demand for the output of each sector shifts, the derived demand for labor inputs shifts. Under conditions of labor unemployment, the increased demand for labor can be met out of the pool of unemployed resources. When the pool is exhaused, however, firms begin to bid workers away from other firms to meet continued increases in the demand for their products. The firms which give up workers do so by either 1) decreasing their output, or 2) adopting labor-saving technologies. One might assume that those which underwent contractions were "marginal" firms which were earning very low profits (or perhaps were realizing capital losses). These firms were probably (though notnecessarily) among the lowest wage firms in the sector. Thus, one would expect the workers who shifted from the contracting firms to the expanding firms to realize some increment of wage improvement, though the difference would not be entirely in the form of real "rent," since there would be costs associated with the shift.

In the case of laborers released by labor-saving technologies, the process is somewhat different. Their former employers are probably not "marginal" firms. If they were, the owners would be unwilling to undertake the capitalization necessary to switch from a high variable-low fixed cost technology to the high fixed cost technology suggested by the process of capital substitution. Thus, one should not surmise that these firms are among the lower wage firms. On the other hand, it is probable that those workers being released are not the firms' highest salaried production workers. The process of capital substitution usually proceeds through the jobs having the lowest skill requirements. Thus, it is probable that the average wage of the workers released is lower than the average wage of all production workers in the firm. Whether it is lower than the average of all production workers in the industry is an empirical question. There is reason to believe that the increased capitalization would occur in the higher profit firms which also tend to pay higher wages. This would at least partially offset any tendency of capital to substitute for lower wage production jobs. In the absence of an extensive and detailed study of this question, it is perhaps most defensible to simply assume that the two more or less offset each other and that the labor released by capital substitution realized little or no transfer rent, even when demand for labor is increasing. Thus, the only rents realized occur through the process of shifting from marginal to expanding firms.

Wage rates within the "marginal" firms differ from industry to industry. They normally differ by more than do the wage rates between marginal and expanding firms within the same industrial sector. These differences are largely due to differing capital-labor ratios and skilled-unskilled labor ratios between the different production processes.

While some inter-industry labor transfers can and do occur under conditions of increasing demand for labor, the differing labor skill mixes provide some limit to these transfers. Inter-industry transfers normally occur within individual job classifications. Wage differences within the classifications are normally much smaller than the differences between classifications, especially in union-scale trades. Thus, the rents realized by a worker shifting from one industry to another are much smaller than the difference between the average wages for all production workers in the two industries would suggest, since the worker is likely to remain in the same trade.

In the absence of data regarding the shift patterns of labor, one alternative is to use the average wage from the sector having the lowest average wages in establishing the alternative costs of labor. In view of the large inter-industry wage differentials highlighted above, this convention would appear to greatly understate the real opportunity cost of the laborers who change jobs. The skills of most of the workers will greatly exceed the average level found in the lowest wage sector. However, this apparent understatement is ameliorated by the "syphon-like" process through which the labor market operates: as one worker moves to higher employment, he is replaced by a second worker of (marginally) lower skill, who is replaced by a third whose skill is (marginally) lower than the second. This process continues until all of the positions are filled or until the limit of the labor supply is reached. The net effect of the process is to increase the sum of the earnings of all involved in the "syphon" by the difference between the new job at the top and the alternative earnings of the last worker affected. Under conditions of unemployment, the last worker syphoned up would come from the unemployed; the net results would be the wages of the new job minus the cost of unemployment. Under conditions of "full" employment, the alternative at the bottom of the syphon would be some wage paying job. The convention adopted here is to assume that the alternative is employment as an "average" production worker in the lowest wage industry. This constitutes a very conservative evaluation of the average opportunity costs, since it assumes that the syphoning effect will go all the way to the bottom of the currently employed labor force for every worker affected by the exogenous impact.

The Wage Rent Coefficient

If one accepts the assumptions outlined above regarding labor opportunity costs, a "wage rent coefficient" for use in developing a vector of "wage rent multipliers" can be developed from secondary sources. The data needed are

C_i = total labor compensation in each industry (i)

L_i = total employment in industry i

C_s = total labor compensation in lowest average wage industry, where average wage is defined as C_i/L_i

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Ls = total employment in lowest wage industry

Si = total value of sales in industry i

The "wage rent coefficient" is defined as

$$Wi = \frac{(Ci/Li - CS/Ls)\ Li}{Si}$$

$$= \frac{Ci - (Li/Ls)\ Cs}{Si} \quad .$$

The wage rent coefficient can then be used in place of the household row coefficients in the direct requirements matrix in generating "wage rent" multipliers in lieu of the income multipliers. The wage rent multipliers yield estimates of <u>changes</u> in labor incomes stimulated by the exogenous change in demand, rather than the <u>total</u> wages, salaries and profits paid by the industry as a result of expansion of output which the traditional "income multipliers" provide.

The reader should be cautioned that the "wage rent coefficient" is merely an attempt to deal with one of the problems posed by traditional multiplier analysis - i.e., the zero valuing of labor opportunity costs. The estimation procedure outlined in the above formula is based upon only a gross approximation of the real opportunity costs involved. Very seldom will the approximation be accurate. The basis upon which the approximation is accepted is that the arbitrary assumptions involved in its derivation constitute an improvement over the assumptions of the traditional multiplier approach. Like the original multiplier pr

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presentation, the above derivation is simplistic, and the mathematical symbols used reveal no great truths in themselves.

Estimating Profit Changes

> Business profits are one of the hardest kinds of income to measure. Any business enterprise should be able to state accurately the sums that it has paid out in the course of a year as wages, interest and rents; it should be able to state also what income it has paid out to its owners. But the profits of the enterprise itself are not definite sums fixed by past transactions. On the contrary, they are appraisals of net changes in the position and prospects of the business as a whole--appraisals that look forward to the uncertain future as well as back to the irrevocable past. Like all mixtures of past history and future anticipations, statements of profits are necessarily subject to variable margins of uncertainty.
>
> Wesley C. Mitchell[31]

The Profit Component of Value Added

In the preceding section, the division of the household or the value added row of the direct requirement matrix into a wage component and a profit component was discussed. The procedure by which the wage component might be divided into an opportunity cost component and a rent component was outlined. The use of the rent component in devising "wage rent multipliers" as an alternative to "income multipliers" was discussed.

Much of the discussion regarding the wage component is applicable to the discussion of the profit component. At least in concept, one should treat capital in much the

the same way as labor. The rents or quasi-rents which accrue to its employment should be treated as benefits; its opportunity costs should not be. The principle is, on the surface, a fairly simple one. In practice, however, the concept of returns to capital is very difficult to deal with.

According to orthodox economic theory, quasi-rents are short-run returns to capital, after deducting variable costs. Quasi-rents can be divided into payments to cover fixed costs, and profits. Under pure competition, both are short-run returns, since in the long run the fixed costs become variable, and competition will drive all profits down to the "normal" return on capital. Thus, secondary benefits from the employment of fixed capital are theoretically short-run in nature. In the absence of market distortions which allow idle capacity or excess profits, no secondary benefits from capital employment would be possible. One might say that secondary benefits to capital employment arise out of errors in planning. This is especially true in the case of excess capacity, since its existence indicates that either too many plants or plants of the wrong size were built. Once the investment is made, it is considered to be irreversible or "sunk," in the short run. Thus, the surplus of gross receipts above variable costs has traditionally been considered to constitute a net benefit from capacity utilization.

In those cases in which plant capacity was being fully utilized <u>and</u> excess profits were occurring in the industry, secondary benefits could also accrue. In this case, the benefits would consist of the surplus of gross receipts over both variable and fixed costs, since new capital investment would be required if production were to be expanded. Thus, the "quasi-rents" would consist of only the "pure profit" component, after deducting the "normal returns" to capital.

It is possible to estimate the profit per dollar of sales component in the input-output matrix in the same manner as the wage component. The National Income Issues (July issue) of the <u>Survey of Current Business</u> provide data on profits before and after taxes by major industry group. By dividing the profit data by the sales data, one can obtain an average profit per dollar of sales for the year in question. There are, of course, problems involved in using such data in this manner. Some of these are the same problems which plague the input-output model: The problems of aggregation. In addition, there are the problems posed by the accountant's concept of profits versus the economist's concept.[4] Accounting profits are very difficult to translate into the economic theory equivalent because of 1) the effects of inflation on book values of capital assets, 2) the difficulty of estimating "user cost," 3) the difficulty posed by accelerated depreciation for tax purposes, and 4) the treatment of re-invested profits. All of the tricks available to the accountant coupled with the competing corporate desires to show a good profit rate to the stockholders while holding down tax liabilities make the interpretation of profit statements a precarious exercise.[5] Nevertheless, if one wishes to deal with the returns to capital, he has little choice but to use the profit data supplied by accountants. The alternative is to undertake very expensive primary research (which would be at least as costly as an input-output study) in an attempt to derive the relevant costs and state them in the precise concept of the economist. Some very competent economists have attempted to deal with this problem in the past.[6] The results have largely been frustration and an equally cloudy "translation" of profit estimates. The basic reasons for the difficulties experienced had to do with such things as: 1) Dealing with yearly "profits" where large year-to-year fluctuations occurred and the relevant "cycle" was difficult to determine, 2) separating wage payments from profits in small firms, 3) valuing the alternative costs of the fixed assets used where the "economic" costs (especially user costs) depended upon anticipating future technology and demand, 4) separating the opportunity cost of capital, uninsured risk, and pure profit.

Closely tied to determining the level of "profit" is the problem of defining profit rates and the real opportunity cost of capital. Because the fixed cost-variable cost distinction is not nearly so clear in practice as it is in theory, it is very difficult to determine what constitutes investment and what constitutes recurrent expense. The simultaneous mix of a building having a life of forty years, a machine having a life of ten years (ignoring the rate of use and resultant user cost problems), another having a life of five years, "variable inputs" taking time periods ranging from one day to two years to put "on order" and/or use, and inventory accumulations with warehouse stays ranging from days to years creates serious difficulty in operationalizing the fixed cost-variable cost distinction. Since each of these assets might have been acquired at different times under different financing arrangements and "market" rates of interest, it is difficult to determine the opportunity cost of the capital invested in them by evaluating the alternatives at purchase dates. Using the current market value of the plant as the opportunity cost creates problems also, since the market value includes such intangibles as company image and "goodwill" as well as market contacts and purchase lines for variable inputs. As a result of these factors, estimates of industry rates of return on invested capital have been subject to wide margins of error, which has created great difficulty for analysts attempting to estimate industry profit rates. Thus, while one can readily be critical of the data on "accounting profits" which are available in secondary sources, one is hard-pressed to find an alternative which can be effectively demonstrated to be superior.

If one is willing to accept the profit data found in secondary sources, he still must decide between profits before and profits after taxes. Some tax payments are merely transfers, while others constitute payments to cover the costs of productive public services which are consumed by industry (the highway program is a good example of these). Net profits from the social viewpoint lie somewhere between the before and after tax profits. One can not readily say which figure would provide the closer estimate of profits net of both transfers and real cost of public services. However, since neither of the profit figures have been adjusted for risk and "normal" returns on investment, it is apparent that the profits before tax estimate greatly overstates the real net profits. At the same time, the profits after taxes estimate is also too high, unless the transfer component of the tax payment were equal to or greater than the level of "normal" returns expected in the industry. The actual relationship is not currently known nor easy to determine. It is improbable that the after-tax profits ". . . are in the form of a rent which could be taxed away and still allow . . . them to supply their services."[7] Thus, they do not constitute real benefits to the owners from expanding output. Nevertheless, the after-tax profits per dollar of sales is used her

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herein in estimating the changes in profits which occur as a result of secondary expansions in output. Of the choices available, these data appear to be most in keeping with the previously stated principle of attempting to arrive at the closest logically defensible estimate in reducing the margin between gross and net changes in income via secondary effects. It is the belief of the author that after-tax profits over state-the rents realized by producers. Much additional study of specific enterprises is required in order to answer questions regarding "excess profits" and scale economies. The convention adopted herein can only be defended on the grounds that it provides a more reasonable estimate than does the gross application of input-output multipliers.

Rounds of Expansion and Benefit Creditability

In the immediately preceding sections, it was stated that the net wage coefficients and the profit coefficients could be used in lieu of the household direct requirements coefficients in generating input-output multipliers. Such multipliers provide valuable information in dealing with some problems. However, they are, for the most part, inappropriate for use in evaluating the secondary benefits from water resource development.

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Associated Investments

Most of the income multipliers generated from input-output models include both the direct and indirect effects of final demand changes. That is, they include not only the first round of transactions but also the infinite series of rounds which is supposedly generated (see Chapter IV). Unless unused capacity sufficient to meet all of these outputs exists, additional capital expenditures will be necessary. To give all of the credit for all ensuing income changes to the initial investment does great violence to all of the associated investments which are required to produce the induced outputs. It, in effect, assumes that all associated investments are riskless and that the supply of capital required to undertake them is perfectly elastic. The erroneous nature of such a convention is illustrated by the following example: The Corps of Engineers is dredging a channel which will allow a steel mill to expand its output of steel ingots. The problem is to estimate the income which will be generated as a result of increased purchases of inputs by the steel mill. The analyst used the traditional approach of using a direct-indirect income multiplier which includes the direct and indirect transactions of, among other things, large volumes of limestone. All of the income changes would be included as benefits under the traditional approach. However, in order to provide for the greatly increased purchases of limestone additional investments in quarrying equipment will be required. The credit for these investments are included in the secondary benefits from the investment in dredging. To illustrate the point further, assume that a second Corps of Engineers navigation project is required later to provide access to the limestone quarries necessitated by the increased steel output. The project benefits claimed for the second navigation project will include a sub-set of those claimed for the first project. Thus, not only is the credit for the effects of ensuing investments claimed by the first project, some of the effects are also double-counted in the Federal navigation program account or other development programs.

Inelasticities of Supply

The input-output multipliers project the current composition of input purchases and assume that the demands imposed on the input suppliers can be met at current prices. That is, projections using the model assume that the supply of all factors is perfectly elastic at prevailing prices. Obviously, this is not the case, especially for relatively large changes in demand such as those caused by large-scale water projects. These supply inelasticities restrict the final level of the real multiplier effects. It is difficult to estimate the exact extent of these restrictions, because the relevant supply elasticities are not known.

Some analysts have introduced restraints into the model to adjust for these "leakages." Isard and Kuenne[8] dealt with the problem by excluding important sectors from the structural matrix, thus reducing the level of the indirect effects which were calculated when the matrix was inverted. A principal sector which is often excluded is the household sector, thus eliminating the "household induced" component (which is the principal component of the Keynesian Multiplier, see Chapter IV). A second method of restraining the multiplier has been to truncate the multiplier calculation after an arbitrarily selected number of rounds.

Adjusting the Multiplier

For the most part, "multipliers" provide an estimate of the absolute upper limit to the income changes which *might* occur as a result of a given exogenous change. They assume away the problems of friction, inflexibility, and "improper" reactions to stimuli that are present in any economy. Since they are designed for predicting rather than assigning cause, their use in investment analysis tends to lead to assigning the credit for all changes to the initial "exogenous" change occasioned by the investment.

The problems of "credit" assignment, leakages, and ancillary Government actions millitate against using the full value of the direct and indirect effects generated by most multiplier approaches. With each ensuing round of transactions included in the multiplier, these problems become more intense, and the justification for truncating the analysis becomes stronger. Even in the first round of induced transactions there are likely to be capital costs and risk undertakings which should receive part of the credit.

In the absence of knowledge regarding the levels of leakages, credit, etc., any adjustment of the indirect effects is necessarily arbitrary. It is the author's belief that in few cases should more than the first round of transactions be included in the computation. The arbitrariness of this judgement is realized, as is the justification for sometimes carrying the computation a few rounds further. However, in light of the previously-discussed problems, it would appear that one is very seldom (if ever) justified in computing the rounds through to the full "multiplier" value. According to Clark, Grant, and Kalso, "The stemming-from hypothesis, crediting production of raw products as a 'trigger' and causing the chain of subsequent processes, has limited validity which does not warrant carrying the computation through to the ultimate consumer in all cases" (p. 26). The convention used herein is to use only the first-round direct requirements in computing the wage and profit gains.

Regional Coefficients and Purchases

One of the major drawbacks to using input-output analysis in water resources research has been the lack of regional input-output studies in other than large metropolitan areas. In most cases, regional input-output studies are undertaken largely to provide data from which regional multipliers might be derived. The ever-increasing desire for sources from which such multipliers might be derived has led increasingly to the application of multipliers and/or study data from other areas deemed to be "comparable" to the region being analyzed. Input-output data from other regions having a similar industrial composition have been widely used in deriving local income multipliers because of the belief that "comparable" industry composition indicates comparable "leakages" from the local cycle of re-spending effects. The importance of "leakages" to the level-and, indeed, to the concept-of the multiplier has been discussed in previous chapters. The preceding sections have attempted to show the inapplicability of the "pure" multiplier concept to the evaluation of secondary effects of water resource projects. Tracing the inter-regional trade effects beyond the first round becomes increasingly difficult; and the assignment of "cause" for gains realized from extra-regional trade (especially in regions already enjoying "full employment") becomes increasingly difficult to justify. Limiting the analysis to one round of transactions largely eliminates the need to measure round-after-round of leakages from re-spending and, thus, greatly reduces the advantages of the regional input-output study over the national one in estimating the local impacts. In fact, the national input-output model can be substituted for the regional model, if the analyst is successful in dealing with two issues: 1) Rationalizing the differences between direct requirements coefficients in the two models, and 2) separating "local" purchases from "national" purchases so as to determine the extent of the impact upon local unemployed factors in cases in which the local unemployment rate exceeds the national rate.

Differing Requirements

Actually, the issue of rationalizing differing requirements is not nearly so problematic when the rounds of transactions are limited, since each iteration would have compounded any original difference in the coefficients, especially when "leakages" (intra- as well as inter-regional) are considered. Since the direct requirements coefficients are based largely on technical relationships between inputs and outputs, they do not vary a great deal from one plant to the other; and in long run equilibrium, they should be essentially the same. The greatest difference in direct requirements coefficients grow out of differing systems of aggregation, rather than differing production processes. The greatest difference in indirect requirements coefficients grow out of differing specifications of "leakages" between the models.

Localizing Purchases

There are basically two reasons for wishing to know the proportion of purchases which are local: 1) For estimating the real income effects where the local unemployment rate differs from the national, and 2) for determining the inter-regional distribution effect of the project. Regional input-output studies provide this information directly. Additional data are needed in separating out the regional effects when using a national study.

The secondary outputs to meet the new demands "caused" by the project might be supplied under any of the following three circumstances: 1) From firms (inside of our outside of the region) having excess plant capacity, 2) from marginal outputs from all firms (nationwide) who are operating at or near capacity, and 3) from new plants built specifically to supply the new demands. Under the first and third circumstances, one would expect transport economies to play a large role in localizing the effects within the region. Under the third, the location of new plants would depend upon the plants' "orientation."[9] However, as discussed previously, the "credit" for gains realized from wholly new investments should not be given to the water project; though new plant investments are of great importance in designing programs and strategies for promoting the development of depressed regions. The Corps of Engineers is sponsoring research directed towards assessing the plant location effects of water projects.[10] However, until the direct link is proven and the "credit" assignment problem is solved (i.e., the "marginal product" of the water project in the location function is determined), the addition of plant location effects as benefits in project appraisal only serve to add greater uncertainty and guesswork to the analysis and to intensify the difficulty of separating the net national gains from the transfers. The approach used herein is to assume that any "new" outputs which result from the impact of the project on "national" industries[11] will be distributed nationally in the same proportions as are current outputs. This amounts to an assumption that the national industries affected by the "stemming-from" impacts are not heavily input-oriented and that those affected by the "induced-by" impacts are not "market-oriented." (However, this does not imply that they are market-oriented and input-oriented, respectively.) It is also assumed that the "credit" due the project from ensuing rounds of transactions is approximately equivalent to that unduly assigned to the project in the first round of transactions. As previously discussed, this is very difficult to prove or disprove and constitutes an arbitrary assumption.

The situation in which project-induced requirements are met by marginally increasing the output of all plants is more straight-forward though perhaps less realistic than the other cases. In this case, it is almost definitional to assume that the inter-regional effects are distributed in the same way as are present outputs. While it is unlikely that any plant would order one unit of the same item from every supplier of that item, under some circumstances the aggregate effect might approach this situation. The shifting and realigning of purchases which might occur when a large change in demand occurred in one locality could sift through much of the affected industry. It is unlikely, however, that the effects would be in exactly the same inter-regional proportions as the current capacity in most industries, largely because of transport economies. Nevertheless, the possibility of such an occurrence lends added credence to the convention of allocating inter-regional effects on the basis of current proportions.

In those cases in which regional excess capacity existed in an affected industry, one would be justified in assuming that all of the induced output which could be supplied locally would come from local firms. In most cases, the existence of excess capacity should be known by the local offices of the water resource agencies. In many cases, the projects will have grown out of local support generated by the existence of this excess capacity. Especially in the non-metropolitan localities, the area offices should possess the knowledge of the local economy su

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sufficiently well to ascertain the local existence of excess capacity in the industries to be affected by the water project. In these cases, the analyst should not allocate the impacts according to current inter-area proportions, at least until the excess capacity of the local firms has been absorbed. This would be true even in those cases in which excess capacity existed in other regions, since one would expect regional firms having excess capacity to be able to under-bid outside firms on the basis of transport costs and established market contacts.

Of the two reasons, stated at the beginning of this section, for wishing to know the regional impact, only one has any impact on the "net benefits" of the project. Only in those cases in which regional labor and/or plant capacity are under-utilized relative to the nation is the total output affected. Where the utilization rates do not differ greatly from the national rates, such information is largely secondary or irrelevant. Where local capacity is already fully utilized, local increases in output will require increased capital, which should receive a part of the credit. Thus, the convention of proportioning the regional share according to existing proportions probably does little violence to the concept of "net" local project effects, under conditions of local "full employment." Where local conditions are such that the outputs can be met without additional investments, the net local benefit concept conforms closely to the national concept, and the localization issue is more important. Thus, the analyst should use his knowledge concerning local resource flows to construct the "proper" localization proportions for the industries affected. (He should also utilize his knowledge regarding local employment opportunities in attempting to construct a locally-relevant set of opportunity cost figures for local labor in improving the wage rent coefficients discussed previously.) There is presently no widely available, reliable source of secondary data which would allow the analyst to readily pinpoint the existence of excess capacity, though there has been much research directed towards defining and determining the existence of excess capacity.[12] Unfortunately, the concepts of "capacity" and "capital investment," (and "profits") are components of capital theory, ". . . the most elusive concept of economics."[13] It is perhaps axiomatic that the more "elusive" the concept, the dearer are the sources of data for dealing with it. The cases of profits and capacity lend credence to such an axiom.

National and Local Industries. Leontief, in his study of the impact of an arms cut,[14] divided the industries into "local" and "National" categories on the basis of the proportion of sales going to local markets. Those industries, such as personal services and wholesale and retail trade, which service basically local markets were classified as "Local." The industries, such as primary metals and other manufactured goods, which went primarily to "National" markets were classified as "National" industries.

While there are some difficulties posed by the categorizing of "Local" and "National" industries, this differentiation is helpful in the attempt to separate out the impacts which are primarily local and those which are national in getting at the problem of estimating interregional trade flows posed by the absence of a regional input-output study. As discussed in previous paragraphs, the analyst's personal knowledge of the local trade flow structure can be used to supplement this differentiation where there are "National" industries which are servicing primarily local demands (such as a manufacturing concern which produces inputs which are wholly-used by another "National" firm in the local area).

Those industries which are classified as Local seldom sell in National markets. For the most part, their impacts can generally be considered to be wholly local. The reverse is not always true of the National industries, however, as alluded to in the preceding paragraph. While the National industries are not normally restrained by the location economies which effect the local industries, there are many examples of nationally-oriented firms whose outputs go largely to the local area. In addition to input suppliers, there are also nationally-oriented firms selling to "final demand" which sell largely within the local area. However, because of the scale economies involved in the production and marketing of the products produced by such firms, the case of such National firms selling to local markets is most common in local areas which include large metropolitan areas.

Localization Ratio. The approach used in the model is to use "Localization Ratios" to estimate the proportion of the national impacts which will occur locally. In the case of the "Local" Industries (as defined by Leontief), the Localization Ratio is assumed to be unity (1.0). That is, all of the sales which result from the secondary impacts on those industries are expected to occur locally. For those industries which are classified as "National," the Localization Ratio is based upon the proportion of total national employment in the industry located in the region. For example, if one-fourth of all employment in auto manufacturing in the United States were located in the state of Michigan, the Localization Ratio for that industry for the state (defined as the "region") would be 0.25. Thus, the model would assume that 25 per cent of all increases in auto sales would be supplied by production from the state of Michigan.

Employment proportions obviously are not identical to capacity proportions, though they are very closely related. The convention of using employment as a basis for estimating localization is based upon two considerations: 1) The general availability of data-relating to employment at sub-national levels in light of the lack of similar sources relating to other parameters of output capacity for sub-national areas, and 2) the fact that the major objective of the model is to estimate wage changes -- thus, the employment sensitivity of the local industry is more important than its output capacity.

Some might find the Localization Ratio an overly-simplistic tool for estimating the local proportion of the total impacts. It admittedly extrapolates the average localization of employment to the marginal case, and economists are constantly cautioning against such procedures. It is not alone in this regard, however, since many applied economics techniques (including input-output models - see Chapter IV) have the same faults. In most cases, such extrapolations of average relationships are used because information regarding marginal relationships is impossible (or expensive -- i.e., uneconomic) to get. Thus, while economic theory generally deals with relationship at the margin, economic practice often deals in the application of data regarding averages. The pervasineness of this practice among economists does not justify the use of averages in marginal analysis; however, it does indicate the difficulty economists have experienced in developing data sources amenable to marginal analysis.

Applying the Model

The preceding sections of this Chapter have dealt with the conceptual basis of the proposed model for estimating secondary benefits. Following sections of this chapter deal with the application of the model to the Detroit River, Trenton Channel Project, of the Army Corps of Engineers. The application serves two functions: First, it serves to demonstrate the procedures by which the model can be applied, and second, it generates an additional set of numbers to be used in Chapter VI in the comparison of alternative estimates of the secondary benefits of the Trenton Channel Project.

The Trenton Channel Project

The proposed Trenton Channel Project of the Army Corps of Engineers is a navigation project designed to provide access to deepwater transport for an extended portion of the Detroit River navigation channel. While there will be some side effects on recreation and the environment, the basic economic impacts come from the provision of lower cost transport.[15] The principal user and primary beneficiary of the extended channel will be the McLouth Steel Company, which has indicated that it will expand its steel production, if the channel is extended. Ostensibly, an additional 3000 workers would be employed by the firm, and output of steel in the Detroit area would expand by $40.5 million per year. The principal secondary impacts of the project would come via the increased purchases of inputs by the steel plant (induced-by), the increased purchases of inputs by users of the steel (stemming-from), and the purchases of inputs for the construction of the navigation channel.

The Detroit metropolitan area - the principal "region" to be affected by the project is not an area of "chronic" unemployment. Rather, the employment problems of the area are cyclical because of the heavy dependence of the economy upon durable goods manufacturing.[16] Thus, the local resources which would be stimulated to employment by the navigation project should not be viewed as long-term unemployed resources, and the opportunity costs of those resources should be deducted from the secondary income generated, as discussed in preceding sections.

The Computation Procedure

Induced-by Benefits

Induced-by benefits are those which result from the increased purchases of inputs by local industries as a result of the provision of some water service - in this case navigation. The estimated increase in direct purchases of inputs by the McLouth Steel Company is shown in column 3 of Appendix Table 1. The estimate is derived by multiplying the $40.5 million of increased steel sales by the

Direct Requirements Coefficients in column 2. The Direct Requirements Coefficients show the proportion of each dollar of sales of Primary Metals going for the purchase of inputs from each sector. For example, for every dollar of sales of Primary Metals, \$0.02994 goes for the purchase of Electricity, Gas and Water Services. Thus, \$40.5 million in steel sales results in \$1,213,000 in purchases of Electricity, Gas and Water. The other entries in column 3 are similarly derived (i.e., \$40.5 million x .00007 = \$3,000;\$40.5 million x .04657 = \$1,886,000; etc.).

The secondary sales shown in column 3 indicate the first round of "activity" generated by the increase in steel sales (see Chapter IV). This does not represent net benefits to anyone, since these are merely payments for productive services which also have costs associated with their production.

The proportion of induced sales which go for the purchase of labor by each affected industry can be estimated by multiplying the "Labor Coefficients" in column 4 by the respective induced sales in column 3. The Labor Coefficients show the proportion of each sales dollar (for the industries arrayed on the left of the table) which goes to purchase labor inputs (i.e., 42.24% of gross receipts by Electricity, Gas and Water producers are paid out in wages and salaries. Thus, \$1,213,000 in sales results in \$561,000 in payments to labor). The total wages and salaries generated can be obtained by summing column 5.

Again, column 5 does not represent the first round induced benefits to labor, unless all of the laborers employed had absolutely no other productive alternative use. As discussed previously, this is the estimate used for the labor component in traditional income multiplier approaches.

The number of workers effected can be estimated by dividing the induced wages in each industry by the average production worker wage in that industry shown in column 6. Thus, for Electricity, Gas and Water, an addition of 74 workers (column 7) will be required as a result of the increased demand posed by the expansion of the steel plant. These represent "new" jobs only if they will be supplied by previously unemployed resources. Under "full employment" conditions, they must be filled by workers from another industry. In the model, it is assumed that they will be filled by workers previously employed in the Service industry. Thus, the "net" wages received by each new worker in the Electricity, Gas and Water industry will not be \$7,500 as shown in column 6, but, rather, it will be \$7,500 minus the \$4,765 which was being earned in the Service industry; the difference (\$2,735) is shown in column 8. Similarly, the difference between \$4,765 and \$6,180 (i.e., \$1,415) would represent the increase in wages for those who shift from Services to the Printing and Publishing industry. By multiplying the "Wage Rents" in column 8 by the "Workers Affected" shown in column 7, one can estimate the total change in wages resulting from the induced effects of the expansion in steel production. This total for each industry is shown in column 9.

The reader might note that the entry for the Service industry in column 9 is zero. The analysis says that there are no induced effects upon the Services industry. However, column 7 shows an increase of 58 in the demand for Service workers. While the model assumes that 1,021 workers are being drawn away from the Service industry and into new jobs. This should result in a deficit of 1,079 Service workers relative to the demand for outputs from the Services sector. The degree to which this represents an induced disbenefit depends upon the elasticity of supply and demand for services as compared to that for the other outputs produced by the workers attracted away from the Services industry.

Under conditions other than total unemployment, there will be some cost associated with stimulating factors to "higher" employment. The convention of subtracting the earnings in the Service sector from those in the "higher" employment makes certain assumptions about the utility realized from the production and consumption of services. The simplest means of dealing with the welfare changes posed is to assume that the market for services is competitive, such that the marginal utility from services consumption is equal to its price. Assuming that the total utility was captured by service workers in the form of payments for services, the wage rent estimated in the model would represent the real welfare gains involved in the shift of the marginal worker. The validity of extending this "marginal" relationship to all 1,079 workers affected depends upon the slope of the aggregate marginal utility function for services consumption relative to the marginal productivity of the 1,079 service workers. The greater the slope of the function in this range relative to the marginal product of service labor, the greater will be the discrepancy between real negative changes in welfare and the opportunity cost accounting embodied in the price of service labor. The model assumes that both are horizontal and equal and that the wages paid to service workers represents the total utility realized in the production and consumption of services. The net wage gains shown in column 9, then, represent "real" changes in welfare, under these assumptions.

The net wage gains shown in column 9 are the estimated gains for the nation as a whole. To estimate the proportion which accrues to the Detroit area, the "Localization Ratios" in column 10 are multiplied by the respective figures in column 9. (The derivation of the Localization Ratios is discussed in the preceding section of this chapter).[17] The Localization Ratio for the Local Industries is set a 1.0, as discussed above. Thus, that portion of column 11 is identical to column 9. However, the local proportion of the induced-by effects upon the National Industries is a much smaller proportion of the total effects -- an average of 2.84 per cent in this case. As a result, the total "local" effects in terms of wage changes is estimated to be about 37 per cent of the total "national" wage effects. Whether this proportion would be estimated from a regional input-output model of the Detroit area can be determined only when such a model becomes available.

The wage gains estimated in Appendix Table 1 were estimated without the use of the wage rent coefficient discussed above. This was done in order to show the process through which the wage rent coefficient operates. Using the wage rent coefficient, columns 4, 5, 6, 7 and 8 could be replaced by one column (or one "vector," if matrix procedures are used. See Schmid and Ward, _op cit_, Appendix). The wage rent coefficient (for Electricity, Gas and Water, for example) can be computed by dividing column 8 by column 6 and multiplying the quotient by column 4 (e.g., 2735/7500 x .4624 = .1686). Multiplying column 3 by this wage rent coefficient yields column 9. The wage rent coefficient is used throughout the remainder of this study rather than the longer procedure used in Appendix Table 1.

The computation of profit gains is similar to that of wage gains, except that the "Profit Rents" are obtained directly by assuming them to be approximated by "profits after taxes." The induced sales in column 1 of Appendix Table 2 are multiplied by the average after-tax profits per dollar of sales coefficients of column 2. The result is column 4 showing the profit gains induced by the steel expansion. The Detroit portion is then estimated by applying the Localization Ratios of column 4 to the Profit Gains. Thus, it is estimated that $208,530 in Profit Gains accrue in the Detroit area of the $951,061 which accrue to the nation as a whole.

The sum of the Wage Gains and Profit Gains induced by the steel output for the Detroit Region is estimated at $1,204,728, while that for the nation as a whole is estimated to be $3,680,783.

Stemming-From Benefits.

Stemming-from benefits are those increases in wages and profits which result from increased availability of inputs into other production processes. The readiest example is that of the increased supply of agricultural products to food processors as a result of an irrigation project. Stemming-from benefits have not been as widely treated in the literature as have induced-by benefits. This is because (as discussed in Chapter II) stemming-from benefits are basically supply effects,[18] while traditional multiplier analysis has dealt with demand effects.

At the national level when wide-scale unemployment does not exist, a water resource project should produce stemming-from (supply) effects to help the economy to absorb the induced-by (demand) effects without simply creating inflation. Ideally, the supply and demand effects would be commensurate, so that the "multiplier" indicated real income changes. As argued by Clark, et al, one should not add together supply and demand in estimating national secondary benefits, since the two act jointly in determining equilibrium output. However, at the regional level, the two effects can be additive, since the increased outputs outside of the region might have grown out of the inter-regional "leakages" of the induced-by (demand) effects of the project. However, these "leakages" are not included as regional induced-by imports. Thus, the stemming-from (supply) effects allow some of the interregional effects of the project to be recaptured by the project region. As a result, stemming-from benefits are only regional in nature and should not be included as "net" benefits from the national standpoint (i.e., though they are "real" benefits to the project region, from the national standpoint they are simply transfers which cancel out somewhere else). Even from the viewpoint of the region, the stemming-from effects are net for only those increased output which are exported from the region, since those sold internally largely go to satisfy the increased intraregional demand created by the "induced-by" effects.

Stemming-from effects constitute special problems for the analyst, since their validity depends upon the importance of the water project-related factor in further production processes. Of great importance are the elasticities of substitution of the relevant factors and their elasticities of supply with and without the water project. As discussed in Chapter II, a serious drawback to most analyses of stemming-from impacts has been the tendency to assume the perfect elasticity of all factors, besides the water project-related factor. It was pointed out in Chapter II that such an assumption creates an inverse relationship between the stemming output and the proportion of production costs represented by the water project-related factor.

The problems of "importance" of factors are dealt with in the model by adopting a convention assuming that the proportion of the sales dollar going to each factor indicates its relative importance in the production process. Thus, a factor whose cost represents 20 per cent of the sales dollar of some product is twice as "important" in the production process as a factor which absorbs 10 per cent. These percentage weights are used as a rough means of adjusting the stemming outputs to account for inelasticities of other factors and for the tendency to assign credit in an inverse fashion. The approach used in the model does have some basis in economic theory, since normally the "credit" assigned to each input should be related to its value in producing the final output. If the input prices reflect their marginal value products (as they should under perfectly functioning input markets), then the average outlay for water project-related inputs per dollar of sales is a good approximation of the credit which should be given to the water project for the stemming-from output.

In Appendix Table 3, the outputs of steel are distributed among the steel using industries in the proportions indicated by the 1963 National Input-Output Study. The distribution coefficients, are arrayed in column 1. Column 1 indicates that Primary Metals production receives the greatest share of primary steel output - i.e., approximately 20 per cent. Multiplying these coefficients by the $40.5 million increase in steel output yields column 2 showing the expected distribution by industrial purchaser of the project-related steel output. Primary Metals, for example, will purchase $8,279,820 of the output (i.e., $50.5 million x .204). The value of purchases of steel by each sector is taken to represent the portion of stemming effects which can be credited to the increased availability of steel, as a result of the weighting scheme discussed in the preceding paragraph. Since primary steel inputs absorb 20.4 per cent of each dollar of sales of the primary metals industry, the stemming output under the traditional assumption regarding the elasticity of other factors would be estimated at $39,730,000 (i.e., $8,279,820/.20840). The convention of crediting the stemming outputs in proportion to the input costs results in multiplying the total output of $39,730,000 by the relative weight of

.20840, which gives the original steel sales figure of $8,279,820. The same is true for each sector affected. Thus, the sales of steel to each industry shown in column 2 represent also the portion of stemming output creditable to the increased steel production.

The Profits and Wage Rents are computed in the same manner for the stemming-from benefits as for the induced-by benefits, with one exception. Since only the exports of the increased outputs create net gains to the region, the local sales of steel must be isolated and excluded from the computations. Locally-contained demand effects must be spent upon locally-produced goods in order to generate the wage and profits estimated in the induced-by effects. Thus, the local stemming-from effects are simply the counter part of the induced-by effects. Stemming-from production is available for export, only if the local stemming-from effects exceed the local induced-by effects for a particular sector. For example, the induced-by effects upon the Printing and Publishing sector (Appendix Table 1) increases the demand for Printing and Publishing by $3,000. (All of these demands are assumed to be local). For this demand increase to affect wages and profits in that sector, an output response must be made by the sector. Unless the supply of Printing and Publishing is perfectly elastic, the project-related demand increase can not be given full credit for the response, in the absence of a commensurate project-related supply effect. Column 2 of Appendix Table 3 indicates that the stemming-from (supply) effect on Printing and Publishing is $3,240. Thus, $240 in "exportable surplus" Printing and Publishing services are created. Only the Profit Rents and Wage Rents which accrue to this $240 in Printing and Publishing "exports" is included as local stemming-from benefits. The derivation is straight-forward for the "Local Industries," since the Localization Ratio is 1.0. For the National Industries, the surplus (deficit) from the national viewpoint must be determined first. Then any surplus production is apportioned according to the Localization Ratios. For example, the National "surplus" of non-durable goods amounts to $453,190 (i.e., $809,190 minus $376,000). Since 0.12 per cent of that industries employment (capacity) is located in Detroit, $544 of the exportable surplus is estimated to accrue to the Detroit Region. The Wage and Profit Rents on this $544 of "exports" are included as Detroit Region stemming-from benefits. The same procedure is followed in calculating the stemming-from benefits for the other industrial sectors. Those for which the induced-by effects exceed the stemming-from effects are assumed to produce no "surplus." Thus, there is no stemming-from benefit computed for them. The total of Wage and Profit Rents due to stemming-from effects is $368,383.

<u>Construction Impacts: Induced-By</u>. In addition to the secondary impacts from project-related output expansions

there are also secondary impacts which occur as a result of project construction expenditures. The construction effects are basically induced-by effects or aggregate demand effects. The generation of secondary income via construction expenditures represents the point at which water resource development policy comes most directly into line with the policy of aggregate demand maintenance voiced in the Employment Act of 1946. While the induced-by and stemming-from effects from project <u>outputs</u> are to some extent mutually self-effectuating, the induced-by effects from <u>construction</u> expenditures depend wholly upon existent flexibility (i.e., supply elasticity) in the economy to make their multiplier effects "real." In the absence of such flexibility, the "balanced budget multiplier" effects of the tax-expenditure sequence is lost on inflation, and little or no real income changes result. The induced-by effects are largely inter-regional changes in incidence of income, since (from the project-by-project viewpoint of local interests - see Schmid and Ward, p. 38-41) the project region receives a large part of the construction impact while paying a small part of the cost. Part of the inter-regional income re-distribution could represent real gains, if the project region were experiencing under-employment conditions while the rest of the nation was not. However, such conditions did not prevail in the Detroit area during the period relevant to the analysis presented herein. Thus, in this analysis the construction impacts are treated as inter-regional income transfers, and inclusion is made only in the regional account.

The estimation of the secondary impacts induced-by the construction of the Trenton Channel Project follows essentially the same lines as the procedure used in estimating the changes induced by the steel output, with two exceptions: 1) The vector of direct requirements is taken from the Haveman and Krutilla study[19] rather than the 1963 Input-Output Study, and 2) only the local portion of the induced-by impacts are counted. The direct requirements vector in this case shows the distribution of each dollar of Federal expenditure for dredging. For example, 10.3 percent of the costs spent in the Non-durable goods industry. Multiplying this vector by the construction cost of the project ($31,400,000) gives the estimated impact by industrial sector. Following the procedures outlined previously, the Detroit Region impact from the construction expenditures is estimated in Appendix Tables 5 and 6 to be $309,310 in Wage Gains and $174,611 in Profit Gains, respectively.

Trenton Project Secondary Benefits Summarized

The secondary benefits of the Trenton Channel Navigation Project have been estimated in the above sections from two viewpoints: 1) That of the Detroit Region and 2) that of the nation as a whole. The estimation procedure attempted to find means of estimating the real net changes in income which accrued at both levels as a result of the project. The defects of simplifying the various reactions and interactions into such a two part framework have been widely discussed.[20] Nevertheless, since this convention was the format suggested in the Water Resource Council Task Force Report, an attempt was made herein to work within such a framework.

The secondary benefits from the Detroit Region viewpoint consist of $996,198 in Wage Gains induced-by the steel mill expansion, $208,530 in profit gains stemming-from the steel mill expansion, $309,310 in Wage Gains induced-by project construction expenditures, and $174,611 in Profit Gains induced-by project construction expenditures. The sum of these effects is $2,055,584.

From the National viewpoint, the secondary benefits consist of only the Wage and Profit Gains induced-by the increased steel output. The estimated National Wage Gains total $2,729,672, while the Profit Gains total $951,061. The sum of the two is $3,680,733. However, since there were no unemployed resources in the Detroit area, there were probably no National indirect benefits at all, after accounting for declines in other sectors.

The Underlying Assumptions of the Model

Within the scope of the limits defined,
The results have been quite conclusive:
That assuming the assumptions
That have been assumed
The problem becomes unobtrusive.[21]

The distinguished planner and development economist, Albert Waterston, has noted that economic planners often provide plans of little practical value because of the restrictive assumptions which are made. He points out that

> Because analytical complexity increases with the number of variables used, planners include as few variables as possible in their closed system models and rely on ceteris paribus or mutatis mutandis to maintain control over the excluded variables. This approach necessarily constricts the limits of possible answers. By posing questions which are shielded from outside disturbance or uncertainty, answers are bound to be simplistic; by narrowing the scope of problems, solutions are sure to be circumscribed.[22]

The essence of model building is simplification. The objective is the optimization of the competing desires for conceptual manageability and prescriptive relevance to a complex world. This "two-horned dilemma" pervades practically all of economic analysis, and, unfortunately, its dangers are not always recognized and appreciated by economic practitioners. The proliferation of econometric and mathematical models which purported to "simplify reality" and/or make economic analysis more "scientific" during the 1960's bears ample witness to the ever present danger of "losing sight of reality in a maze or pretentions and unhelpful symbols."

The assumptions which surround any analysis often constitute the key to understanding the problem which is being analyzed. As pointed out above, simplifying assumptions are a necessary part of model building, if the objective of the model is to make understandable the fundamental relationships involved. Yet, the assumptions themselves constitute real variables (exogenously defined) whose relationship to the endogenous variables must also be understood, if the analyst is to draw the full measure of the heuristic value of his analysis. Sometimes, (as was suggested in the quotation introducing this section) it turns out that the assumptions *a priori* specify the most important variables in the analysis, and the results become foregone conclusions, thus destroying much of the value of the "analysis."

The objective of this section is to attempt to deal with the problems posed by the assumptions made in the analysis in preceding sections. The explicit assumptions of the model, most of which were discussed in the text, will be outlined. An attempt will be made to identify the implicit assumptions and to spell them out. The underlying assumptions (as best they can be delineated by the author) will be presented so that the reader might make his own analysis of their effects. The result, it is hoped, should aid both the author and the reader in interpreting the validity of the model and of its results.

Assumptions Common to Multiplier Analysis

1. There are no negative local indirect impacts from the acquisition of funds to build the project by the public sector. The situations in which this would be true are:

a) "Money creation" equal to the public expenditure,

b) Bond sales which were paid for from "hoarded" savings,

c) A balanced budget multiplier equal to the estimated indirect effect of the project, or

d) All money used for project cost comes from taxes in <u>other</u> regions

2. The money invested in the project would not otherwise have been spent. Otherwise, the multiplier impact would have occurred anyway.

3. Federal monetary and fiscal policy will continue to be administered such that the employment rates and resultant opportunity costs will not change during the time period under analysis.

4. The total supply effects of the stemming-from impacts and existent supply elasticities are sufficient to complement the induced-by effects at current price levels. Otherwise, the demand multiplier effects would create mostly inflation.

5. Changes in personal income represent "equivalent" changes in inter-personally comparable social welfare. Otherwise, the comparison of income changes is not a good welfare measure.

Assumptions Common to Input-Output Models

1. All of the production functions involved are linearly homogeneous: The marginal factor-factor and factor-product relationships do not change as output expands.

2. The composition of input purchases and the distribution of outputs remain the same as output increases in each industry.

Additional Assumptions From Conventions in Rent Model

1. All purchases of inputs from firms classified as "Local" come from within the project region. This assumption was implemented through the assignment of localization ratios equal to unity (1.0) for the "Local" industries.

2. Purchases of inputs from industries classified as "National" are distributed inter-regionally in the same proportion as is employment in those industries. This assumption was reflected in the localization ratios, which were derived by dividing employment in the particular industry in the project region by the employment in that industry in the nation as a whole. This assumption and the immediately preceding assumption were made in attempting to determine the <u>local</u> impacts using a <u>national</u> input-output model.

3. The "National" industries which are effected by the project are not input-market-oriented. This assumption results from the restraints imposed by the localization ratios also. If the National industries were input-market-oriented, the localization ratios would greatly understate the proportion of induced-by sales which would come from the project region.

4. The "Local" industries which are effected by the project are output-market-oriented. All of the sales of Local industries are assumed to go to the project region.

5. The marginal wages paid equal the average wages for each effected industry. Thus, each new job created in each industry adds one new worker at the "average" wage for that industry.

6. The average alternative cost is equal to the average production worker wage in the lowest paying industry in the region. This assumption is related to the method of computing the Wage Rent Coefficient. Since the real alternatives for each worker was not known, it was assumed for computational purposes that the alternative would be at least equal to the average wage in the lowest wage sector.

7. The surplus of actual profits over the profits which would be required to bring about the current rate of production is equal to after-tax profits. This amounted to the assumption that all "take-home" profits were a

surplus which could be taxed away without affecting output.

8. The marginal rate of profit rent is equal to the average rate for each industry affected. The "average profit rent" was assumed to be equal to the after-tax profit rate. This rate was used in computing the rates for any change in induced sales.

9. Declines in employment occur only in jobs whose overall average wages are equal to those in the lowest wage industry; declines in production occur only in those industries which are earning no profits. This assumption is implicit in the Rent Model, since the model traces only the expansions and not the contractions which occur in the system. The subtraction of the "alternative" wages from the new wages attempts to adjust for these changes on the employment side. Declines in production are partly dealt with by the assumption made elsewhere that the demand change is "new" demand and not a shift. Failure to account for profit contractions due to labor resource price increases are "justified" by assuming zero profitability of contracting industries.

10. The total rents which are generated in the first round of expansion are equal to the portion which is creditable to the project from all rounds of expansion. The problem of assigning credit for all rounds of expansion was "assumed away" by adopting the convention of assigning

only the credit for the rents generated in the first round to the project.

11. The relative cost of each factor in each industry indicates its relative marginal value product in that industry. Since the production functions are linearly homogeneous, the marginal value products do not change as output increases (and inputs are added in constant proportions). This assumption arose from the convention of assigning stemming-from credit on the basis of the proportion of total cost in the stemming-from production process which was represented by the project output.

12. Net marginal social utility in the consumption of goods produced by the industries which decline is equal to zero (for all units by which production is curtailed). The welfare of producers in the declining industries was dealt with in assumption 9, above. However, the welfare of consumers of those products must also be dealt with. The simplest procedure is to assume that all consumers of the products no longer available were not realizing any "consumers surplus" from the consumption of those commodities. That is, the demand for those commodities was perfectly elastic.

Footnotes

1. A. Allan Schmid and William Ward, A Test of Federal Water Project Evaluation Procedures With Emphasis on Regional Income and Environmental Quality (East Lansing: April 1970).

2. The closest relationship is found between the proportion of large firms in a particular industry and the average wage rate for the industry. Generally, the greater the proportion of large firms, the higher are the average wages. See Stanley H. Masters, "An Interindustry Analysis of Wages and Plant Size," The Review of Economics and Statistics (August 1969).

3. "The Problem of Measuring Profits: A Preliminary Note by Wesley C. Mitchell" in Ralph C. Epstein, Industrial Profits in the United States, National Bureau of Economic Research, Inc. (New York: 1934), 4.

4. George J. Stigler, Capital and Rates of Return in Manufacturing Industries (Princeton: 1963).

5. U. S. Congress, Profits: Report of a Sub-Committee of the Joint Committee on the Economic Report on Profits Hearings (Washington: 1949).

6. For example Stigler, op cit, and Ralph C. Epstein, Industrial Profits in the United States (New York: 1934).

7. Huffschmidt, et al., Standards and Criteria for Formulating and Evaluating Federal Water Resource Developments (Washington: June 30, 1961).

8. "The Impact of Steel Upon the Greater New York-Philadelphia Industrial Region." The Review of Economics and Statistics (November 1953).

9. That is, whether the firm were "product market oriented" or "factor market oriented." See Isard, et al., Methods of Regional Analysis, Chapter 7.

10. See, for example, Calvin S. Schneider, Procedures Manual for Determining Preliminary Expansion Benefits for Appalachian Water Projects, (Lexington: 1968).

11. "National" industries are those which sell primarily to national markets.

12. See Edwin Kuh, "Unemployment, Production Functions, and Effective Demand," Journal of Political Economy (June 1966).

13. Oskar Morgenstern, On the Accuracy of Economic Observations (Princeton: 1950).

14. Wassily Leontieff, et al., "The Economic Impact-Industrial and Regional of An Arms Cut," The Review of Economics and Statistics (August 1965).

15. Schmid and Ward, op cit.

16. Ibid.

17. The Localization Ratio for Stone, Clay and Glass products was set at zero, because the principal input purchased from that sector by the steel industry is limestone, which comes from outside of the region. See Schmid and Ward, op cit, 29-30.

18. Clark, et al., op cit.

19. Unemployment, Idle Capacity, and the Evaluation of Public Expenditures: National and Regional Analysis (Baltimore: 1968), 20-21.

20. See A Summary Analysis of Nineteen Tests of Proposed Evaluation Procedures on Selected Water and Land Resource Projects, Report to the Water Resource Council by the Special Task Force (Washington: July 1970).

21. William A. Ward, "Economic Research: Prologue and Epilogue," American Journal of Agricultural Economics (February 1970).

22. "Resolving the Three-Horned Planning Dilemma," paper presented at a meeting of the American Society of Planning Officials, New Orleans, March 29, 1971.

CHAPTER VI

A COMPARATIVE ANALYSIS OF TWELVE SECONDARY BENEFIT APPRAISALS

Overview

In Chapter II, the different concepts and definitions of secondary benefits were discussed. Three general categories of such benefits were delineated. In Chapter IV, the different methods of estimating one of these categories, the multiplier impacts, were discussed. In Chapter III, the concept of "rent multipliers" was introduced and discussed as an alternative to the traditional "income multipliers," and in Chapter V a model designed to estimate the rents creditable to the initial project was discussed and used in estimating the secondary rents from the Trenton Channel Project. In the closing section of Chapter V, the underlying assumptions of the model were delineated, and the role of assumptions in economic analysis were briefly discussed.

In Chapter VI, the "customary" variety of secondary benefits from four Federal water resource projects are looked at. In the case of each project, three different estimates come from the reports submitted by the Test Teams which tested the Water Resource Council's proposed evaluation procedures as presented in June 1969. The third estimate comes from the application of the model which was presented in Chapter V to the respective projects (see Appendix). The objective of this comparative analysis is to determine the differences in analysis and in results which might arise from differing concepts regarding secondary benefits (the "customary" variety) and from differing methodological approaches to dealing with them on the part of different analysts.

In the sections of this chapter which immediately follow, the concepts, beliefs and assumptions which are discernible from the reports to the Water Resource Council by the Test Teams are discussed. This discussion reveals significant differences among the Test Teams regarding the concept of secondary benefits. Several different measures are proposed by the teams, as well as several methods of estimating the relative magnitude of the measures suggested. Widely differing assumptions are discerned regarding the state of the economy and aggregate demand maintenance. Other assumptions regarding resource mobility and interregional employment differences are also seen. Tables 2, 3, 4, and 5 outline the assumptions and beliefs of each of the Test Teams regarding the evaluation of secondary benefits.

In Table 6 the secondary benefit estimates of each of the Test Teams are presented, along with those generated by the model presented in Chapter V of this study. As can be

TABLE 1

After-Tax Profits Per Dollar of Sales Compared With Before-Tax Profit Rates Reduced by Fifty Per Cent

	Before-Tax Profits/$ Sales/2[a]	After-Tax Profits/$ Sales[b]
Local Industries		
Electricity, Gas & Water	.0891	.0873
Printing & Publishing	.1016	.0512
Transportation & Warehousing	.0272	.0135
Wholesale & Retail Trade	.0121	.0146
Communications	.1016	.0943
Services	.0235	.0219
Construction	---	.0160
National Industries		
Metal Ores Mining	.0604	.0403
Coal Mining	.0263	.0355
Non-durable Goods	.0338	.0371
Lumber & Wood Products	.0283	.0402
Chemicals & Allied Products	.0338	.0615
Primary Metals	.0450	.0547
Fabricated Metals	.0339	.0438
Stone, Clay & Glass Products	.0416	.0464
Non-electrical Machinery	.0522	.0533
Electrical Machinery	.0399	.0415
Motor Vehicles	.0527	.0557
Other Transportation Equip	.0296	.0319
Instruments	.0747	.0782
Misc-Manufacturing	.0309	.0386

[a]As used in Schmid and Ward, *op cit*, p. 35.

[b]See Appendix Table 2, Column 2.

TABLE 2

Trenton Channel Project: Outline of Test Team Approaches to Secondary Benefit Estimation

	Corps of Engineers Test Team	Michigan State University Test Team
Definition of Secondary Benefits	Changes in employment and income stimulated by the project. Increased stability.	Changes in rents to factors stimulated to higher employment by the project.
Measure of Benefits Used (Suggested)	Employment generated in steel and related sector and induced employment in "service" sector.	Difference in wages generated by sector and lowest alternative wages available to those workers. "Abnormal" profits earned on increased output.
National vs. Regional Benefits	All real benefits in regional account belong in National. Regional benefits at expense of other regions should not be counted as benefits.	Some regional income gains are transfers from other regions. National gains are arrived at only after netting out the transfers.
Estimation Procedure Used (Suggested)	Employment Base Multiplier	Input-output, sectoral multipliers, adjusted for alternative wages.
Explicit and Implicit Assumptions and Beliefs of Test Teams	1. Extensive growth in Detroit represented intensive National growth 2. Laborers employed by plant were earning lower wage in other region 3. Extensive growth in Detroit is good from the local viewpoint 4. Basic/non-basic ratio is stable	1. All employment generated would be supplied by laborers from Service sector ("under-employment"benefits) 2. Expansion of outputs and inputs will be linear 3. No supply in elasticities in first round 4. Half of profits are "abnormal" 5. Localization of impacts would be equal to current employment ratios

TABLE 2 (Continued)

	Corps of Engineers Test Team	Michigan State University Test Team
Formula and/or value of multiplier	$\frac{Et}{E_t - E_{nb}} = 3.0$ Where: E_t = total employment in the region E_{nb} = regional employment in non-basic (i.e., service) industries	aij (aih - a_{sh}) Where: a_{ij} = direct requirement from industry i per dollar of sales by industry j, a_{ih} = value added per dollar of sales by industry i a_{sh} = value added per dollar of sales by service industry
Rounds of Expansion	Infinite	One round

TABLE 3

Stonewall Jackson Reservoir: Outline of Test Team Approaches to Secondary Benefit Estimation

	Corps of Engineers Test Team	Cornell University Test Team
Definition of Secondary Benefits	Wages, salaries & profits from investments wholly or partly induced to locate in region by project	Regional: Change in real regional income. National: Payment to previously unemployed factors when water project is clearly a constraint to growth
Relevant Benefit Parameter	Employment and personal income	Per capita change in real income - i.e., <u>intensive</u> income growth
National vs. Regional Benefits	Regional = National if resources used would have been unemployed; otherwise no national benefits	Both can occur. Regional might be transfers from other regions, however,
Estimation Procedure Used (Suggested)	Economic Base Multiplier	(Input-output model, induced multiplier)
Explicit and Implicit Assumptions and Beliefs of Test Teams	1. Basic-non basic ratio is constant as regional income grows. 2. Alternative factor earnings equal zero 3. Perfect factor markets in other regions; imperfect factor markets in project region	1. Migrants earn no rent. 2. Only unemployed factors can create real national gains. 3. Labor supply and aggregate supply not perfectly elastic. 4. "Use externalities" exist but cannot be evaluated
Formula and/or Value of Multiplier	$\frac{E_T}{E_T - E_{NB}}$ and $\frac{Y_T}{Y_T - Y_{NB}}$ Where: E_T = total regional employment E_{NB} = non-basic (service employment in the region, Y_T = total regional income Y_{NB} = non-basic (service) income in the region	2.36 adjusted to 1.8 to reflect supply inelasticities

TABLE 3 (Continued)

	Corps of Engineers Test Team	Cornell University Test Team
Rounds of Expansion	Infinite	Truncated at 1/2 total effects to adjust for supply inelasticities

TABLE 4

Poteau Watershed Project: Outline of Test Team Approaches to Secondary Benefit Estimation

	Corps of Engineers Test Team	Soil Conservation Service Test Team
Definition of Secondary Benefits	Growth in income per capita (intensive), after deducting inflation effects	Net income effects of Second and following round of expansion.
Relevant Benefit Parameter	Extensive employment growth. (Change in real income)	Multiplier effects of difference between poultry processing wages and unemployment compensation.
National vs. Regional Benefits	Equal, if unemployed resources existed in project area	National multiplier = 3.85. Regional = 1.57 because of "leakages."
Estimation Procedure Used (Suggested)	Employment Base Mult. (Keynesian Multiplier) (Input-output multiplier (Comparative projection)	Multiplier transplant
Explicit and Implicit Assumptions and Beliefs of Test Teams	1. All resources used would be unemployed otherwise. 2. Aggregate supply not perfectly elastic (inflation). 3. All multipliers yield same results. 4. Marginal utility of Regional income = national average	1. Resource allocation frictions (not barriers) existed which would take 20 years to overcome. 2. Water shortage was effective "bottleneck."
Formula and/or Value of Multiplier	$(\frac{1}{1\text{-MPL}}$ suggested$)$ $\frac{E_T}{E_T - E_{NB}} = 1.65$ used Where: MPC = Marginal Propensity to consume E_T = total regional employment E_{NB} = regional non-basic (service) employment	National: 3.85; Regional: 1.57; Local "induced by": 1.10
Rounds of Expansion	Infinite	Infinite

TABLE 5

Mountain Home Project: Outline of Test Team Approaches to Secondary Benefit Estimation

	Corps of Engineers Test Team	University of Wisconsin Test Team
Definition of Secondary Benefits	Increase in level and stability of personal income. More diverse economic base. More job opportunities	Change in rents realized by factors affected, both positive and negative
Measure of Benefits Used (Suggested)	First round of multiplier generated by Team actually used gross income from recreation expenditures	Income from first round of agricultural sales and purchases. (Change in net income of factors).
National vs. Regional	Regional = National. Unemployed resource benefits equal in two accounts, though	Partly competitive; partly complementary. Net national gains are "probably minimal."
Estimation Procedure Used (Suggested)	Multiplier Transplant for irrigation effects. Base multiplier for Recreation development, using misspecified Keynesian form	Input-output. Sectoral multipliers
Explicit and Implicit Assumptions and Beliefs of Test Teams	1. Income multiplier in region exceeded that in other regions. 2. Propensity to consume locally out of local income=proportion of visitor expenditure spent locally. 3. National benefits are chiefly local in accrual. 4. Alternative labor opportunities for farmers existed, though they were in other regions. 5. Rate of return on farm capital non-project alternative = 0	1. Water availability would increase average size of farms in project area and open new farming opportunities there. 2. New farmers would come from contiguous region & rest of nation, causing declines in income in these places. 3. All farmers had some alternative. 4. Farm income changes re-spent in fixed proportions. 5. After first round of re-spending, income effects could not be attributed to project.

TABLE 5 (Continued)

	Corps of Engineers Test Team	University of Wisconsin Test Team
Formula and/or Value of Multiplier	$\dfrac{\text{Secondary sector Income} + \text{Tertiary sector income} \text{ and } \frac{MPC}{1-MPC}}{\text{acres irrigated}}$	$a_{ij}(a_{hj})$; where: a_{ij} = purchases from industry i per dollar of sales by industry j, a_{hj} = value added in industry j.
Rounds of Expansion	Infinite	One round

TABLE 6

Estimates of Regional and National Secondary Benefits: Comparison of Rent Model and Approaches Used By Others

	Regional Secondary Benefits ($/year)	National Secondary Benefits ($/year)
Trenton Channel Project		
MSU Test Team	1,719,000	0
Corps Test Team	135,000,000	0
Rent Model	2,055,584	2,831,000
High minus low	133,281,000	2,831,000
Mountain Home Project		
U of Wisc. Test Team	1,415,000	2,453,000
Corps Test Team	16,649,000	2,972,000
Rent Model	405,000	415,000
High minus low	16,244,000	2,557,000
Stonewall Jackson Project		
Cornell Test Team	55,000	137,000
Corps Test Team	70,600,000	7,080,000
Rent Model	135,000	0
High minus low	70,545,000	7,080,000
Poteau Project		
Corps Test Team	1,584,000	368,000
SCS Test Team	395,000	614,000
Rent Model	200,000	240,000
High minus low	1,384,000	374,000

seen, the estimates vary greatly. The estimates presented by the Test Teams were hurriedly prepared; many of them did not result from the application of the approaches advocated by the respective Test Teams. Thus, the magnitudes are not directly related in all cases to the estimation methods advocated by the teams. Nevertheless, the estimates are of significance, since they give an indication of the relative magnitude of secondary benefits estimates which the respective Test Teams would expect to result from their advocated estimation procedures.

Trenton Channel Project

The Trenton Channel Project has been briefly described above in Chapter V. No additional description will be presented here.

The comparative analysis of the Test Team appraisals of the Trenton Channel Project presented herein differs somewhat from that of the other projects. In the discussion which immediately follows, the results from the Rent Model are compared not only to the results from a different approach but also to the results from a slightly different version of the Rent Model. This additional comparison allows one to appraise the differences in results obtained from two appraisals which are similar in concept but different in coefficients, as opposed to those from two appraisals using essentially different approaches.

Michigan State University Test Team

The Michigan State University (MSU) Test Team approach to estimating the secondary benefits from the Detroit Trenton Channel Project used an earlier version of the model presented in Chapter V of the present study. The earlier version was identical in concept to the present version. Thus, most of the assumptions outlined in Chapter V above also apply to the version used by the MSU Test Team. The greatest difference lay in the treatment of rents stemming-from the increased production of steel. The MSU Test Team used the full value of the resulting output of the Fabricated Metals industry in estimating the Wage and Profit Rents stemming-from primary steel production. No other industries were included in the analysis of stemming-from impacts, since steel was a relatively minor input to most other industries. Because of the inverse relationship between relative factor cost and traditional stemming-from benefits, the MSU Test Team felt that to include the industries in which steel was a minor input was "to assume the tail wags the dog."[1]

The application of the earlier version of the model by the MSU Test Team differed also in the direct requirements coefficients used in estimating the secondary outputs. Since the 1963 Input-Output Study was not available to the Test Team at the time of its analysis, the coefficients from the 1958 study were used.

A third difference between the MSU Test Team version and the present version of the Rent Model lay in the wage rates used in evaluating the alternative earnings of local laborers. The earlier version used national wage rates for both local and national industries, while the present version used local wage rates in assessing the alternatives to labor in the local industries.

The fourth difference between the MSU Test Team procedure and that used in Chapter V herein related to the treatment of Profit Gains. The Test Team used the profits before taxes in estimating the Profit Gains, but then "rather arbitrarily" reduced the result by one-half to reflect the recognition that these profits were not "net" in the sense that they could not have been taxed away without causing a reduction in the level of investment.[2] In fact the "rather arbitrary" reduction of before-tax profits by 50 per cent was no more arbitrary than the acceptance of the after-tax profit rate used in Chapter V herein. The fact that the results are relatively close (Table 1) is probably due in greatest part to the 48 per cent rate at which corporate profits are taxed. Consequently, there is little difference in the results obtained from the Rent Model under the two different conventions for dealing with profits.

The absolute difference between the results obtained from the two versions of the Rent Model appear large

(Table 6). However, when compared to the differences which obtain between analyses based upon differing approaches in ensuing sections of the present chapter. The differences obtained from the two versions of the Rent Model are relatively small. While the differences between coefficients in the two versions caused some difference in the final estimates obtained, those differences are not so large as the potential differences obtainable when differing benefit parameters are being estimated -- e.g., gross activity generated as opposed to employment in the "non-basic" sectors. Much larger differences are obtained when the basic assumptions differ between analyses -- e.g., those relating to the alternative cost of the factors affected and to the creditablity of ensuing rounds of expansion.

The MSU Test Team differed from the other test teams in the treatment of the source of funds for financing the project. The MSU Test Team argued that the taxing and spending decisions of the Federal government should not be treated as separate and independent acts, not even from the local standpoint. The process of building a Corps of Engineers project in the Detroit area required that taxes be collected to finance the project. The MSU Test Team pointed out that project regions typically view the project expenditures as "new money" in the region: In the aggregate, such cannot be the case, however, since each new project increases taxes in all regions. The MSU Test Team was arguing that at least some of the indirect effects of project expenditures would have occurred in the region anyway, had money not been taxed away from the region to help build the project. When all projects are viewed together, the aggregate demand effect simply reduces to the balanced budget effect, which is a much smaller change than that suggested by the sum of each project treated in isolation.

Corps of Engineers Test Team

The Trenton Channel Project constituted a special case of secondary benefit evaluation. The Detroit metropolitan area was characterized by a low unemployment rate and a high level of average income at the time of the test team reports. The Corps of Engineers Trenton Channel (CETC) Test Team pointed out that the major economic problem in the area was the cyclical nature of employment and income because of the high proportion of durable goods manufacturing.[3] While average wages in these industries tended to be much above the national average, employment in these industries was highly sensitive to overall changes in the economy. It was pointed out that diversification of the economy to achieve more stable employment was difficult because the high wages paid by the automobile industry and related industries tended to keep out the less cyclical industries which tended to pay generally lower average wages. The expansion of the McLouth steel plant, which would be made possible by the project, was not seen as having a stabilizing effect upon the local economy.

The expansion of the McLouth steel plant would be the generator of most of the benefits of the project, since it could not be proven that other firms would use the channel. Thus, the employment effects resulting from the steel mill expansion constituted the basis for the estimated secondary benefits.

The primary employment impact would be an increase of 3,000 workers at the steel plant. The test team postulated the effects of this additional employment on the local economy by assuming an employment base multiplier of 3.0 -- i.e., a ratio of "primary" to "residentiary" employment of 1.0:2.0. Thus, 6,000 additional jobs in the services sector would be created. The CETC Test Team also postulated that stemming-from effects would be realized in the metal fabricating industry leading to the employment of an additional 1,500 workers in that industry. The team assumed that one-half of the McLouth company's output would go to metal fabricators, while the other half would go to the automobile industry. That part going to the automobile industry would have no local stemming-from impact on employment, since the steel would have otherwise been bought elsewhere and the same level of local employment would have occurred. The stemming-from employment effects would also have an effect upon local "residentiary" employment. The employment multiplier of 3.0 was applied to the 1,500 jobs created in Metal Fabricating, indicating an additional

3,000 jobs in the service industry. Thus, the total employment effects postulated for the region were 4,500 industrial jobs and 9,000 service sector jobs.

Since the Detroit metropolitan area did not have a pool of idle labor, the team concluded that these jobs would be largely filled by migrants from other regions. Assuming a laborer-dependency ratio for the industrial sector of 1.0:3.0 and for the "residentiary" sector of 1.0:2.0 (since half of these employees would be female), the team estimated that regional population would increase by 22,500 persons.

The CETC Test Team concluded that the overall effect of the project "would be to increase employment and population in the Detroit area at the expense of other regions but to the overall benefit of the nation."[4] This conclusion could not have been derived solely from the data presented. There were involved some assumptions regarding the relative welfare of the prospective migrants in their community of origin versus their community of destination, the Detroit area. The test team spoke of "regions" as the bearers of benefits and costs rather than people as the bearers. Thus, it was not clear whether the test team was referring to the migrants alone, or all of the people of the areas involved. Their statement would imply that the "collective good" of the Detroit area would increase, while that of the other regions would decline. Perhaps the ambiguities surrounding the problem of evaluating real welfare under changing conditions of population density, related social anomie, etc., should not be treated herein, though the test team made some sweeping judgements regarding these factors in coming to its conclusion. Assuming that the test team spoke only of the migrants involved, something more concrete can be said about their assumptions regarding the net income effects of the project. Ostensibly, all of the laborers attracted to the Detroit area would have been earning lower wages in their regions of origin. Thus, overall national efficiency would be enhanced by reallocating these resources to more productive employment. The regions from which they came would be made worse off by the loss of these laborers. One could surmise that the disbenefit would arise largely from the associated decline in regional production and the taxes thereon.

The test team seemed to believe that "extensive" economic growth was good, from the viewpoint of the Detroit region. Extensive growth has been defined previously as an increase in regional employment which occurs without increasing the wages of any people already in the region -- i.e., more workers at the same wage level. In the Trenton Channel case, the new steel manufacturing employment would be complemented by additional service employment according to the existent "basic-non-basic ratio." This is, in reality, extensive growth. Extensive employment growth can be very beneficial to the tax base of economic communities

of smaller scale which are struggling to establish viable community services. In the case of a metropolis such as Detroit, however, it would appear that limited scale is no longer a problem. Indeed, the problem with the provision of these services in Detroit may well be that diminishing returns to scale will occur with continued extensive growth.

The test team apparently viewed the employment stimulated by the project as "intensive growth" from the national viewpoint -- i.e., growth in which average returns to labor rise. Such would be the case if a more "efficient" allocation of labor occurred by the shift to employment in the higher-wage Detroit area. If such were the case, then greater ambiguity is made apparent in the test team's reference to the relative welfare of "regions." Ostensibly, the migrants will have been made marginally better off by this change in residence and employment. However, their region of origin has supposedly been made worse off. But, using regional delineations for benefit assignment, should the before-project or the after-project populace be used as the basis for comparison? It is not made clear which is used by the test team. It does make a difference for the analyst's ultimate concern should be for human welfare and not for some ill-defined regional entity.

Stonewall Jackson Reservoir

The Stonewall Jackson Reservoir is a proposed Corps of Engineers Project on the West Fork River in northern West Virginia. The project area is located in Appalachia. The project itself, as it was initially designed, is primarily a flood control project with some water supply, recreation and water quality (low flow augmentation) aspects. Hydro-electric power production from this project was found to be infeasible. The first cost of the project was estimated to be $33,954,000 in July 1964 prices. The annual operation maintenance and replacement costs were estimated at $164,000, at the same price level.

The principal industries in the project area are coal mining, glass manufacturing, and livestock production. The area produces about 20 per cent of the total output of both coal and agricultural products of the state of West Virginia. Nevertheless, population out-migration rates have been very high; and, for all except perhaps the last decade of the past thirty years, out-migration rates have exceeded birth-rates, leading to a decreasing population. Largely as a result of this out-migration, unemployment rates have slowly declined from very high levels toward (but not yet reaching) the national average. Average wages in the area are nearly 20 per cent lower than national average wages.

The project area is located in Appalachia and, thus, qualifies for the consideration of redevelopment benefits.

As a result, one would expect an extensive analysis of the secondary impacts of the project. However, very little was said about such impacts in the initial project report, and little more has been added by the two test teams in their analyses. Nevertheless, the two test teams do make explicit statements concerning the evaluation of secondary benefits for the project which serve to illucidate their stances and which allow for an evaluation of their basic assumptions and presumptions regarding them.

Corps of Engineers Test Team

The Corps of Engineers Test Team which applied the proposed new evaluation procedures to the Stonewall Jackson Project (CESJ Test Team) was composed of Corps of Engineers personnel from the Ohio River Division and the Pittsburgh District Offices. Thus, the same offices were involved in producing the CESJ Test Team Report[5] as were involved in producing the original Project Report. Therefore, in applying the new procedures the test team had the added advantage of familiarity with the project.

Because secondary benefits were not evaluated in the original Project Report on the Stonewall Jackson Reservoir, the CESJ Test Team did not have the advantage of having had data collected for that purpose. The test team indicated that the time limitations were such that they were unable to provide any new data for the test evaluation. Thus, all of the analysis of secondary effects was hypothetical.

The CESJ Test Team began their discussion by stating their concept of secondary benefits. The benefits from "regional economic development" would consist of wages, salaries and profits from investments that would be "wholly or in part induced to locate in the project area." It was pointed out that, insofar as these might have been located elsewhere in the absence of the project, the total was not net to the nation as a whole, though it would be to the region. However, if the resources which were employed as a result of the investment locating in the project area would have been unemployed otherwise, then the wages and salaries would be net benefits to the nation as a whole.[6] Though the CESJ Test Team did not point out the reasoning behind this conclusion, the implicit assumption is that the opportunities available to the resources which would have been employed in the other region in which the investment would occur in the absence of the project were exactly equal to the factor payments which the foregone investment would have made, while the alternatives in the project area were assumed to be valued at zero. Thus, the investment must have been attracted away from another region which had perfectly functioning factor markets and into a region in which no effective demand existed for the resources which the investment employed.

The CESJ Test Team saw the basic effects upon employment as occurring via the construction, operation and maintenance of the project and via the provision of flat, flood-free land for commercial and industrial development. They foresaw additional employment resulting from the demands imposed by recreation users of the lake for gasoline, restaurant and motel facilities. The test team believed water supply provision to bear insufficient inducement to attract industrial location and felt that the greatest potential for regional employment generation lay in the provision by the project of flood-free plant sites.

Because the Project Report on the Stonewall Jackson Reservoir had not included an analysis of the employment effects via investment attraction, the test team was unable to say how much of an attraction to new investment would be created by the project and how much of an effect upon local employment the project would have. Nevertheless, a hypothetical rule-of-thumb analysis of the benefits from such effects was presented.

The test team used a variant of the method developed by Spindletop Research Center[7] to estimate the number of potential jobs resulting from the creation of flood-free industrial sites. The average number of employees per acre in existent plants in the area was determined and multiplied by the acreage of suitable plant sites created by the project. This gave an estimate of the potential new industrial jobs. The average wages and salaries paid in these jobs would then be multiplied by the number of new jobs to determine the total of the new income created by the potential plant locations. The most likely industries to locate on these sites were judged to be apparels and electrical machinery manufacturing. This was concluded from information contained in the economic base study of the Ohio River Basin Comprehensive Survey. The average of wages paid in the two industries was taken as the relevant wage for use in estimating the total potential income change. Then, it was suggested that a multiplier of 2.0 be used in estimating the associated change in service sector employment and income. The multiplier was taken from studies of the Appalachian area by Robert R. Nathan Associates, Incorporated, and Spindletop Research Center. The total would yield an estimate of the regional development benefits. However, only that part of the total which would accrue to unemployed resources were viewed as national gains.

Since the out-migration experienced in the area in previous decades had also decreased the unemployment rate, it was concluded that unemployment in the area would eventually equal the national rate of unemployment. Trend analysis indicated that this would occur around the year 2000. Thus, unemployment benefits could only be claimed for that portion which in the absence of the project would not have out-migrated and found employment in other areas. For test evaluation purposes it was assumed that the project would reduce the rate of unemployment in the area to the national average rate by the year 1975. Those employed by the project in 1975 would be accounted for in the national account. However, diminishing proportions of those employed would be included in the national account for ensuing years, and for the year 2000. and thereafter none would be included.

The CESJ Test Team was perhaps the most skeptical of all the Federal agency test teams regarding the nature and existence of secondary benefits for the project which they were evaluating. Perhaps this was due to the nature of the project and the area in which it was located. The project had no irrigation nor hydro-electric capacity built in. These are the most easily evaluated aspects of a project so far as secondary income creation is concerned, since they are both directly used as production inputs and often are the limiting factors of output expansion. In most cases the users of these project outputs are already located in the area or are planning to do so pending their provision. However, in the Stonewall Jackson Reservoir case, the other factors were not obviously ready and waiting for the project outputs, and the outputs were not so obviously strategic to any foreseeable production process. These factors might have been instrumental in eliciting the warning which the test team voiced regarding the credit for expansion benefits. In essence, they warned against the "one factor theory" of production in saying that credit for any expansion benefits would be in part due to the new interstate highway system and the Appalachian corridors, as well as other associated investment expenditures. Thus, while the provision of flood free land was seen as important to the development process, the test team felt that all of the benefits from economic expansion should not be assigned to the provision of flood control and urged that an attempt be made to develop a method for determining the proportion which should be assigned to each contributing factor.

The test team felt that underemployment was a "reasonable simple concept" but that it was "very difficult to measure." However, an attempt was made to measure the extent of underemployment in the area. "Per capita income was used as a proxy measure in which the Clarksburg Economic Area was compared to the United States average."[8] The percentage difference was taken as the measure of underemployment. The reasons for using per capita income rather than average wages or some other labor-based unit were not given; neither was the "reasonably simple concept" of underemployment held by the test team stipulated. However, a recognition on the part of the test team of the part played by educational and attitudinal factors in development was indicated in another section of the report. Thus, the test team must have believed that even in perfectly functioning markets the (short run) average wages for the Appalachian laborers would have been lower than the average for the rest of the nation. Therefore, the income problem was not simply one of demand deficiency but also one of resource productivity; the latter was probably instrumental in causing the former. As a result, the test team tended to under-emphasize the income producing effect of the aggregate demand changes occasioned by construction, operation and maintenance expenditures. Whether this was due to a belief on their part that few local laborers would be employed and that most project-induced spending would occur elsewhere, or whether it was due to a down-playing of the effects of aggregate demand changes on local income could not be determined. Nevertheless, it was apparent that the test team gave little consideration to the aggregate demand effects of the project-related expenditures on the area.

There was some inconsistency on the part of the test team in that a relatively large multiplier was accepted in evaluating the secondary income producing effects of employment opportunities created by flood-free site provision, while little was said about the secondary effects of construction, operation and maintenance of the project. The discrepancy in treatment must have been due to an oversight rather than a belief that the multiplier effects would have been 2.0 and zero, respectively.

An economic base multiplier of 2.0 was accepted as the relevant measure of the secondary income producing effects of new plant employment in the area. In using such a multiplier to estimate secondary benefits several assumptions must be made. First, it must be assumed that the relationship between "basic" employment and income and "nonbasic" employment and income in the area will remain approximately the same as area income increases. Whether or not this would be true for such a region as Appalachia is perhaps debatable. Secondly, it must be assumed that those employed in non-basic activities because of the multiplier effects of the new basic employment would not have been employed otherwise, and that their forced leisure was of zero value to them. Thirdly, if the secondary benefits are to be net to the nation, it must be assumed that the other region in which the plant would have located was experiencing full employment and perfect factor market operation.

Cornell University Test Team

The Cornell University (CU) Test Team Report discussed both the economies of scale type of secondary benefits and the conventional variety of secondary benefits. However, the test team preferred to view the former as a variety of "national efficiency benefits." Only those changes in income which occurred through the multiplier effects of the project were viewed as secondary benefits. While the test team believed that net secondary (multiplier) benefits could prevail at the national level, it was decided that the multiplier impacts would be evaluated only in the Regional Income Account of the project analysis, and it was suggested that any adverse effects upon other regions should be analyzed and discussed therein as well.[9]

The CU Test Team was very dubious of the analysis of secondary effects under the "use externalities" definition provided by the Task Force. They were particularly concerned about the imputation of causation for the increased outputs to water services, ". . . in view of the essentially permissive nature of water resources in the regional growth process. . ." Thus, they felt that the evaluation of such effects should be included ". . . only if a strong and prior case can be made that shortage of water services act as a constraint on more optimal production or that a water project will bring about technological change." Like the Corps of Engineers Test Team the Cornell University Test Team felt that too many other factors were ". . . required at predetermined levels (water is usually not) to be able to ascribe reduced labor unemployment solely or partially to the effect of water development on industry growth." Thus, the test team recommended that ". . . both of the approaches, suggested by the Task Force, to measure 'national income secondary benefits' be rejected in the case where a proposed project is assumed to have impacts on labor unemployment and immobility through expansion of industries directly or indirectly using project outputs."[10] The reasons for the suggested rejection were delineated as 1) the inability to separate joint effects, 2) the permissive role of water in growth, 3) the possibility of technical substitution, and 4) the uncertainty involved in forecasting human resource immobilities.

The CU Test Team expressed similar beliefs to those expressed by the MSU Test Team regarding the credit for economic expansion. The MSU Test Team felt that some credit should be given to the water project, though they could not say how much. The MSU Test Team gave credit for only the first round of expansion. The position of the CU Test Team was that no credit should be assigned to the water project. This extreme position is justifiable only by negating the projects primary benefits, which depended largely upon the development of flood-free industrial sites. The CU Test Team position on the indirect project impacts indicates that the test team did not believe that the primary project benefits from site creation would materialize.

The CU Test Team felt that indirect impacts upon the region from recreation development were a distinct possibility. Thus, their approach in dealing with recreation impacts was different from that dealing with flood control. It was felt that a multiplier analysis of recreation expenditures could be carried out, since recreation development was likely to occur. However, these impacts should be limited to the regional account.

It was suggested that secondary (multiplier) benefits of a project only be included in the national income effects account for the impact on long run unemployed labor put to work by the expenditure of funds for construction, operation and maintenance. No other effects should be included, because of the uncertainty involved in predicting long range resource immobilities and the expansionary effects of project outputs on other sectors. Furthermore, in calculating the multiplier effects of the project expenditures, care should be taken to determine the origin of the resources employed. Even though unemployment rates might be high in the project region, the expansionary effect would not constitute real net benefits if workers were drawn from other employment in other regions.

The test team felt that the relevant measure of secondary benefits was the growth in per capita income rather than gross regional income or product. Thus, "extensive" growth would not constitute a real secondary benefit to the region. However, since one could easily estimate the per capita measure from the total, it was suggested that gross income estimating procedures were permissable as means of getting at the secondary benefit estimates.

The position of the CU Test Team regarding intensive growth as the measure of regional development is similar to the position taken in the present study. The Rent Model is an attempt to operationalize the concept of intensive growth through its emphasis upon changes in income to previously employed laborers. Similar positions were taken by the MSU Test Team and the University of Wisconsin (UWMH) Test Team.

Like many of the other test teams, the Cornell University Test Team appeared a bit contradictory in their efforts to separate the national efficiency benefits, the national secondary benefits, and the regional secondary benefits. Part of the confusion perhaps was caused by their attempt to consider secondary benefits only in the regional income account -- as they interpreted the Task Force Report to suggest -- while they believed that under certain conditions net national secondary benefits could occur as well. Additionally, the attempt to categorize the project effects into "national efficiency" accounts and "regional income" accounts rather than primary and secondary benefits also seemed to add to the confusion. In large part, this latter confusion appeared to stem from the failure to distinguish adequately between regional income changes due to inter-regional pecuniary effects and those due to net national secondary changes in output which were localized in the region. The same difficulty was had by other test teams.

The test team was skeptical of the analysis of secondary benefits at the national level due to under-employment. They felt that under-employment was a very poorly defined concept and that there was ". . . no resource that cannot be put to some 'higher use' given effective demand." Thus, they recommended that only employment benefits for unemployed labor be included in the "national efficiency account." It was considered permissable to include the evaluation of benefits from under-employed labor in the regional income account, however, since presumably one should include pecuniary effects as well in that account.[11]

Again, the CU Test Team position is somewhat extreme regarding benefits to "under-employed" labor. It is possible for laborers to achieve "higher" employment without the changes being purely pecuniary. The conditions under which such might be the case are perhaps also extreme, but they nevertheless exist. For example, it is quite possible that increased availability of a water service might markedly increase the marginal physical product of labor, particularly if the two were complementary inputs. In the case of irrigation water provision, there is good reason to expect such complementarity. In the extreme case, if labor were perfectly inelastic in supply and the product being produced were perfectly elastic in demand, much of the increase in value produced would redound to labor in the form of "rent." The price of the product would not change. Purchases of other goods need not decline, since the income generated would be sufficient to purchase the increased output. Pecuniary ramifications could be minimized by invoking monetary policy to increase the nominal money supply equivalent to the change in output.

The CU Test Team position regarding changes in wages to labor failed to consider both parameters of the derived demand for labor. The CU Test Team dealt only with the Keynesian induced demand effects upon the demand for products, which tend to be largely pecuniary in nature. The demand for a factor of production depends also upon its physical productivity, however, and resource demand changes which occur through changes in physical productivity need not be wholly pecuniary.

The test team was very cognizant of the secondary benefit limitations posed by supply inelasticities, especially that relating to the supply of labor. In essence, labor was treated as the critical factor in the aggregate production function. The assumption made by the test team regarding the aggregate supply function (via the labor supply function) were made explicit throughout the analysis of secondary benefits. Moreover, an attempt was made to adjust the secondary employment effects for the probability that not all of the increased labor income would accrue to previously unemployed laborers. The estimates of the multiplier effects of recreation expenditures, for example, were cut in half to reflect this belief.

By interpreting the instructions from the Task Force in such a manner as to limit the consideration of secondary benefits to the regional viewpoint, the test team, unlike the MSU Test Team, circumvented the necessity of overtly specifying (or implicitly assuming) the fiscal conditions under which their analysis would be relevant. Except for the fact that a small portion of the tax-financed cost of the project would have come from the area, it would make little difference from the regional viewpoint how the project was financed. From the national viewpoint, however, it would make a difference; and the acceptance of the Task Force instructions constituted an implicit acceptance of the assumptions which underlay them. By evaluating only the secondary impacts accruing to the project region they implied that either 1) the costs to other regions and the nation as a whole were irrelevant either because they were presumably small or because great value was placed upon the stimulation of secondary benefits in the project region, or 2) it was assumed that there were no secondary impacts (either positive or negative) upon other regions and that the project financing did not cause other employment opportunities to contract. The test team did ameliorate this implied position somewhat by suggesting that the regional account should also show the effects upon other regions.

In suggesting the exclusion from regional secondary benefit calculation of those laborers who came from outside of the region, the test team by implication assumed that either 1) the laborers were earning equivalent wages before migrating, or 2) the process of regional population growth had an equivalent welfare decreasing effect upon the previous residents of the region. In a perfectly competitive setting (and ignoring the spatial aspects) the former would be logically acceptable; however, if sufficient market imperfections existed to cause unemployment (or underemployment) in the region, it is possible that the adjustments through migration were non-marginal to the laborers involved. In the case of the latter, the test team might have harbored such a belief, though in no place in their report did they make it explicit.

In summary, the CU Test Team accepted a fairly restrictive definition of secondary benefits. Only the multiplier impacts were considered "indirect." Their consideration was limited to the regional account. Moreover, project effects upon resource productivity were considered to belong in the "national efficiency account." The multiplier effects of project construction expenditures were considered to contribute to regional secondary benefits. Secondary effects from project outputs were considered to be too uncertain and/or not sufficiently causally-linked to the project to justify their inclusion as regional or national benefits, even in the presence of unemployment. Thus, all stemming-from benefits were excluded from the analysis, and much of the induced-by effects were omitted (the exception being those induced by project construction). Changes in the employment of labor which lead to higher regional per capita income were seen as the relevant measure of secondary benefits. Direct effects upon enemployed labor were seen as belonging in the national efficiency account, while indirect effects upon unemployment were seen as belonging in the regional (secondary) income account.

Poteau Watershed Project

The Poteau Watershed Project was constructed by the Soil Conservation Service of the United States Department of Agriculture. The basic work plan provided for (a) land treatment measures to reduce flooding, sedimentation, and erosion, (b) 17 floodwater retardation structures (c) one multi-purpose structure for flood control and water supply, (d) 10 miles of channel improvement. The area to be effected by the project consisted of Scott County, Arkansas, and Le Flore County, Oklahoma. The project area was classified as economically depressed and qualified for the consideration of redevelopment benefits.

The most certain of the anticipated redevelopment effects of the project were to come from the employment effects generated by the increased output of a poultry processing plant. The increased output was to be made possible by the provision of additional water supply by the project. Additional income and employment effects were to come from increased expenditures for recreation in the area by thoseliving outside of the area.

The original evaluation of the project by the Soil Conservation Service (SCS) included, in essence, two categories of secondary benefits. First, their consideration of redevelopment benefits in the form of increased wages and salaries to those previously unemployed workers who would be employed as a result of construction and operation and maintenance of the project constituted one form of secondary benefit. Also, the increased employment due to the industrial water supply effects were placed in the same category. Secondly, the SCS increased their primary benefits by 10 per cent and described the addition as "secondary effects" of the project. The 10 per cent adjustment could be called a "multiplier" effect. Multipliers are normally applied to some exogenous change in income or employment, or whatever is being evaluated. Unless all of the primary benefits come in the form of exogenous changes in income, the effective multiplier used by the SCS is not 1.10, though there is implicit in the procedure used some subscription to the multiplier concept.

Corps of Engineers Test Team

A test team made up of staff members from the Southwestern Division and the Tulsa District Offices of the Corps of Engineers (CEP Test Team) comprised one of the units which tested the proposed new evaluation procedures upon the Poteau Watershed Project. The CEP Test Team did not attempt a primary research effort to evaluate the secondary impacts of the project. However, they did present some very definite ideas about how such evaluation should be done.[12]

The CEP Test Team agreed in principle to the inclusion of the entire wages and salaries of the workers employed by the processing plant as project benefits. However, the team felt that the inclusion of the direct change in wages alone was incomplete: The multiplier effects of those changes should also be included. In addition, the team felt that the proper measure of the recreation benefits of the project was the change in area income directly and indirectly stimulated by expenditures for recreation. The multiplier effects of the increased poultry plant employment were called "redevelopment benefits." The economic effects of the recreation expenditures, it appeared, were intended to represent the principal quantitative measure of the recreation benefits.

The term "secondary benefits" was used only in referring to the multiplier effects. The employment effects, such as those felt by the poultry processing employees, were included in the primary benefit account. The secondary benefits were computed as the multiplier effects of these and other primary benefits. Secondary benefits were computed for both the National Income Account and the Regional Income Account. The argument for including them in the National Account was two-fold. First, there was the existence of unemployed and under-employed labor in the project area. Thus, it was argued, resources put to use in the area represented real gains to the nation as a whole. Second, the argument was made that ". . . the decision to develop one region of the country at the expense of another contains inherent equity and regional considerations, in terms of both income distribution and population dispersal, which offset the opportunities foregone" (in other regions).[13] The first of these reasons would appear to be more amenable to economic analysis than the second.

The team was cognizant of the part played by aggregate supply in determining the real income multiplier effects. They discussed the existence of unemployment in the area and the effect this unemployment would have upon the net national income effects of industrial expansion in the area. Moreover, they felt that increases in per capita income, "after allowance for inflation," was the proper measure of progress. Thus, they recognized both the problem of aggregate supply elasticity and that of "intensive" regional growth. That is, they viewed the income issue as one of not merely increasing the gross product of the region by job and worker migration, but of increasing the real incomes of those already residing in the area. In so far as there were unemployed and under-employed workers in the area, it was possible to increase area incomes without causing a decline in incomes in another area.

The team felt that an income multiplier, "based on the marginal propensity to consume," should be derived for the area. The team was unable to derive such a multiplier in the time allotted for the test, it was pointed out. However, the team was confident that a reasonably accurate multiplier could be developed from secondary data. The use of an input-output study was mentioned, but it was considered to be too expensive. For purposes of illustration, a multiplier of 1.65 was accepted for the test. The multiplier was drawn from a recent economic base study done by the Department of Labor which indicated that ". . . providing 100 jobs in manufacturing would create 65 additional jobs in other segments of the economy."[14] This multiplier was applied to the income changes occasioned by the expansion of the poultry processing plant. However, some inconsistency in their approach resulted from its use, since the economic base multiplier is an extensive growth multiplier, while the team felt that real growth resulted only from intensive changes in income.

The team felt that multiplier should be estimated for all project areas. They mentioned some possible means by which these estimates might be made: "An input-output study, a study of published data, a historic study of completed projects, field work, or any combination which will produce the most reliable result." "Historic study" apparently refers to the comparative projection technique. The team apparently believed that each of these approaches would yield comparable multipliers.

The team considered both unemployment and underemployment to be problems in the Poteau project area. Thus, they believed that the multiplier effects of increases in the level of regional aggregate demand would be beneficial to the area. However, in discussing the evaluation of the multiplier impacts, the team made no distinction between the evaluation of the impacts upon the two groups. The opportunity costs in both cases were assumed to be zero.

As was pointed out in preceding sections, only in very limited circumstances would the alternatives be valued at zero even for those totally unemployed. Certainly, in the case of the under-employed one should not value the alternative at zero.

The team included the increased profits from the poultry processing operation in the evaluation of project benefits. They did not describe them as "secondary" benefits, however. It was their belief that the profits constituted primary benefits of the project. In evaluating the secondary project effects, these profits were not treated in the same manner as were the wages and salaries, however. The multiplier was not applied to the increased profits. Consistency would dictate that wages, salaries, and profits be treated alike in this instance: Ostensibly, all are exogenous increases in area income, and the second round effects of the expenditure of that income should be similar. However, if the persons to whom the profits accrued were not area residents, the exclusion of the secondary effects of the profits from the regional account would be appropriate. If unemployment existed in the area in which the profits would finally be re-spent, then the secondary effects would accrue in the national account, though not in the regional account.

In summary, the team was cognizant of the role played by unemployed labor and resultant supply elasticities in determining the extent of real changes in national income caused by regional changes in aggregate demand. Furthermore, the team viewed changes in regional employment which drew labor from outside the area as having possible deleterious effects upon other regions. They believed that net secondary benefits could occur nationally as well as locally, however, if unemployment existed in the project area. It was the viewpoint of the team that regional income considerations should prevail, since the Water Resource Council had allegedly made population re-dispersion an overt objective of the water resources program. Thus, secondary income effects at the local level should be the factor evaluated. This, in effect, constituted an implicit assumption that the marginal utility of income in the project region was greater than that of the nation as a whole.

Soil Conservation Service Test Team

The Soil Conservation Service Test Team (SCSP Test Team) and the other teams which tested the proposed procedures on the Poteau Watershed Project had some advantages over the other teams involved in the testing in dealing with the "expansionary" effects of the project. The poultry processing plant which was a major direct beneficiary of project water had already begun to receive the increased water supply and had expanded operations as a result. Thus, "The Test Team found the data available exceeded that which would normally be available. For example, there was an existing industry having unused capacity within the project and it was obvious that lack of water was the bottleneck for expansion. In addition data was available for effects after the bottleneck was eliminated."[15] As a result of these factors, the SCSP Test Team was able to estimate, with an unusual amount of certainty, the effects of the project upon employment via the elimination of a production bottleneck.

The case of a food processing plant provides an excellent example of the bottleneck thesis as it relates to the water resource program. In the processing of most foods, water is a strategic factor of production. Its presence or absence strongly influences the location of food processing plants, and its degree of abundance limits the extent to which those plants can expand. This industry is somewhat unusual in its degree of dependence upon water. The "bottleneck clause" in the Task Force Report is most strongly supported by the food processing example.

The case of the poultry processing plant fits the bottleneck thesis so well that both the original evaluation of the Poteau Watershed Project and the SCSP Test Team Report considered the expansionary effects upon the wages, salaries and profits from the poultry processing plant as primary (direct) project benefits. These effects were classified as "redevelopment benefits" and were grouped with the wages paid to otherwise-unemployed individuals who were employed as a result of construction, operation and maintenance of the project. This group of benefits, in essence, was composed of the "first round effects" of the project upon local unemployed.

The second and later round effects of the project upon exogenous demand were classified as secondary benefits and were treated separately from the "redevelopment benefits." The secondary benefits consisted of the multiplier effects of the increases in exogenous income to the region resulting directly from the project. The exogenous changes were expected to come from 1) per diem expenditures in the region by project construction workers whose primary residence was outside of the region, 2) expenditures by visitors from outside of the region in using the recreation facilities provided by the project and, 3) the increased income realized from the change in wages and salaries from the poultry processing operation. The increased profits from the poultry processing plant were included in the national account but not in the regional account, since the owners of the plant resided outside of the region.

In evaluating the "expansion benefits" from the above-described exogenous changes in regional demand, the SCS Team selected a multiplier which was based on data prepared by Clinton Russell, Agricultural Economist, SCS, Little Rock, Arkansas. The multiplier had a value of 3.85, which the SCSP Test Team concluded "it appeared that for this portion of Arkansas, the multiplier should be . . ." However, since "a leakage of 80 per cent was considered realistic for this region," the multiplier used in the regional account was lowered to 1.57. The full value of 3.85 was considered to be the relevant multiplier for evaluating changes in the national account, since ". . . the leakage would have a stimulating effect nationally." However, "in the absence of knowledge concerning the gains that could have been made had project resources been used elsewhere," the test team could not make a realistic appraisal of the effect.[16]

The "redevelopment benefits" of the project were estimated to have the potential effect of employing all idle labor in the region. The SCSP Test Team recognized that no "slack" existed which would allow the multiplier to create net national gains in the region. Thus, the multiplier effects were de facto restricted to the regional account, though "expansion benefits" were displayed in brackets in the national account without being included in the benefit-cost ratio.

In evaluating the employment effects of the project, the SCS Team assumed that the unemployment rate in the area would have declined to the national average in 20 years in the absence of the project. Thus, the "redevelopment benefits" were restricted to the first 20 years of the life of the project. There is implicit in this assumption a "belief" regarding the manner in which the inter-regional reallocation of resources occurs and a "judgement" regarding the amount of lag in the market reallocation process that society should tolerate. The SCSP Test Team apparently believed that there existed frictions (though not absolute barriers) to the inter-regional flow of resources and that in this case the frictions were such that a 20 year lag would be required for an "efficient" allocation to be achieved. The consideration of redevelopment and secondary benefits indicated that the SCSP Test Team felt that 20 years was too long, in view of the distributional and equity considerations involved. This does not mean, however, that they did not agree with Eckstein and others that price (wage) differentials are the prime movers of a market economy. There is a normative question involved which regards the trade off between maintaining incentives to better allocation of resources and re-dressing the distributive (pecuniary) effects of a market which does not re-allocate resources instantaneously and along a continuous function of alternatives, as marginalist theory depicts the process.

In evaluating the expansion benefits in the region from the wages received by those who would be employed as a result of the project, the SCSP Test Team subtracted the unemployment compensation payments from the new wages and applied the multiplier to the differential. This was done in recognition of the fact that the unemployment payments constituted exogenous income which would be lost as a result of the employment. More importantly to the present study, however, the deduction for the income foregone in this "first round transaction" constituted a step towards the same deduction for ensuing rounds.

In evaluating the expansion benefits from exogenous expenditure for recreation, the SCS Team assumed that each visitor from outside of the region would spend an average of $5.00 per day in the region. It was assumed that the profit rate on these expenditures would be about 20 percent. The multiplier was applied to the profits which accrued to the exogenous recreation expenditures.

By applying the multiplier to only the profits from the recreation expenditures, the SCS Test Team eliminated the portion of secondary effects which has been called "induced-by" effects by practitioners in the water resources field. As was pointed out in Chapter IV, there is a semantic problem involved in the nomenclature of the different multiplier effects. In the water resource field, "induced-by" effects are discussed as those increases in income which occur secondarily as a result of expenditures for inputs required to meet a specified level of production (either assuming or due to a specified level of demand for that production). However, in the Regional Science field and in Macro-economics literature, "induced" effects are discussed as those secondary income effects which result from the respending of income (in the form of wages, salaries and profits) through the household sector. In essence, there exist two practically identical names for the two separate components of the first round dollar. The water resource field's nomenclature applies to the "cost-of-production" component of the exogenous expenditure, while the Regional Science-Macro-economics nomenclature applies to the household re-spending component of incomes earned. In the report, the SCSP Test Team actually used the "household induced" component of the expenditure in applying the multiplier to the recreation expenditure.

The convention used by the SCSP Test Team in evaluating the secondary benefits from recreation warrants a return to the earlier discussion in the present study regarding what the multiplier actually is and what it should be used to multiply. In the SCSP Test Team report a multiplier was adopted which looked to the SCSP Test Team members like what the multiplier for the area "should be." There was no discussion in their report regarding the kind of multiplier which had been accepted. If the multiplier actually adopted was a Keynesian (i.e., "household induced") multiplier, then the application of that multiplier to the profit component was perhaps the proper application.

The adjustment of the multiplier for "leakages" from the region provides an additional point for discussion regarding the validity of the multiplier. In essence, "the multiplier" provides an estimate of the total volume of income over time that a given exogenous change in demand can sustain. Because of the process by which costs to one factor become returns to another factor, every dollar which is respent becomes income to someone. Thus, the limit to the multiplier is set by the leakages from the stream of respending. These leakages can occur through hoarding of income by parties to the cycle or by "exporting" part of the respending -- i.e., by importing goods and services from outside of the system. Frictions which merely delay the respending do not effect the final value of the multiplier, since the process is infinite and timeless (i.e., there is no discounting of the income stream). In essence, all of the income effects are assumed to occur instantaneously, as a result. The multiplier which the SCSP Test Team adopted and then adjusted for "leakage" must have already been adjusted for some degree of leakage; otherwise its value would have been infinite. The degree to which it had already been adjusted depends upon the <u>kind</u> of multiplier which was estimated in the first place. In reality, the leakages which occur in an economic system (regional or otherwise) are very difficult to estimate. Furthermore, the difference that "frictions" which delay responding actually make when the element of time is considered can constitute a substantial "quasi-leakage" to the stream. Thus, conventions such as excluding households from the endogenous matrix or other such methods are used to place a limit on the multiplier which is not otherwise provided in a secondary impact study. Often these adjustments offer very rough representation of the recognition that this problem exists. All of this again points up the question voiced in Chapter IV concerning exactly what it is that the multiplier shows. The Haberler argument that the multiplier represents merely a mathematical tautology is relevant to such a discussion.

The SCSP Test Team also included the evaluation of an "induced-by" component in estimating the secondary benefits of the project. In this instance, they did not use the multiplier to estimate the secondary income effects. Rather, they used ". . . percentage estimates of primary flood prevention and recreation benefits and of the effects of increased costs of producing added goods as induced by the project." They used a figure of 10 per cent to reflect the profits realized at other stages of the production process. The practice in this regard was very similar to that used by the Bureau of Reclamation in estimating "induced-by" benefits. The SCSP Test Team felt that this was an acceptable procedure under the circumstances, since "tracing out the income flows through the economy" would have been ". . . a laborious process and the study was considered too costly for a comparatively small watershed project."[17] In essence, they assumed that the "output multipliers" for the sectors affected averaged 1.10.

In summary, the SCSP Test Team enjoyed the luxury of some hindsight in their test. They tested the new procedures on a project which provided a classic case of the water service bottleneck thesis. There was substantial evidence that unemployment existed and that the effects of the project upon the unemployed was beneficial. Since, there had been "slack" in the local economy, there were opportunities for net national secondary effects which at the same time could help meet regional growth objectives.

The SCSP Test Team made some explicit and implicit judgements about how resource allocation occurs. They believed that the process would require 20 years to rectify the area's unemployment problem, and they judged that 20 years was too long to wait. They used multiplier analysis to estimate the effects of the project in speeding up this readjustment process. The multiplier used appeared to be a Keynesian "induced" multiplier, but no attempt was made to explain its form or its appropriateness. An adjustment was made in the multiplier to account for "leakages" of the effects to outside of the project area. While some adjustment of the multiplier which was accepted was perhaps indicated by its magnitude, the rule-of-thumb adjustment of an already uncertain figure regenerated earlier questions regarding the meaning and validity of such analysis.

Mountain Home Project

The Mountain Home Project of the Bureau of Reclamation is primarily an irrigation project. The key feature of the project is the reclamation of the drylands of the Mountain Home Desert, though the project includes other objectives such as electric power production, water supply, flood control, and fish and wildlife enhancement. The primary secondary impact is expected to develop from the irrigation effects, since much of the electric power generated by the project will be used for pumping irrigation water and since the lake is not expected to have a large recreation impact. Project construction cost is estimated at $153,700,000.

Corps of Engineers Test Team

The Corps of Engineers (CEMH) Test Team which tested the proposed procedures on the Mountain Home Project felt that "no particular problems were raised by the regional development benefit analysis." The team "used income as the measure of the benefits." However, they felt that "more study would be required on multiplier effects of direct expenditures for general application in project analysis."[18] The team did nevertheless include multiplier effects in their report.

The CEMH Test Team believed that only the income realized by those persons who would have been unemployed in the absence of the project should be included as net national secondary benefits. Their report stated that "if in the absence of the project, comparable employment would exist elsewhere, no labor resource utilization credit nationally is realized."[19] While not elaborating upon this statement, the team appeared to express a viewpoint often encountered in the theoretical literature, but not often expressed by Federal water resource agency personnel. The viewpoint holds that the aggregate demand multiplier effects created by the project are not net to the nation, if the funds to build the project were taxed away from other uses. Thus, the project impacts are not necessarily net national gains, ". . . since equivalent developments undoubtedly would take place elsewhere in the nation in the absence of the project."[20] "If in the absence of the project comparable employment would exist elsewhere, no labor resource utilization credit nationally is realized."[21] However, the team felt that it was impossible to determine the net employment differences caused by the project. Thus, they felt that nothing could be said with any degree of certainty regarding the net national secondary effects of the project. Nevertheless, the team did include national secondary benefits in their evaluation. They assumed that 20 per cent of those employed by the project would have been otherwise unemployed "anywhere."

The Corps Team was insightful in pointing out other "secondary benefits" than those of aggregate demand stimulation. These additional benefits consisted of more stable employment, more diversified economic base, increased investment and an expansion in job opportunities. The latter two are normally associated with secondary benefits and warrant little further discussion. The former two, however, constitute something of a departure from the general categories of consideration in secondary benefit evaluation. In fact, to a large degree they must be played off against multiplier effects in decisions regarding the proper development strategy. In general, the local economy which exhibits the greatest input-output linkages (and, hence the highest local inter-industry multipliers) also exhibits the least diversified economic base. This depends, of course, upon the kind of multiplier adopted in the analysis. However, the multipliers which allow the greatest disaggregation and have the greatest potential of accurate representation are the input-output multipliers. These clearly tend to force a trade off between diversification and multiplier potential. The CEMH Test Team did not elaborate upon this aspect of the additional group of secondary benefits, however.

The CEMH Test Team went furthest in the evaluation of regional development benefits. This was logical, however, since the team believed that "all national income benefits generally accrue to the region in which the project is located or the area of influence for which it is developed." Thus, the benefits in the regional account included all of those in the national account. In addition, the regional account included secondary project effects which exceeded those of the nation as a whole. This was true because of the convention adopted by the team whereby only 20 per cent of the employment stimulated in the region was assumed to have been otherwise unemployed "anywhere." In effect, the assumption was made that the real income multiplier in the project region was greater than that in other adversely effected areas, presumably the rest of the nation. Given the economic base of the project region, it is tenuous to assume that the local multiplier exceeded by the amount postulated the average of those for other localities in the nation.

The local income multiplier effects were based upon the direct benefits from irrigation, recreation, and fish and wildlife. The secondary benefits from irrigation were estimated using a local income multiplier developed in a research project at Washington State University on the Columbia Basin Project. The multiplier expressed a relationship between income generated "in the secondary sector (project stemming from effects)" and income generated "in the tertiary sector (project induced by effects)," and the number of acres irrigated. The team believed the multiplier transplant to be justifiable because of similarities between the two areas in terms of economic base, climate, irrigated area, population density, regional markets, and transportation facilities. However, since the elevation of the project areas was 1,500 feet greater than the Columbia Basin area, the multiplier was adjusted downward by 10 per cent. Whether or not the adjustment was appropriate is a question which could not be answered without a great deal of research. Thus, little more can be said herein than to comment that the transplant has all of the inherent problems discussed in Chapter II above, and that the amount of study required to adequately justify and adjust a proper multiplier transplant is probably not greatly different from that required to construct a local multiplier first-hand.

In estimating the secondary benefits from recreation and from fish and wildlife development, a different approach was used. The team developed a multiplier from data on expenditures by visitors from outside of the project areas of several projects. The data which were used related to average expenditures per visitor per day and the proportion of that expenditure which accrued to the project area. Total expenditures were obtained by multiplying per person expenditures by the estimated number of visitors from outside the project area expected each year.

The multiplier was developed using the generalized Keynesian form and was somewhat analogous to the simple economic base multiplier, the numerator consisting of the proportion of total expenditures by outsiders which accrue locally and the denominator consisting of one minus the proportion of total expenditures by outsiders which accrue locally. The difficulty, however, is that both the numerator and denominator are badly mis-specified. The team explicitly assumes that the propensity to consume locally out of local income is identical to the proportion of visitation expenditures spent locally. Obviously, there is no *a priori* reason to assume this to be the case, and there is no basis in theory for linking the two ratios. Actually, what has been done is to define an income flow from the recreation user to the local area and back to the recreation user in the same proportion, then back to the local area again, etc., *ad infinitum*. Neither of the above two cases is very realistic. The former would provide the more acceptable alternative, if it could be demonstrated empirically that the marginal propencity to consume locally were equal to the proportion of visitation expenditures accruing locally.

An additional point which can be made at this juncture relates to the multiplicand of the multiplier generated by the Corps Team. The expenditure proportions which are used relate to gross income to those who provide the goods and services to the visitors. Thus, notwithstanding the misspecification of ensuing rounds in the team's multiplier, the first round of local income accrual is mis-specified.

In evaluating the direct benefits, the team was very diligent in attempting to determine the real costs and returns to fixed factors which would be employed as a result of the project. The distinction between regional and national benefits forced them to effectuate certain assumptions and beliefs regarding regional and inter-regional resource mobilities. These same assumptions and beliefs then came into play as the team evaluated the secondary impacts of the project.

The CEMH Test Team felt that a reasonable return to the farm operators' labor should be included as a cost item in the farm budgets (contrary to Bureau of Reclamation practice). They believed that to do otherwise was to assume that, in the absence of the project, the farmer would have been totally unemployed. To adjust for this omission, they adjusted the net farm income downward by one half. This reflected their belief that the increased irrigation water would cause a better utilization of the farmer operators managerial ability. The productivity which would be lost was a cost of the project. However, the team included it as a cost only in accounting for the national income benefits. In the regional account the alternative cost of the farm operators, labor was not included. The differentiation between the two accounts is justifiable only under certain conditions. If the farm operator in question were employed at a lower level in some other part of the country and moved to a project farm and realized a higher income, then the team's convention was perhaps correct. (Other similar resource movements could have the same net effect). Only under such restrictive conditions would the alternative costs not be felt in the project region as well. Considering the migration pattern for the region, the direction of resource flow required to make the team's accounting correct is not the flow which one would normally predict.

Return to farm capital was treated in similar fashion to farm operator's labor. It was deducted as a production cost in the national account, while it was treated as a benefit in the regional account. The only conditions which might justify this distinction would be a zero rate of return on capital in all non-project alternatives in the region, while the rate of return in the rest of the nation was equal to the rate of return on capital invested in project farms. Such a situation is unlikely. Ordinarily one would include normal returns to capital as a benefit only when the capital was already sunk and not transferable. Then any benefits to its employment should be included in both accounts.

The treatment of farm labor income was analogous to that of farm operator's income. Fifteen per cent of farm labor income was assumed to go to unemployed farm labor and hence was treated as a benefit in the national account, while all of the wages were included in the regional account as benefits. One possible justification for this distinction would be a belief or an assumption that 85 per cent of those laborers would be mobile between regions (during the period of project effectiveness) and would migrate to the jobs which would have existed in other regions in the absence of the project. This, obviously, would constitute a "slippage" of 15 per cent in the resource adjustment process. Thus, the team seems to question the instantaneous adjustment process of micro-economic theory.

The team also evaluated the secondary income created by the production of electric power. They used multipliers which related increased output in electro-process industries to income induced in the local economy by that output. This was used in conjunction with estimates of output per kilowatt for aluminum and other electro-process industries to estimate the induced income from the electrical output of the project. The derivation of the multipliers apparently used an input-output type model. The multipliers were taken from a preliminary study done at the University of Washington.

In addition to the regional definition problems involved in determining the relevant regional multipliers in this case, there are the problems of forecasting the users of the output within that region once the region is defined. Whether or not the multipliers which were accepted adequately represent the probable pattern of secondary income accrual cannot be answered without a great deal of research. Again, the multiplier transplant derived from other areas is a problem. Perhaps of potentially equal importance, however, is the fact that the multipliers were taken from a preliminary draft of a study which was released for comment only. It is an ever-present danger of such transplantation that the adaptor does not fully know or appreciate the rule-of-thumb adjustments which went into a model, the range and conditions of applicability, and the sensitivity of the individual components to slight differences in industrial composition.

In summary, the CEMH Test Team generally held an appreciation for the aggregate supply aspects involved in income multiplication from the national viewpoint. However, they did not apply the same considerations to the analysis of regional secondary benefits. Very restrictive and often untenable assumptions were necessary to rationalize this differentiation between the two accounts. The team apparently believed that resource mobility at the national level was at least partially restricted for time periods conforming to the impact period of the project. They believed that because of the interation between project expenditures, project funding, and distributional effects of project outputs, the net secondary effects at the national level were unknowable. In estimating the regional multiplier effects, the team used transplanted multipliers quite liberally. In one case, the degree of refinement of the transplant multiplier was not yet acceptable to its developer. Additionally, several of the multipliers used dealt with gross income generated rather than net income. In all, despite the quickness herein to point out their failures, the team did a commendable job on many counts. They were at times even insightful, especially in dealing with the alternative costs of the labor and capital in the national account and in pointing out the often overlooked aspects of industrial diversification and employment stability.

University of Wisconsin Test Team

The University of Wisconsin (UWMH) Test Team report[22] dealt largely with the development of a planning-decision model for choosing among public water resource investments. An integral part of that model had to do with the secondary income effects of the project. Though these effects were not treated as extensively as in some other test team reports, some aspects of the treatment presented by the UWMH Test Team constituted significant contributions in dealing with the evaluation of secondary impacts.

Perhaps the most important contribution of the UWMH Test Team in regard to secondary benefits was their approach to inter-regional income effects of the project. Their desire to incorporate this effect into an explicit decision model led them to attempt to conceptualize an operational approach to the measurement of the project impacts both in the project region and in other regions of the country. In doing so, they divided the country into three regions:

1) The project region - i.e. the state of Idaho,
2) the contiguous region, defined as the states of Washington and Oregon, and
3) the rest of the nation.

They then attempted to evaluate the primary project impacts upon the three regions of the country.

The principal primary effect evaluated was that caused by the increased availability of irrigation water. It was assumed in the analysis that adjustments would be made by project area farmers which would increase the average size of farms (and thus the efficiency of the operation). This process would at the same time open up new farming opportunities in the project area, which would attract new farmers to the area. The result would be an increase in input purchases in the area, an increase in agricultural income, and an increase in raw materials for agricultural processing and marketing firms. All of these would have secondary effects upon other producers in the project area.

At the same time, however, as the UWMH Test Team pointed out, the new farmers necessary to take advantage of the new farming opportunities provided by the project must come from somewhere. To illustrate their suggested approach, the team arbitrarily assumed that half of the new project farmers would come from the contiguous region and that the other half would come from the rest of the nation. In their discussion, they emphasized that the provision of the new farmers was not costless to the economy and that the effects upon the economy of the region from which they would come should also be evaluated. The effects envisioned would be of the same nature as those evaluated for the project region, except the effects realized by the other regions would be negative. Thus, declines outside of the region in farm income, agricultural supply sales and agricultural processing opportunities should be evaluated for the other regions just as they were being evaluated for the project region.

The UWMH Test Team also pointed out that those people who would be attracted to project farm land from within the region should not be considered as costless resources either. The team felt that deductions from new farm income should be made to reflect the income given up in other employment by these new farmers. In the case of both these farmers and those attracted from outside of the region, the principle was presented that the alternative cost of the new income should be considered in appraising the net changes in income.

While the UWMH Test Team Report made some very valuable contributions on other accounts, their most important contribution to secondary benefit evaluation lay in their insistence upon the inclusion of the opportunity cost of the expansion effects. They discussed these opportunity costs in two contexts: 1) The regional economic costs in the form of income foregone in other regions, and 2) the personal economic costs in the form of the income foregone in other employment (in some cases in another region).

In evaluating the expansion effects of the project, the UWMH Test Team traced through only the first round of expenditures using a very aggregated industrial classification scheme (the team's approach was similar in many ways to the Rent Model). The degree of aggregation accepted was seemingly an item of convenience, since - as the team pointed out - they were interested only in demonstrating the principles involved. The reasons for which the team limited the expansion effects to one round were not apparent in their report. However, members of the team, in personal conversation with the author, indicated that they did not believe that full credit for all ensuing expansions should be credited to the project. Thus, since direct credit for the effects became increasingly difficult to assign, they chose to make the arbitrary cut-off after one round, feeling that to be the most defensible course of action.

In estimating the secondary expansions in income, the UWMH Test Team used an input-output type format in allocating the change in farm income to respending in other sectors. It was assumed that net farm income changes would be re-spent in fixed proportions. By the same token, it was assumed that farm production expenses would exhibit the same sort of linearity and proportionality as output expanded. On the basis of these assumptions, the increase in farm receipts was allocated among other sectors.

Though the UWMH Test Team emphasized the desirability of including in the analysis of secondary effects the opportunity costs of the factors used in the project region, no systematic attempt was made to include those considerations in the analysis. A bid was made by the team for the provision of information regarding the present occupation and earnings of workers attracted by the project, as well as information regarding their previous residence. Additionally, the team emphasized that information on the nature and magnitude of expected new jobs in associated industries would be helpful.

In summary, the UWMH Test Team made substantial conceptual contributions to the evaluation of secondary benefits. Their emphasis of the inter-regional dimension and of the alternative cost dimension were two of the most important contributions. However, the team itself failed to adequately demonstrate in their appraisal example how the inclusion of the latter might be achieved.

Effects of Differing Approaches on Secondary Benefit Estimates

In the above sections of this chapter, the differences in beliefs, assumptions and outlooks of different analysts were discussed. The different concepts and approaches of the different analysts were outlined. In the section which follows, the effects of these differences in concept and approach upon the magnitude of the resulting secondary benefit estimates will be discussed. The discussion must of necessity deal with the aggregate effects of differing approaches, since it is impossible to separate out the effect of each differing assumption.

For purposes of comparison, the Rent Model was applied to each of the projects discussed above. The results of these applications are presented in Appendix Tables 1-22. There are many problems with the manner in which the model was applied. The primary benefits to which the model was applied were those discussed by the respective test teams. These benefits had to be accepted at face value. Additionally, because of limitations of time and research funds, secondary sources had to be relied upon. Because of the small size of the employment base of some of the regions, differing degrees and kinds of aggregation had to be resorted to due to disclosure problems in the secondary data sources. The application of the model to the other projects was largely mechanical. In this respect, it is probably not vastly different from many of the other analyses, nor from the application one might expect to occur too often in agency practice. Thus, while the author is reticent to vigorously defend the numbers generated, the numbers serve a heuristic function in the following comparison of the numerical results yielded by the several analyses.

The effects of differences in analytical approaches upon the resulting secondary benefit estimates are reflected in a striking manner in Table 6. In the case of all four projects, the range of estimates between the lowest and the highest benefit estimates can be measured in multiples of the lowest estimate. For example, the Regional Secondary Benefits from the Trenton Channel Project which were estimated by the Corps of Engineers Test Team are approximately eighty times larger than those estimated in the other two analyses of the same project. The pattern is the same for each of the other projects. In all cases, the range of estimates is substantial. In most cases, the Rent Model gives the lowest secondary benefit estimate. It might be noted that the Corps of Engineers Test Team which reappraised the Trenton Channel Project presented both the highest and lowest secondary benefit estimates among the twelve appraisals: $135,000,000 in Regional Secondary Benefits and zero in National Secondary Benefits. This striking dichotemy largely resulted from two factors: 1) The test team's inclusion of gross income as regional benefits, coupled with the acceptance of very large regional income multipliers, and 2) the test team's belief that no net national benefits would result in the absence of local unemployed labor (i.e., migrants who came in to take the newly-created jobs earned no wage rents; all local secondary benefits were income transfers from other regions.) The Corps of Engineers test team appraisal of the Trenton Channel Project showed a National Secondary Benefit estimate of zero. Similar patterns emerge in the appraisals of the other three projects, the exception being the case of the Stonewall Jackson Project appraisal. The Corps of Engineers Test Team which appraised the Stonewall Jackson Project estimated that Regional Secondary benefits would be approximately ten times as great as those accruing to the project region. The Cornell University Test Team in its appraisal of the same project also estimated that Regional Secondary Benefits would be approximately ten times as great as those accruing locally. However, the actual magnitude of the two sets of estimates differed greatly. The very large difference in the estimates arrived at by these two test teams can be basically traced to the following factors:

The Corps of Engineers Test Team included the provision of flood-free industrial sites as secondary benefits; the potential income from the full development of these sites provided the measure of the secondary benefits; it was implicitly assumed that the provision of flood-free sites was sufficient to cause plants to locate in the area, and all of the credit for such location was given to the project. The Cornell University Test Team, on the other hand, did not believe that the provision of water supply nor flood-free sites were sufficient to induce plant location. Furthermore, the test team felt that so many other factors were involved that it would be erroneous to give the credit to the water project. Thus, no secondary benefits from plant location were assigned to the project by the Cornell University Team. However, the Cornell University Test Team did credit the project with indirect benefits from recreation development.

The lowest relative variance occurred in the appraisal of the secondary benefits of the Poteau Project, which was the smallest and perhaps simplest to appraise of the four projects. Still, the highest estimate of the Regional Secondary Benefits was almost eight times as great as the lowest estimate and four times as great as the other estimate. Much of the difference between the two higher estimates was explained by the difference in the size of the income multipliers applied by the two teams. The difference between the two multipliers related largely to differing assumptions (beliefs) regarding the magnitude of "leakages" from the multiplier. Both test teams considered the opportunity cost of the effected factors to be zero.

The Mountain Home Project ranked third in terms of the magnitude of the variance of the secondary benefit estimates. Nevertheless, the highest Regional Secondary Benefit estimate was approximately thirty-five times larger than the lowest estimate and twelve times larger than the other estimate. The difference in estimates between the three appraisals was in part due to the differences in the number of rounds of expansion included in the analysis. The Corps of Engineers Test Team used an infinite-rounds multiplier, while the other two appraisals included only the first round of expansion. Additionally, the Corps of Engineers Test Team assumed the opportunity cost of local labor to be zero, while the other two appraisals did not.

It is interesting to note that the two test teams which voiced the greatest skepticism regarding the appraisal of secondary benefits provided the highest estimates of secondary benefits among the twelve appraisals. The Corps of Engineers Team which appraised the Trenton Channel Project was particularly skeptical of the possibility of net national secondary benefits and demonstrated its skepticism by assigning no secondary benefits to the National Account. However, the team's Regional Secondary Benefit estimate was the highest among the twelve appraisals. The second highest estimate was made by the Corps of Engineers Test Team which appraised the Stonewall Jackson Project. However, in the Stonewall Jackson Project appraisal, national (i.e., net) secondary benefits of $7,080,000 were included in the National Account by the Corps of Engineers Test Team.

Secondary Benefits Compared to Primary Benefits

In the immediately preceding section, a striking variance between secondary benefit estimates of the different test teams was observed, with the differences generally being measurable in multiples of the lowest estimate. In Table 7, the primary benefit estimates are juxtaposed with the secondary benefit estimates of the eight test teams. It might be observed that, while the highest primary benefit estimate for each project is not routinely a large multiple of the lowest as in the case of the secondary benefit estimates, there is nevertheless substantial difference between the primary benefit estimates. The largest difference occurs in the appraisal of the Mountain Home Project, in which case the Corps of Engineers Test Team's estimate of the primary project benefits is many times larger than the estimate accepted by the University of Wisconsin Test Team, in both the Regional and National accounts.

In both the Stonewall Jackson Project appraisals and the Poteau Project appraisals, the higher estimate of National Primary Benefits is more than 150 per cent of the

TABLE 7

Primary and Secondary Benefit Estimates from Eight Appraisals: Regional and National Accounts

	Regional Account		National Account	
	Primary Benefits	Secondary Benefits	Primary Benefits	Secondary Benefits
Trenton Channel Project				
MSU Test Team	2,623,000	1,719,000	2,623,000	0
Corps of Engineers Test Team	2,755,000	135,000,000	2,755,000	0
Mountain Home Project				
Univ. of Wis. Test Team	232,000	1,415,000	200,000	2,453,000
Corps of Engineers Test Team	13,496,000	16,649,000	10,075,000	2,972,000
Stonewall Jackson Project				
Cornell Univ. Test Team	1,436,000	55,000	1,436,000	137,000
Corps of Engineers Test Team	1,967,000	70,600,000	2,702,000	7,080,000
Poteau Project				
Corps of Engineers Test Team	1,911,000	1,584,000	790,000	368,000
Soil Conservation Test Team	504,000	395,000	504,000	614,000

estimate. The MSU Test Team did not address itself to an estimate of gross direct benefits but used the original Corps of Engineers estimate in its tabular presentations. (The Michigan State University Test Team differed with the Corps of Engineers Test Team in their treatment of the costs of the dock and the dredging of berthing areas by the steel company, however.)[23] A similar pattern of variance is observable in the analyses of the Regional Primary Benefits. While the variance in the primary benefit estimates is not so great as that in the secondary benefit estimates, it would appear to be sufficient to give credence to the statement by the Michigan State University Test Team that "The biggest problem in water project evaluation is estimation of the value of the water product or service."[24] The Cornell University Test Team reflected similar beliefs in its discussion of benefits from the creation of flood-free sites. There is apparently much room for disagreement (and for improvement) in the appraisal of primary benefits. In comparing the primary benefit estimates to the respective secondary benefit estimates, one finds that one-half of the appraisals the Regional Primary Benefit estimates exceed the respective Regional Secondary Benefit estimates. The same proportion applies to the estimated National benefits. However, the appraisals in which the Regional Primary Benefits exceeded the Regional Secondary Benefits are not the same appraisals as the four in which National Primary Benefits were larger than the National Secondary Benefits.

Again, the Corps of Engineers appraisal of the Trenton Channel Project is the most striking, in that the Regional Secondary Benefits greatly exceed the Regional Primary Benefits, while in the National Account the test team estimated that no secondary benefits would be realized. The Michigan State University Test Team, on the other hand, estimated National Secondary Benefits which exceeded their estimate of National Primary Benefits, while the relationship was the reverse in that test team's Regional Account. Again, a similar pattern prevailed in the other three sets of appraisals. In all cases but two in each account, the Secondary Benefit estimates constituted a substantial proportion of the total benefits estimated.

Regional Versus National Input-Output Coefficients

A further test of the Rent Model was made by comparing the results obtained using national input-output coefficients and applying localization ratios with those obtained using local input-output coefficients. Since no regional input-output models were known to exist for any of the test project areas, the comparison was applied to a hypothetical project in a region for which a regional input-output model did exist. The region selected was the Charleston, South Carolina, metropolitan area. The input-output model used was developed by Laurent and Hite.[25] The Poteau Project was used as the hypothetical case, and the Rent Model was applied to the increased sales of processed poultry. Appendix Tables 23 and 24 indicate the results obtained from the two approaches. The "regionalized" version of the Rent Model using the Charleston input-output coefficients yielded an estimate of induced-by wage gains of $69,510. The application of the Rent Model using national input-output coefficients yielded an estimate of induced-by wage gains of $168,591. As in the case of the differing approaches used by different analysts discussed above, the results of the two applications differed substantially. Not only was the overall difference substantial, the differences between estimates for particular industries were also quite large. Part of the difference was due to differing technical coefficients between the Charleston firms and the average for the nation. However, a larger part was due to the failure of the localization ratios to adequately determine the portion of the induced-by sales which would occur locally. The combination of errors due to differing technical requirements and those due to inadequacies in the localization ratios can lead to great divergence.

The application of the national model is probably most subject to question when projects in small economic areas are being analyzed. Projects such as the Mountain Home Project and the Poteau Project would not appear to be good candidates for the national model. The Trenton Channel Project, and the other hand, would not appear to be an unreasonable application, since the national technical coefficients are probably most closely represented by those in such large metropolitan areas as Detroit. The localization ratios are still subject to question even in such areas as Detroit, however,

Summary

The effects of differing assumptions and approaches by the different analysts upon the relative magnitude of the secondary benefits estimated were substantial. The difference between the highest and the lowest estimate for each project could be measured in multiples of the lowest. Additionally, substantial differences were detected in the estimates of primary benefits, though the discrepancies were not as great as in the case of the secondary benefit estimates. There was little conformity in the relative magnitudes of the primary and secondary benefit estimates between the two accounts by the eight test teams.

The results of the application of the Rent Model based on regional versus national input-output coefficients were similar to those summarized above. The indirect income estimate using the national model was over twice as large as that obtained from the regional model.

Footnotes

1. Schmid and Ward, op cit, 23.

2. Ibid., 15.

3. U. S. Army Corps of Engineers, A Special Study of the Detroit River, Trenton Channel Project (Detroit: March 1970).

4. Ibid., 17.

5. U. S. Army Corps of Engineers, A Special Study of the Stonewall Jackson Lake, West Fork River and Tributaries, West Virginia (Pittsburgh: March 1970).

6. Ibid., p. 15-18.

7. Schneider, op cit.

8. U. S. Army Corps of Engineers, loc cit, 20.

9. Ibid., 23-25.

10. Ibid.

11. Ibid.

12. U. S. Army Corps of Engineers, A Special Study of the Poteau River Watershed Project (Tulsa: March 1970).

13. Ibid., 22.

14. Ibid., 13.

15. U. S. Department of Agriculture Soil Conservation Service, Report of Testing Special Task Force Evaluation Procedures, Water Resource Council, for Poteau River Watershed, Scott County, Arkansas and Le Flore County, Oklahoma, (December 1969), 25.

16. Ibid., 17.

17. Ibid., 10.

18. U. S. Army Corps of Engineers, A Special Study of the Mountain Home Division, Southwest Idaho Water Development Project, (Boise: March 1970), 2.

19. Ibid., 16.

20. Ibid., 32-33.

21. Ibid., 16.

22. Daniel W. Bromley, et al., Procedures for Evaluation of Water and Related Land Resource Projects: An Analysis of the Water Resource Council's Task Force Report (Madison: April 1, 1970).

23. Schmid and Ward, op cit, 8.

24. Ibid., 1.

25. Eugene A. Laurent and James C. Hite, Economic-Ecologic Analysis in the Charleston Metropolitan Area: An Input-Output Study (Clemson: 1971).

CHAPTER VII

SUMMARY AND CONCLUSIONS

Review of the Study Objectives

This study began with the overall objective of rationalizing the difficulties which might emerge with the addition of secondary benefit concepts to the appraisal of Federal water projects. This was pursued by attempting to fulfill the following set of objectives:

1. Surveying, evaluating, and synthesizing of the current theory and concepts regarding secondary benefits;
2. Identifying the elements in objective one which could be forged into a generally applicable model which
   a) can be applied to all or most Federal water projects,
   b) uses generally available secondary data,
   c) makes explicit the assumption and conditions under which it is operable;
3. Demonstrating and testing the model by applying it to four test case projects;
4. Comparing the test results of the model with the results obtained by other test teams and

identifying the reasons for differing test results from the several analyses;

5. Evaluating the applicability of the model and appraising the current status and applicability of secondary benefit concepts.

Objective number one was met in Chapter II, in which three general categories of secondary benefits were identified: 1) The customary multiplier variety, 2) economies of scale and externalities, and 3) dynamic secondary benefits. It was concluded that only the first, the customary multiplier variety, was currently amenable to generalized estimation.

Objective two was met in Chapters III, IV and V. The relationships between net changes in factor payments and economic rent theory and their applicability to multiplier analysis were discussed in Chapters III and IV; and a model through which economic rent and multiplier concepts could be applied to the estimation of the customary multiplier variety of secondary benefits was presented in Chapter V.

Objectives three and four were met in Chapters V and VI in which the model was first demonstrated by applying it to the Trenton Channel Project and then compared to other approaches by applying it to four other projects which had been appraised by other analysts. In Chapter VI, it was found that the model generally provided lower estimates of multiplier benefits than did the approaches with which its results were compared. The higher estimates yielded by the other approaches were in most instances largely due to their evaluating factor opportunity costs at zero and assigning the credit for infinite rounds of income expansion to the water project. Other differences in assumptions and basic approaches which were suspected of creating a differential in estimated benefits between analysts were identified in Chapter VI as well. Some of the major differences revolved around different assumptions regarding inter-regional income leakages and different assumptions regarding the effect on industrial location of providing water project-related goods and services. It was found that large differences in secondary benefit estimates occurred between different analysts appraising the same project. The differences were often measurable in multiples of the lowest estimate. Large differences in primary benefit estimates were also found, though they were not of the magnitude observed among the secondary benefit estimates.

The Estimation of Secondary Benefits

The Rent Model

A major goal of this study, as expressed in objective two, was to develop a secondary benefit model which was generally applicable to water project appraisal and which would not necessitate primary data collection for its implementation. The study was only partially successful in that regard. It is the author's belief that the conceptual basis of the model is correct - i.e., that economic rent concepts should form the groundwork for the appraisal of the customary multiplier variety of secondary benefits. However, there are many weaknesses in the model. One of the most important of these is its failure to specify the location and magnitude of the contractions in the adversely affected areas and sectors. The assumptions regarding the Services industry and "marginal firms" only serve as stop-gap remedies to this problem. It is possible (perhaps remotely) that the results of these assumptions adequately represent reality. However, this is an empirical question which can not be satisfactorily answered inductively. Unfortunately, the research necessary to locate and measure these contractions would be at least as extensive as that involved in constructing the input-output model. The myriad of supply and demand relationships involved would appear to require a general equilibrium-type model to trace them. The closest the economics profession has come to such a model is the inter-regional input-output model, which is linearly homogeneous in all sectors, with constant factor-factor ratios. It does not allow for factor substitution, which would be implied by the contraction of some sectors simultaneous to the expansion of others.

A second shortcoming of the model in its present form relates to the localization of economic activity. It is not sufficient to simply assume that output increases will be located according to the current location of capacity, especially at projected output levels which approach or surpass current capacity. The analyst's knowledge of the local economy can be utilized to supplement the model when there is locally available excess capacity. This would perhaps be a workable alternative in regional economies which were fairly simple in structure and in which the project analyst had worked for several years. Where local excess capacity did not exist, however, specific studies would be needed to determine where new capacity would locate. The local analyst would not generally be able to do such studies.

The failure of the study to locate secondary sources from which the opportunity cost of labor could be evaluated dealt a serious blow to the attempt to implement the economic rent concept. The convention of using Service sector wages was at best on arbitrary proxy with little inductive basis. Thus, establishing the relevant opportunity costs is again an empirical question which would necessitate a major primary research effort or, more realistically, a change in the local system of reporting unemployment.

The attempt in Chapter V to identify the major assumptions of the model was instructive (at least to the author) in pointing up the myriad of assumptions involved in implementing such a model. Many more underlying assumptions, and beliefs doubtlessly went unspecified. Some assumptions, or exogenous specifications, are necessary to "identify" any model. These "identifying assumptions" alone are often sufficient to pre-specify the outcome of the analysis. The additional assumptions necessitated by the lack of secondary data described above make the results obtained from the model even more tenuous. Similar skepticism would appear to be warranted for the other approaches to estimating secondary benefits which were discussed in Chapter VI. The widely divergent results yielded by the different analyses gave an indication of the effects of differences in the large matrix of possible assumptions and beliefs between analysts. While some of these differences were noted in the discussion in Chapter VI, it would be impossible to identify all of the differences, since many of the basic ones are epistemological in nature. Thus, even in the presence of a "general model" such as the Rent Model, differences between analysts would persist.

Recommendations for Further Study

The results of the comparisons made in Chapters V and VI indicate that there are major deficiencies in the Rent Model in its present form. The results of the Rent Model and of the indirect benefit estimates of the other analysts were widely divergent. Much divergence was due to the differing assumptions underlying the analyses. However, an unknown quantity of divergence was doubtless attributable to the shear randomness associated with "estimating" indirect income changes using very imperfect tools of analysis. The only real consistency added by the Rent

Model was its tendency to provide a lower estimate of the "total" income changes expected to occur.

The comparison of results obtained from the Rent Model based on national coefficients and an application using a local input-output model provided a further test of the localization assumptions of the Rent Model. The difference in estimates yielded by the two approaches is sufficient to cast serious doubt upon the inter-regional trade assumptions underlying the localization ratios. Measuring the local component of the total impact is critical, since contributions to regional development have been given increased importance under the new water project appraisal standards. Additionally, there is greater agreement among economists concerning the possibility of positive net changes in income at the local level than at the national. The author does not have sufficient confidence in the estimates of local impact yielded by the model to recommend its immediate acceptance as a planning model. Many improvements are necessary before the Rent Model will yield estimates which are vastly more dependable than the other approaches treated critically in Chapters IV and VI. To say that the Rent Model consistently yields lower estimates of a set of benefits which are almost always overstated is not sufficient to recommend its application.

Some Further Refinements of the Model

The original objective of this study was to present and test an easily applicable model for estimating indirect benefits of water projects. An inexpensive approach which utilized currently-existent data was desired. These objectives were achieved. However, as is usually the case, achieving objectives of keeping down the cost of information development competes with the objective of having complete and accurate information. The former objectives were probably met at too great a sacrifice of the latter objectives. The result is probably some degree of "false economy." In light of this conclusion the following refinements of the Rent Model are recommended as areas deserving further study.

Construct Local Input-Output Models. Local input-output models should be constructed for projects in which the indirect effects on income are *a priori* deemed to be of importance because of the nature of the project and the project region. The input-output model need not contain all industrial sectors in the region. Only those impacted in the first three rounds would probably be sufficient, since there is no household induced component in the Rent Model to carry the impacts to the other sectors. Purchases and sales by each sector sustaining any significant impact should be taken in detail using direct questionnaires. By beginning with round one and tracing purchases and sales, it would be possible to determine <u>who</u> will be affected and by what amounts. If the impacts are significant and are discernible by the prospective recipients, the survey should not be stymied by a failure to cooperate on the part of the effected parties. Any reticence should be closely scrutinized in light of the Compensation Ability Principle discussed in preceding chapters. There is an observed reticence to provide input and output information on the part of firms operating in oligopolistic industries. Such reticence usually yields in the face of real opportunities to increase profits. Firms operating under different industry structures generally do not hesitate to supply such information, even when direct returns to them do not appear to be great.

The task of building an input-output model by tracing back from the direct impacts would not be great, except in the case of multi-product projects in a highly developed region. In the case of one-product projects in an underdeveloped region, the task would be relatively simple. The author has undertaken similar studies in conjunction with World Bank project appraisal missions. The objective there was to trace the direct and indirect input requirements in order to establish the indirect foreign exchange requirements of the projects under appraisal. Generally, in small depressed countries as in small depressed regions, most of the impacts have "leaked" out to more developed areas by the end of the third round. Tracing through three rounds for relatively small projects in underdeveloped countries normally takes less than five man-days for an experienced economist. A similar procedure in the United States should not be vastly different in this regard.

Detail of Job Requirements. Additional refinements can be made in Rent Model by breaking the value added down into greater detail. By utilizing currently available data from the Department of Commerce Bureau of Labor Statistics,[1] it is possible to break the production worker requirements of different sectors down into detailed job categories. Thus, estimates of indirect demands upon the work force can be converted into the classification scheme used by State Employment Security Commission offices. Supplementing these data with information on multiple job shifting which is now beginning to become available hopefully would allow some of the assumptions regarding source and alternative earnings of Wage Rent receivers to be accurately determined. Additional research of the type reported by Chilton Research Services[2] would help in estimating the sum of gains via the syphon effect, or "musical chairs" as the former have chosen to call the trickle down phenomenon.

Use Linear Programming to Restrain Gains. By converting the job requirements into classifications used by State Employment Security Commissions, it is possible to estimate a priori the local "bottlenecks" in labor supply which might limit the indirect expansion from the project.

Supplementing the local employment data with the job transformation possibilities observed in the "musical chairs" studies would allow a determination of the amount of job switching which might occur. Combining the information on unemployment by job classification with that on job switching would allow one to develop a set of equations which could be used as "restraints" in determining how much expansion might occur locally before _local_ labor becomes a severely limiting factor. Each restraint could be sequentially relaxed to estimate the marginal social product of aiding in the retraining of local labor in categories not utilized. The same procedure could also be used to estimate the in-migration necessary for the indirect impacts to carry through the full local multiplier effect. Instead of arbitrarily limiting the rounds of expansion to one round, the multiplier analysis could be done using a linear programming format in which expansion was "restrained" or stopped on the round in which local unemployment and job switching possibilities were exhausted in one category. By sequentially relaxing restraints, estimates of retraining and/or in-migration needs could be developed. By comparing the difference in gains between restrained maxima, the marginal product of retraining and/or in-migration could be estimated.

Footnotes

1. Manpower Administration, Occupational Employment Patterns for 1960 and 1975 (Washington: 1968).

2. Chilton Research Service, Multiple Job Shifts Associated With Business Loans (Philadelphia: 1970).

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APPENDIX

APPENDIX TABLE 1

Trenton Channel Project -- Sales, Labor Compensation and Net Wage Gains Induced-by Increased Steel Output: National and Local

	1	2
	Increased Sales of Steel ($ million)	Direct Requirements Coefficients[2] (Steel)
Local Industries[1]		
Electricity, Gas & Water		.02994
Printing and Publishing		.00007
Trans. & Warehousing		.04657
Trade		.02994
Communications		.00417
Finance, Ins. & Real Estate		.03090
Services		.01589
Construction		.00704
Sub-Total		
National Industries[1]		
Metal Ores Mining		.04752
Coal Mining		.01908
Non-durable Goods		.00929
Lumber & Wood Products		.00152
Chemicals & Allied Prod.		.01673
Primary Metals		.22035
Fabricated Metals		.02362
Stone,Clay & Glass Prod.		.00185
Non-Elec. Machinery		.01999
Electrical Machinery		.00689
Motor Vehicles		.00314
Other Transportation Equip.		.00005
Instruments		.00094
Miscellaneous Mfg.		.00127
Sub-Total		
Total	40.5	

APPENDIX TABLE 1 (cont'd)

3	4	5	6	7
Induced Sales ($)	Labor Compensation Per Sales $ [3]	Induced Wages ($)	Average Production Worker Wage/Year [4]	Annual Job Equivalents Required
1,212,570	.4624	560,692	7,500	74.758
2,835	.1979	561	6,180	.090
1,886,085	.5181	977,181	8,125	120.268
1,192,320	.6152	733,515	5,870	124.959
168,885	.4315	72,874	7,500	9.716
1,251,450	.3850	481,808	6,717	71.729
643,545	.4333	278,848	4,765	58.520
285,120	.3049	86,933	7,417	11.720
1,924,560	.4405	847,769	7,556	112.198
772,740	.4405	340,392	7,556	45.049
376,245	.1800	67,724	6,180	10.958
61.560	.3165	19,484	5,162	3.774
677,565	.2484	168,307	8,136	20.686
8,924,175	.2714	2,422,021	7,873	307.636
956,610	.3490	333,857	7,141	46.752
74,925	.3454	25,879	6,779	3.817
809,595	.3902	315,904	7,830	40.345
279,045	.3877	108,186	7,071	15.299
127,170	.1865	23,717	8,475	2.798
20,250	.3868	7,833	8,477	.924
38,070	.3814	14,520	7,539	1.925
51,435	.3477	17,884	5,663	3.158

APPENDIX TABLE 1 (cont'd)

8	9	10	11
Wage Rent Per Job Equivalent	Net Wage Gain	Localization Ratios[1]	Detroit Wage Gains
2,735	204,439	1.0	204,439
1,415	127	1.0	127
3,360	404,100	1.0	404,100
1,105	138,080	1.0	138,080
2,735	26,573	1.0	26,573
1,952	140,015	1.0	140,015
0	0	1.0	0
2,652	31,081	1.0	31,081
	944,415		944,415
2,791	313,145	.0016	501
2,791	125,732	.0016	201
1,415	15,506	.0012	19
397	1,498	.0001	0
3,371	69,733	.0192	1,339
3,108	956,133	.0349	33,369
2,376	111,083	.0595	6,609
2,014	11,504	**	0
3,065	123,657	.0492	6,084
2,306	35,279	.0048	169
3,710	10,381	.2709	2,812
3,712	3,430	.1573	540
2,774	5,340	.0228	122
898	2,836	.0065	18
	1,785,257		61,783
	2,729,672		996,198

APPENDIX TABLE 2

Trenton Channel Project -- National and Local Profit Gains Induced-by Increased Steel Production

	1	2
	Induced Sales (from Appendix Table 1)	After-tax Profits Per Dollar of Sales[5]
Local Industries		
Elec., Gas, Water & Sanitary Services	1,212,570	.0873
Printing & Publishing	2,835	.0512
Transp. & Warehousing	1,886,085	.0135
Whlse. & Retail Trade	1,192,320	.0146
Communications	168,885	.0943
Fin., Ins., & Real Est.	1,251,450	--
Services	643,545	.0219
Construction	285,120	.0160
Sub-Total		
National Industries		
Metal Ores Mining	1,924,560	.0403
Coal Mining	772,740	.0403
Nondurable Goods	376,245	.0371
Lbr. & Wood Products	61,560	.0402
Chemicals & Allied Prod.	677,565	.0615
Primary Metals	8,924,175	.0547
Fabricated Metals	956,610	.0438
Stone,Clay & Glass Prod.	74,925	.0464
Non-Elec. Machinery	809,595	.0533
Electrical Machinery	279,045	.0415
Motor Vehicles	127,170	.0557
Other Transp. Equip.	20,250	.0319
Instruments	38,070	.0782
Misc. Manufacturing	51,435	.0386
Sub-Total		
Total		

APPENDIX TABLE 2 (cont'd)

3	4	5
Profit Gains	Localization Ratios[1]	Detroit Profit Gains
105,895	1.0	105,895
154	1.0	154
25,461	1.0	25,461
17,710	1.0	17,710
15,937	1.0	15,937
--	1.0	--
14,104	1.0	14,104
4,560	1.0	4,560
183,821		183,821
77,578	.0016	124
31,152	.0016	50
13,950	.0012	17
2,492	.0001	0
41,697	.0192	801
488,143	.0349	17,036
41,917	.0595	2,494
3,480	0	0
43,173	.0492	2,124
11,579	.0048	51
7,074	.2709	1,916
64	.1573	10
2,972	.0228	68
1,969	.0065	13
767,240		24,709
951,061		208,530

APPENDIX TABLE 3

Trenton Channel Project -- Local Sales and Net Wage Gains Stemming-from Increased Steel Production

	1	2	3
	Increased Steel Sales ($ million)	Distribution of Steel Sales[6]	Sales Stemming From
Local Industries[1]			
Elec., Gas, Water & Sanitary Services		.00230	93,150
Printing and Publ.		.00008	3,240
Trans. & Warehousing		.00913	369,765
Whlse. & Retail Trade		.00186	75,330
Communications		0	0
Fin., Ins., & Real Est.		.00105	42,525
Services		.00048	19,440
Construction		.01632	660,960
Sub-Total			
National Industries[1]			
Metal Ores Mining		.00194	78,570
Coal Mining		.00158	63,990
Non-durable Goods		.01998	809,190
Lbr. & Wood Prod.		.00324	131,220
Chem. & Allied Prod.		.00922	373,410
Primary Metals		.20444	8,279,820
Fabricated Metals		.07047	3,025,350
Stone,Clay & Glass Prod.		.00479	193,995
Non-elec. Machinery		.12340	4,997,700
Electrical Machinery		.05695	2,306,475
Motor Vehicles		.14026	5,680,530
Other Transp. Equip.		.03777	1,529,685
Instruments		.00593	240,165
Misc. Manufacturing		.00824	333,720
Sub-Total	40.5		
Total			

APPENDIX TABLE 3 (cont'd)

4	5	6	7
Sales Induced-by (from Appendix Table 1)	Net Production (3) - (4)	Localization Ratio[1]	Local Exportable Surplus
1,212,570	---		
2,835	240	1.0	240
1,8886,085	---		
1,192,320	---		
168,885	---		
1,251,460	---		
643,545	---		
285,120	375,960	1.0	375,960
1,924,560	---		
772,740	---		
376,245	433,190	.0012	520
61,560	69,220	.0001	7
677,565	---		
8,924,175	---		
956,610	2,068,350	.0596	123,067
74,925	118,995	0	0
809,595	4,187,700	.0492	206,035
279,045	2,027,475	.0048	9,732
127,170	5,553,530	.2709	1,504,451
20,250	1,527,685	.1573	240,305
38,070	202,165	.0228	4,609
51,435	282,720	.0065	1,838

APPENDIX TABLE 3 (cont'd)

8	9
Wage Rent Coefficients	Local Net Wage Gains
.2140	51
.1090	40,980
	41,031
.0412	21
.0243	0
.1161	14,288
.1527	31,462
.1264	1,230
.0816	122,763
.1693	40,684
.1403	647
.0551	101
	211,196
	252,227

APPENDIX TABLE 4

Trenton Channel Project-Local Profit Gains Stemming-from Increased Steel Production

	1	2	3
	Local Exportable Surplus (from Appendix Table 3)	After-Tax Profits Per Dollar of Sales[5]	Local Profit Gains
Local Industries			
Elec., Gas, Water & Sanitary Services			
Prtng. & Publishing			
Transp. & Warehousing	240	.0135	3
Wholesale & Retail Trade			
Communications			
Fin., Insurance & Real Estate			
Services			
Construction	375,960	.0160	6,015
Sub-Total			6,018
National Industries			
Metal Ores Mining			
Coal Mining			
Nondurable Goods	520	.0371	19
Lbr. & Wood Products	7	.0402	*
Chem. & Allied Prod.			
Primary Metals			
Fabricated Metals	123,067	.0438	5,390
Stone,Clay & Glass Prod.			
Non-electrical Mach.	206,035	.0533	10,982
Electrical Machinery	9,732	.0415	404
Motor Vehicles	1,504,451	.0556	83,798
Other Transp. Equip.	240,305	.0319	7,666
Instruments	4,609	.0782	360
Misc. Manufacturing	1,838	.0386	71
Sub-Total			108,690
Total			114,708

APPEDIX TABLE 5

Trenton Channel Project-Sales and Local Net Wage Gains Induced-by Project Construction

	1	2	3	4
	Construction Cost ($ million)	Direct Require-ments	Induced Sales ($1000)	Wage Rent Coeffi-cients[7]
Agric., For. & Fisheries		0	0	0
Mining		0	0	.177
Construction		0	0	.091
Non-durable Goods Mfg.		.103	3,234.2	.074
Lumber & Wood Products		0	0	.091
Stone & Clay Products		0	0	.163
Primary Metals		.045	1,413.0	.162
Fabricated Metals		.021	659.4	.156
Non-electrical Machinery		.001	31.4	.194
Construction Machinery		.032	1,004.8	.176
Electrical Mach.		0	0	.162
Transp. Equip.		.151	4,741.4	.176
Misc. durable Goods		0	0	.103
Transp. & Warehousing		.017	533.8	.232
Whlse. & Retail Trade		.056	1,758.4	.038
Services		.028	879.2	0
Total	31.4			

APPENDIX TABLE 5 (cont'd)

5	6	7
Net Wage Gains ($)	Localization Ratio[1]	Local Net Wage Gains ($)
0	0	0
0	.001	0
0	.016	0
239,330	.011	2,633
0	.004	0
0	.017	0
228,906	.037	8,470
102,866	.060	6,172
6,092	.050	305
176,845	.050	8,442
0	.005	0
834,486	.111	92,628
0	.042	0
123,841	1.000	123,841
66,819	1.000	66,819
0	1.000	0
		309.310

APPENDIX TABLE 6

Trenton Channel Project -- Local Profits Induced-by Project Construction

	1	2
	Induced Sales (from Appendix Table 5) ($)	Profits per Dollar of Sales
Agric., For. & Fisheries	0	.030
Mining	0	.077
Construction	0	.028
Non-durable Goods Mfg.	3,234,200	.068
Lbr. & Wood Products	0	.057
Stone & Clay Products	0	.080
Primary Metal Products	1,413,000	.090
Fabricated Metal Prod.	659,400	.078
Non-electrical Machinery	31,400	.104
Construction Machinery	1,004,800	.090
Electrical Machinery	0	.080
Transportation Equip.	4,741,400	.090
Misc. Durable Goods	0	.062
Transportation & Whsg.	533,800	.054
Wholesale & Retail Trade	1,758,400	.024
Services	879,200	.047
Total		

APPENDIX TABLE 6 (cont'd)

	3	4	5
	Induced Profits ($)	Localization Ratios	Local Profit Gains ($)
	0	0	0
	0	.001	0
	0	.016	0
	219,925	.011	2,419
	0	.004	0
	0	.017	0
	127,170	.037	4,705
	51,433	.060	3,086
	3,266	.050	163
	90,432	.050	4,522
	0	.005	0
	426,726	.111	47,367
	0	.042	0
	28,825	1.000	28,825
	42,202	1.000	42,202
	41,322	1.000	41,322
Total			174,611

APPENDIX TABLE 7

Stonewall Jackson Reservoir-Sales and Net Wage Gains Induced-by Recreation Expenditures

	1	2
	Annual Recreation Expenditures[10] ($)	Distribution of Purchases[11]
Food & Kindred Products		.252
Restaurants		.084
Hotels		.254
Transportation		.211
Misc. Services		.199
Total	469,500	

APPENDIX TABLE 7 (cont'd)

3	4	5	6	7
Induced Sales ($)	Proportion Spent Locally[11]	Local Induced Sales ($)	Wage Rent Coefficients[7-8]	Local Net Wage Gains ($)
118,314	.15	17,747	.2615	4,641
39,438	.48	18,930	.6081	11,511
119,253	.75	89,440	.6081	54,388
99,065	.25	24,766	.4813	11,920
93,431	.40	37,372	.5314	18,859
				101,319

APPENDIX TABLE 8

Stonewall Jackson Reservoir-Sales and Profit Gains Induced-by Recreation Expenditures

	1	2	3
	Local Induced Sales (from Appendix Table 5)	After-Tax Profits-per Dollar of Sales[5]	Local Profit Gains
Food & Kindred Products	17,747	.0209	371
Restaurants	18,930	.0257	487
Hotels	89,440	.0257	2,299
Transportation	24,766	.0144	357
Misc. Services	37,372	.0373	1,394
			4,908

APPENDIX TABLE 9

Stonewall Jackson Reservoir-Sales and Local Net Wage Gains Induced-by Project Construction

	1	2	3
	Construction Cost ($'000)	Direct Requirements[9]	Induced Sales ($)
Agriculture, For. & Fisheries		.000	0
Mining		.041	2,053,485
Non-durable Goods		.026	1,302,210
Lumber & Wood Prod.		.006	300,510
Stone,Clay & Glass Products		.060	3,005,100
Primary Metals		.035	1,752,971
Fabricated Metals		.077	3,856,545
Non-electrical Mach.		.043	2,153,655
Construction Equip.		.044	2,203,740
Electrical Mach.		.046	2,303,910
Transportation Equip.		.006	300,510
Misc. Durable Goods		.002	100,170
Transp. & Warehousing		.039	1,953,315
Wholesale & Retail Trade		.061	3,055,185
Services		.027	1,352,295
Total	50,085		

APPENDIX TABLE 9 (cont'd)

3	4	5	6	7
Induced Sales ($)	Wage Rent Coefficients[7]	Net Wage Gains	Localization Ratio[1]	Local Net Wage Gains
0	.0000	0	.0057	
2,053,485	.1771	363,692	.0057	23,749
1,302,210	.0358	46,619	.0112	522
300,510	.0497	14,935	.0075	112
3,005,100	.0669	201,041	.0463	9,308
1,752,971	.1056	185,114	.1442	26,693
3,856,545	.1199	462,400	.0254	11,745
2,153,655	.1505	324,125	.0148	4,797
2,203,740	.1509	332,544	.0068	2,261
2,303,910	.1239	285,454	.0217	6,194
300,510	.0807	24,251	.0056	136
100,170	.1187	11,890	.0227	270
1,953,315	.1713	334,603	1.0	334,603
3,055,185	.0824	251,747	1.0	251,747
1,352,295	.0000	0	1.0	0
				672,137

APPENDIX TABLE 10

Stonewall Jackson Reservoir-Local Profit Gains
Induced-by Project Construction

	1	2
	Induced Sales (from Appendix Table 7)	Localization Ratio[1]
Agriculture, Forestry & Fisheries	0	.0057
Mining	2,053,485	.0653
Nondurable Goods	1,302,210	.0112
Lbr. & Wood Products	300,510	.0075
Stone, Clay & Glass Prod.	3,005,100	.0463
Primary Metals	1,752,971	.1442
Fabricated Metals	3,856,545	.0254
Non-electrical Mach.	2,153,655	.0148
Construction Equip.	2,203,740	.0068
Electrical Machinery	2,203,910	.0217
Transportation Equip.	300,510	.0056
Misc. Durable Goods	100,170	.0227
Transp. & Warehousing	1,953,315	1.0
Wholesale & Retail Trade	3,055,185	1.0
Services	1,352,295	1.0
Total		

APPENDIX TABLE 10 (cont'd)

3	4	5
Local Induced Sales	After-tax Profits per Dollar of Sales[5]	Local Profit Gains
0	.0024	0
134,093	.0403	5,404
14,585	.0371	541
2,254	.0402	91
139,136	.0464	6,451
252,778	.0547	13,827
97,959	.0438	4,290
31,874	.0533	1,699
14,985	.0319	478
47,825	.0415	1,985
1,683	.0319	54
2,274	.0327	74
1,953,315	.0135	26,370
3,055,185	.0146	44,606
1,352,295	.0219	29,615
		135,490

APPENDIX TABLE 11

Poteau Project-Sales and Net Wage Gains Induced-by Increased Poultry Plant Sales

	1	2	3
	Poultry Plant Sales ($'000)	Direct Requirements Per Dollar of Sales[2]	Induced Sales ($)
Local Industries[1]			
Elec., Gas, Water & Sanitary Services		.00667	18,009
Printing & Publishing		.00606	16,362
Transp. & Warehousing		.03314	89,478
Whlse. & Retail Trade		.03497	94,419
Communications		.00257	6,939
Finance, Ins. & Real Estate		.01011	27,297
Government & Private Services		.03594	97,038
Construction		.00200	5,400
Sub-Total			
National Industries[1]			
Agriculture, For. & Fisheries		.30569	825,363
Mining		.00069	22,680
Non-durable Goods		.19986	539,622
Lbr. & Wood Prod.		.00130	3,510
Chemicals & Allied Prod.		.00757	20,439
Primary & Fabricated Mtls.		.00268	7,236
Paper & Allied Prod.		.00049	1,323
Stone, Clay & Glass Prod.		.00031	837
Machinery & Equipment		.00253	6,831
Misc. Durable Goods		.01739	46,953
Sub-Total			
Total	2,700		

APPENDIX TABLE 11 (cont'd)

4	5	6	7
Wage Rent Coefficients[7]	Net Wage Gains ($)	Localization Ratios[1]	Local Net Wage Gains ($)
.4624	8,327	1.0	8,327
.1979	3,238	1.0	3,238
.5181	46,359	1.0	46,359
.6152	58,087	1.0	58,087
.4315	2,994	1.0	2,994
.3850	10,509	1.0	10,509
.4333	42,047	1.0	42,047
.3049	1,646	1.0	1,646
	173,207		173,207
.0000	0	---	0
.1771	4,017	.0078	31
.0358	19,318	.0098	180
.0497	174	.0361	6
.0810	1,656	.0059	10
.1169	846	.0055	5
.1168	155	.0111	2
.0669	56	.0065	0
.1429	976	.0036	4
.1187	5,573	.0069	38
	32,771		276
	205,978		173,483

APPENDIX TABLE 12

Poteau Project-National and Local Profit Gains Induced-by Increased Poultry Processing

	1	2
	Induced Sales (from Appendix Table 9) ($)	After-Tax Profit Per Dollar of Sales[5]
Local Industries[1]		
Elec., Gas, Water & Sanitary Services	18,009	.0873
Printing & Publishing	16,362	.0512
Transp. & Warehousing	89,478	.0135
Whlse. & Retail Trade	94,419	.0146
Communications	6,939	.0943
Finance, Ins. & Real Estate	27,297	---
Government & Private Services	97,038	.0219
Construction	5,400	.0160
Sub-Total		
National Industries[1]		
Agriculture, For. & Fisheries	825,363	.0024
Mining	22,680	.0403
Non-durable Goods	539,622	.0371
Lbr. & Wood Prod.	3,510	.0402
Chemicals & Allied Prod.	20,439	.0615
Primary & Fabricated Mtls.	7,236	.0500
Paper & Allied Products	1,323	.0528
Stone, Clay & Glass Prod.	837	.0464
Machinery & Equipment	6,831	.0477
Misc. Durable Goods	46,953	.0327
Sub-Total		
Total		

APPENDIX TABLE 12 (cont'd)

3	4	5
Induced Profit Gains ($)	Localization Ratio[1]	Local Profit Gains ($)
1,572		1,572
838		838
1,208		1,208
1,379		1,379
654		654
---		---
2,125		2,125
86		86
7,862		7,862
1,981	1.0	1,981
914	.0078	7
20,020	.0093	186
141	.0361	5
1,257	.0059	7
362	.0055	2
70	.0111	1
39	.0065	*
326	.0036	1
1,535	.0069	11
26,645		2,201
34,507		2,201

APPENDIX TABLE 13

Poteau Project-Sales and Local Net Wage Gains Stemming-from Increased Poultry Processing

	1	2	3
	Poultry Plant Sales ($'000)	Distribution of Poultry Sales[6]	Sales Stemming From ($)
Local Industries[1]			
Elec., Gas, Water & Sanitary Services		.0000	0
Printing & Publishing		.0001	270
Transp. & Warehousing		.0017	4,590
Whlse. & Retail Trade		.0098	26,460
Communications		0	0
Finance, Ins. & Real Estate		.0014	3,780
Government & Private Services		.0069	18,630
Construction		.0003	810
National Industries[1]			
Agriculture, For. & Fisheries		.0489	132,030
Mining		0	0
Non-durable Goods		.1778	480,060
Lbr. & Wood Products		0	0
Chemicals & Allied Prod.		.0078	21,060
Paper & Allied Products		.0016	4,320
Primary & Fabricated Mtls.		0	0
Stone, Clay & Glass Prod.		0	0
Machinery & Equipment		.0002	540
Misc. Durable Goods		.0304	82,080
Final Demand		.6909	
Net Export		.0221	
Total	2,700		

APPENDIX 13 (cont'd)

4	5	6
Induced Sales (from Appendix Table 10)	Net Production	Localization Ratios[1]
18,009	(-)	1.6
16,362	(-)	1.0
89,478	(-)	1.0
94,419	(-)	1.0
6,939	(-)	1.0
27,297	(-)	1.0
97,038	(-)	1.0
5,400	(-)	1.0
825,363	(-)	
22,680	(-)	.0078
539,622	(-)	.0093
3,510	(-)	.0361
20,439	621	.0059
1,823	997	.0111
7,236	(-)	.0055
837	(-)	.0065
6,831	(-)	.0036
46,953	127	.0069

APPENDIX TABLE 13 (cont'd)

Local Exportable Surplus ($)	Wage Rent Coefficients[7]	Net Wage Gains ($)
	.4624	
	.1979	
	.5181	
	.6152	
	.4315	
	.3850	
	.4333	
	.3049	
	0	
	.1771	
	.0358	
	.0497	
4	.0810	*
33	.1168	4
	.1169	
	.0669	
	.1429	
242	.1187	29
		33

APPENDIX TABLE 14

Poteau Project-Local Profit Gains Stemming-from Increased Poultry Processing

	Exportable Surplus (From Appendix Table 11) ($)	After-Tax Profits Per Dollar of Sales[5]	Local Profit Gains ($)
Local Industries[1]			
Elec., Gas, Water & Sanitary Services			
Printing & Publishing			
Trans. & Warehousing			
Wholesale & Retail Trade			
Communications			
Finance, Ins. & Real Estate			
Government & Private Services			
Construction			
Sub-Total			0
National Industries[1]			
Agriculture, For. & Fisheries			
Mining			
Non-durable Goods			
Lumber & Wood Prod.	4	.0615	*
Primary & Fabricated Metals			
Paper & Allied Prod.	33	.0528	2
Stone,Clay & Glass Prod.			
Machinery & Equipment			
Misc. Durable Goods	242	.0327	8
Sub-Total			10
Total			10

APPENDIX TABLE 15

Poteau Project-Sales and Local Net Wages Induced-by Project Construction

	1	2
	Project Construction Cost ($'000)	Direct[2] Requirements Per Dollar of Sales
Agriculture, For. & Fisheries		0
Mining		.041
Non-durable Goods		.035
Lumber & Wood Products		.012
Stone, Clay & Glass Prod.		.069
Primary Metals		.005
Fabricated Metals		.126
Non-electrical Machinery		.003
Construction Equipment		.041
Electrical Machinery		.001
Transportation Equipment		.021
Misc. Durable Goods		---
Transp. & Warehousing		.038
Wholesale & Retail Trade		.082
Services		.027
Total	5,500	

APPENDIX TABLE 15 (cont'd)

3	4	5	6	7
Induced Sales ($)	Wage Rent Coefficients	Net Wage Gains ($)	Localization Ratio[1]	Local Net Wage Gains ($)
0	.4217	0	-	0
225,500	.4405	99,333	.0078	775
192,500	.1800	34,650	.0093	332
66,000	.3165	20,889	.0361	754
379,500	.3454	131,079	.0065	852
27,500	.2714	7,464	.0028	21
693,000	.3490	242,134	.0048	1,162
16,500	.3902	6,438	.0024	15
225,500	.3868	87,223	.0027	236
5,500	.3877	2,132	.0066	14
115,500	.3868	44,675	.0027	121
---	.3477	---	.0069	---
209,000	.5181	108,283	1.0	108,283
451,000	.6152	277,455	1.0	277,455
148,500	.4333	64,345	1.0	64,345
				454,365

APPENDIX TABLE 16

Poteau Project-Local Profit Gains Induced-by Project Construction

	1	2
	Induced Sales (from Appendix Table 15) ($)	Localization Ratio[1]
Agriculture, For. & Fisheries	0	---
Mining	225,500	.0078
Non-durable Goods	192,500	.0093
Lumber & Wood Products	66,000	.0361
Stone, Clay & Glass Prod.	379,500	.0065
Primary Metals	27,500	.0028
Fabricated Metals	693,000	.0048
Non-electrical Machinery	16,500	.0024
Construction Equipment	225,500	.0027
Electrical Machinery	5,500	.0066
Transportation Equipment	115,500	.0027
Miscellaneous Durable Goods	---	.0069
Transp. & Warehousing	209,000	1.0
Wholesale & Retail Trade	451,000	1.0
Services	148,500	1.0
Total		

APPENDIX TABLE 16 (cont'd)

3	4	5
Local Induced Sales ($)	After-Tax Profits per Dollar of Sales	Local Profit Gains ($)
0	.0024	0
1,759	.0403	71
1,790	.0371	66
2,383	.0402	96
2,467	.0464	114
77	.0547	4
3,326	.0438	146
40	.0533	2
609	.0319	19
36	.0415	2
312	.0319	10
---	.0327	---
209,000	.0135	2,822
451,000	.0146	6,586
148,500	.0219	3,252
		13,189

APPENDIX TABLE 17

Mountain Home Project-Sales, Wages and Net Wage Gains Induced-by Increase in Agricultural Production: National and Local

	1	2
	Increase in Agricultural Sales ($ million)	Direct Requirements Per Dollar of Sales[2]
Local Industries[1]		
Elec., Gas, Water & Sanitary Services		.00291
Printing & Publishing		.00018
Transp. & Warehousing		.01841
Wholesale & Retail Trade		.02987
Communications		.00125
Finance, Insurance & Real Estate		.03265
Government & Private Services		.01438
Construction		.00524
Sub-Total		
National Industries[1]		
Agriculture, For. & Fisheries		.23992
Mining		.00117
Textile Products		.01576
Lumber & Wood Prod.		.00290
Chemicals & Allied Products		.01472
Paper & Allied Products		.01242
Misc. Non-durable Goods		.02624
Metal Products		.02471
Stone, Clay & Glass Prod.		.00049
Machinery & Equipment		.01147
Misc. Durable Goods		.00006
Sub-Total		
Total	16.0	

APPENDIX TABLE 17 (cont'd)

3	4	5	6	7
Induced Sales ($)	Wage Rent Coefficients	Net Wage Gains ($)	Localization Ratio[1]	Local Net Wage Gains ($)
46,560	.0782	3,645		
2,880	.0336	97		
294,560	.2312	68,157		
477,920	.0161	7,773		
20,000	.0817	1,635		
522,400	.1142	59,673		
230,080	.0000	0		
83,840	.1434	12,030		
		152,970		152,970
3,838,720	.0000	0	.0084	0
18,720	.1771	3,316	.0053	18
252,160	.0556	14,023	0	0
46,720	.0497	2,323	.0010	2
235,520	.0810	19,090	.0013	25
198,720	.1168	23,229	.0014	33
419,840	.0358	15,069	.0022	33
395,360	.1169	46,223	.0004	18
7,840	.0669	525	.0014	1
183,520	.1429	26,243	.0016	42
960	.1187	114	.0016	0
		150,155		172
		303,125		153,142

APPENDIX TABLE 18

Mountain Home Project-National and Local Profits Induced-by Increased Agricultural Production

	1	2
	Induced Sales (from Appendix Table 15) ($)	After-Tax Profits per Dollar of Sales[5]
Local Industries[1]		
Elec., Gas, Water & Sanitary Services	46,560	.0873
Printing & Publishing	2,880	.0512
Transp. & Warehousing	294,560	.0135
Wholesale & Retail Trade	477,920	.0146
Communications	20,000	.0943
Finance, Insurance & Real Estate	522,400	--
Government & Private Services	230,080	.0219
Construction	83,840	.0160
Sub-Total		
National Industries[1]		
Agriculture, For. & Fisheries	3,838,720	.0024
Mining	18,720	.0403
Textile Products	252,160	.0290
Lumber & Wood Prod.	46,720	.0402
Chemicals & Allied Prod.	235,520	.0615
Paper & Allied Products	198,720	.0528
Misc. Non-durable Goods	419,840	.0371
Metal Products	395,360	.0500
Stone, Clay & Glass Prod.	7,840	.0464
Machinery & Equipment	183,520	.0477
Misc. Durable Goods	960	.0327
Sub-Total		
Total		

APPENDIX TABLE 18 (cont'd)

3	4	5
Profit Gains ($)	Localization Ratio[1]	Local Profit Gains ($)
4,065	1.0	4,065
147	1.0	147
3,977	1.0	3,977
6,979	1.0	6,978
1,886	1.0	1,886
---	1.0	---
5,039	1.0	5,039
1,341	1.0	1,341
23,433		23,433
9,213	.0084	77
754	.0053	4
7,313	0	0
1,878	.0010	2
14,484	.0013	19
10,492	.0014	15
15,576	.0022	34
19,768	.0004	8
364	.0014	1
8,754	.0016	14
31	.0016	*
88,627		174
112,060		23,607

APPENDIX TABLE 19

Mountain Home Project-Sales, Exportable Surplus, and Local Net Wage Gains Stemming-from Increased Agricultural Production

	1	2
	Increase in Agricultural Sales ($ million)	Distribution of Agricultural Sales[6]
Local Industries[1]		
Elec., Gas, Water & Sanitary Services		0
Printing & Publishing		0
Transp. & Warehousing		.0015
Wholesale & Retail Trade		.0029
Communications		0
Finance, Insurance & Real Estate		.0442
Government & Private Services		.0121
Construction		.0056
Sub-Total		
National Industries[1]		
Agriculture, For. & Fisheries		.3100
Mining		0
Textile Products		.0295
Lumber & Wood Products		.0188
Chemicals & Allied Prod.		.0009
Paper & Allied Products		0
Food & Kindred Products		.3950
Misc. Non-durable Goods		.0205
Metal Products		0
Stone, Clay & Glass Prod.		.0001
Machinery & Equipment		0
Misc. Durable Goods		.0002
Sub-Total		
Total	16.0	

APPENDIX TABLE 19 (cont'd)

3	4	5	6
Sales Stemming-From ($)	Sales Induced-by (from Appendix Table 15) ($)	Exportable Surplus	Localization
0	46,560	---	
0	2,880	---	
24,000	294,560	---	
46,400	477,920	---	
0	20,000	---	
707,200	522,400	184,800	1.0
193,600	230,080	---	
89,600	83,840	5,760	1.0
4,960,000	3,838,720	1,121,280	.0084
0	18,720	---	
472,000	252,160	219,840	0
300,800	46,720	254,080	.0010
14,400	235,520	---	
0	198,720	---	
6,320,000	711,520	5,608,480	.0078
328,000	419,840	---	
0	395,360	---	
1,600	7,840	---	
0	183,520	---	
3,200	960	2,240	.0016

APPENDIX TABLE 19 (cont'd)

7 Local Exportable Surplus	8 Wage Rent Coefficients	9 Local Net Wage Gains
184,800	.1142	21,110
5,760	.1434	826
		21,936
9,419	.0000	0
0		
254	.0497	13
43,746	.0674	2,948
4	.1186	0
		2,961
		24,897

APPENDIX TABLE 20

Mountain Home Project-Local Profit Gains Stemming-from Increased Agricultural Production

	1	2
	Local Exportable Surplus (from Appendix Table 17)	After-Tax Profits per Dollar of Sales[5]
Local Industries[1]		
Elec., Gas, Water & Sanitary Services		
Printing & Publishing		
Transp. & Warehousing		
Wholesale & Retail Trade		
Communications		
Finance, Insurance & Real Estate	184,800	---
Government & Private Services		
Construction	5,760	.0160
Sub-Total		
National Industries[1]		
Agriculture, Forestry & Fisheries	1,121,280	.0024
Mining		
Textile Products	219,840	.0290
Lumber & Wood Prod.	254,080	
Chemicals & Allied Prod.		
Paper & Allied Prod.		
Food & Kindred Prod.	5,608,480	.0209
Misc. Non-durable Goods		
Metal Products		
Stone, Clay & Glass Prod.		
Machinery & Equipment		
Misc. Durable Goods	2,240	.0327
Sub-Total		
Total		

APPENDIX TABLE 20 (cont'd)

3
Local Profit Gains ($)

92
92
2,691
6,875
10,214
117,217
73
136,570
136,662

APPENDIX TABLE 21

Mountain Home Project-Local Wage Gains Induced-by Project Construction

	1	2
	Construction Cost ($1000)	Direct Requirements
Agriculture, For. & Fisheries		0
Mining		.041
Non-Durable Goods		.026
Lumber & Wood Products		.006
Stone, Clay & Glass Prod.		.060
Primary Metals		.035
Fabricated Metals		.077
Non-electrical Machinery		.043
Construction Equipment		.044
Electrical Machinery		.046
Transportation Equipment		.006
Miscellaneous Durable Goods		.002
Transp. & Warehousing		.039
Wholesale & Retail Trade		.061
Services		.027
Total	153,550	

APPENDIX TABLE 21 (cont'd)

3	4	5	6	7
Induced Sales	Wage Rent Coefficients[7]	Net Wage Gains ($)	Localization Ratio[1]	Local Net Wage Gains ($)
0	0	0	.0084	
6,295,550	.1771	1,114.942	.0053	5,909
3,992,300	.0358	142,924	.0022	314
921,300	.0497	45,789	.0010	46
9,213,000	.0669	616,350	.0014	863
5,374,250	.1056	567,521	.0008	454
11,823,350	.1199	1,417,620	.0001	142
6,602,650	.1505	993,699	.0003	298
6,756,200	.1509	1,109,511	.0000	0
7,063,300	.1239	875,143	.0016	1,400
921,300	.0807	74,349	.0000	0
307,100	.1187	36,453	.0016	58
5,988,450	.2313	1,385,128	1.0	1,385,128
9,366,550	.0161	150,801	1.0	150,801
4,145,850	0	0	1.0	0
				1,545,413

APPENDIX TABLE 22

Mountain Home Project -- Local Profit Gains
Induced-by Project Construction

	1	2
	Induced Sales (from Appendix Table 19)	Localization Ratio[1]
Agriculture, For. & Fisheries	---	.0084
Mining	6,295,550	.0053
Non-durable Goods	3,992,300	.0022
Lumber & Wood Products	921,300	.0010
Stone, Clay & Glass Prod.	9,213,000	.0014
Primary Metals	5,374,250	.0008
Fabricated Metals	11,823,350	.0001
Non-electrical Machinery	6,602,650	.0003
Construction Equipment	6,756,200	0
Electrical Machinery	7,063,300	.0016
Transportation Equipment	921,300	0
Misc. Durable Goods	307,100	.0016
Transp. & Warehousing	5,988,450	1.0
Wholesale & Retail Trade	9,366,550	1.0
Services	4,145,850	1.0

APPENDIX TABLE 22 (cont'd)

3	4	5
Local Sales ($)	After-Tax Profits Per Dollar of Sales[5]	Local Profit Gains ($)
0	.0024	0
33,366	.0403	1,345
8,783	.0371	326
921	.0402	37
12,898	.0464	598
4,299	.0547	235
1,182	.0438	52
1,981	.0533	106
0	.0319	0
11,301	.0415	469
0	.0319	0
491	.0327	16
5,988,450	.0135	80,844
9,366,550	.0146	136,752
4,145,850	.0219	90,794
		311,574

Footnotes

*Less than $0.50.

**Set at zero to reflect importing of limestone used in steel production.

1. Local Industries sell primarily to local markets, while National Industries sell to National Markets. See Leontief, et. al, "The Economic Impact--Industrial and Regional of an Arms Cut," Review of Economics and Statistics (August 1965). Localization ratios derived by dividing local employment in each industry by National employment in that industries (set at 1.0 for local industries).

2. From 1963, Input-Output Study, "Direct Requirements Per Dollar of Gross Output, 1963", Survey of Current Business (November 1969), Vol. 49, No. 11, p. 38.

3. From Leontief, et. al, "The Economic Impact . . .," op cit. Also "Income and Employment by Industry," Survey of Current Business (July 1969, Vol. 49, No. 7, pp. 39-44.

4. Local wage rates used for Local Industries; National wage rates used for National Industries. Source: Employment and Earnings: States and Areas 1939-68. Bulletin No. 1370-6, U. S. Dept. of Labor, Bureau of Labor Statistics (August 1969); Agricultural Statistics 1969, U. S. Department of Agriculture. Gov't Printing Office (Washington: 1969).

5. Survey of Current Business (July 1969).

6. 1963 Input-Output Study, "Table 1. Inter-industry Transactions, 1963," Survey of Current Business (November 1969) op cit.

7. Defines as $\frac{(Wi - We)}{WiSi}$ Ci, where

Wi - average production worker wage in industry i.

We = average production worker wage in lowest average wage industry.

Ci = labor compensation in industry i, and

Si - sales in industry i.

8. Opportunity Cost set at zero. Wage Rent Coefficient reduces to "labor compensation per dollar of sales."

9. Haveman and Krutilla, _op cit_, p. 20.

10. As estimated by Kalter, _et al_, _op cit_.

11. Marion Clawson, _Reports to the Outdoor Recreation Resources Review Commission_, No. 24. Economic Studies of Outdoor Recreation (Washington: 1962), 85.