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Employment Benefits Research At The Institute For Water Resources

EMPLOYMENT BENEFITS RESEARCH AT THE INSTITUTE FOR WATER RESOURCES

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1. Introduction

One of the nationally significant effects of public works projects is the impact of construction and operation on unemployment. Utilization of persons, who, in the absence of a project would be unemployed or underemployed, results in a net gain in national economic well-being. Since the opportunity cost of otherwise unemployed labor is zero, the actual cost to the economy is zero; therefore, net benefits of a project are greater and the benefit-cost ratio is increased. Although economic costs are reduced current evaluation procedures require the estimate to be in terms of increased benefits.

Payments to workers who would otherwise be unemployed (or underemployed) in the absence of the Corps projects are called employment benefits. The Corps uses these benefits in its benefit/cost calculations and has used them to influence priorities for new construction starts during periods of recession.

While employment benefits have been an important benefit category, their use has been subject to a variety of criticisms. A major source of criticism has been over procedures employed to estimate the number of otherwise unemployed workers used on projects. In the past, the Corps had no consistent method for estimating the use of such workers. As a result employment benefit estimates made by districts showed wide variation for similar projects under similar economic conditions. To remedy this situation the OCE published an interim regulation on calculating employment benefits using findings from an EDA study of employment effects of its small construction programs (Thompson & Sulvetta, 1975). In addition, the OCE requested that IWR study the use of otherwise unemployed workers on Corps projects. The objectives of this research were to develop an empirically derived data base of the use of otherwise unemployed workers on Corps construction projects to be used for estimating employment benefits, and to develop procedures for calculating these benefits.

This paper reports on the status of this research to date. To set the presentation of the research into a proper context, conceptual and methodological issues associated with measuring the use of otherwise unemployed workers are first reviewed. IWR research efforts are then described, and a series of employment benefits estimation procedures which have been derived from the research are presented. Finally, other areas of continuing and proposed research related to the topic of the employment effects of Corps construction projects are discussed.

2. Conceptual and Methodological Issues in Measuring the Utilization of Otherwise Unemployed Labor

The theoretical treatment of unemployed/underemployed resources in the economics literature is in substantial agreement. In a perfectly competitive economy at full employment market prices represent the true cost to the economy of using a factor of production. If, however, the economy is operating at less than full employment, market prices overstate true costs. This condition exists because in a full employment economy the market prices of a production factor equals the opportunity cost for that factor, i.e. the value of goods or services produced by that factor in an alternative use. Where there is substantial under-utilization of a resource, however, the opportunity costs of using the resources are lower because less alternative production of goods or services must be foregone than would be the case with a fully utilized resource. A completely unutilized resource has an opportunity cost of zero.

While the economic principle involved in the treatment of underutilized resources has general support as a theoretical statement, many economists have reservations about the appropriateness of applying the concept in a policy relevant context. In the area of employment benefit calculations these reservations have generally concerned several major issues: First, is the idea that using a full employment assumption for all projects insures better comparability in choosing among projects competing for Federal funds; Second, the need to project the degree to which labor resources will be underutilized in the region several years ahead during actual years construction raises the issue of whether such forecasts can actually be made with any kind of quantitative rigor; Finally, a particularly troublesome issue concerns the problem of defining the extent of underutilization of construction labor. Demand for such labor is marked by dramatic seasonality; in addition, the nature of the construction process enables individuals to voluntarily remove themselves from employment for extended periods. These factors have led to the assertion that construction workers plan for and expect to be "unemployed" for extended periods every year, and that such periods should not enter into any treatment of underutilized resources because they are actually part of the lifestyle of construction workers and would occur anyway under conditions of full employment as well. These issues are considered in some detail below.

a. Full-Employment Assumptions.

The view that a uniform assumption of full-employment be used for project evaluation proceeds from a view that under-employment of resources results from the wrong mix of resources in a particular place and time. Structural problems of under-employment are better cured by mobility or retraining. Proceeding from this assumption, market prices are seen to best reflect labor costs (Eckstein, 1958). Differences in wages associated with using otherwise under-utilized labor only represent a temporary situation of local disequilibrium in labor markets which the market will correct via migration or retraining of workers. That is, labor reacts to market signals and either heads for greener pastures or retrains, and ultimately a new equilibrium is reached. While in theory these adjustments explain the response of regional labor markets there are significant impediments in actual responses of labor to such conditions which prevent or at least hinder such adjustments. Such impediments include lack of information about alternate employment opportunities, lack of access to retraining, individual preferences for regional lifestyles, artificial barriers to entry into new occupations, etc.

Critics of this view have also argued that to employ the assumption of national full employment also ignores the contribution that Federal projects can make to regional development (Chalmers and Threadgill, 1978). In this context assuming away this class of benefits removes a potential policy lever which can possibly justify marginal projects in depressed regional areas.

Finally, the issue of whether a full employment assumption should be involved for all projects regardless of local or regional labor conditions implicitly assumes the existence of a full employment national economy. As Knetsch et. al. (1969) note when there are significant, prolonged deviations from a full-employment economy the true social costs of using underutilized resources will be below the apparent market cost and appropriate adjustments to observed primary benefits and costs should be made.

b. Forecasting the Amount of Underutilized Labor Resources.

While employment benefits of employing otherwise underutilized labor occurs at the time of construction, the calculation of the size of such benefits takes place during the planning of the project. For most Corps of Engineers water projects the formulation and evaluation stage is as much as ten years in advance of actual construction. Reluctance has been voiced on the part of some economists to attempt to justify projects using employment benefits when doing so requires speculating about the size of the underutilized labor pool ten or more years in the future. Such individuals question whether forecasts made would be accurate.

Certainly there is ample reason for uneasiness whenever forecasting is encountered, however, many project formulation and evaluation tasks require forecasts. Several categories of National Economic Development (NED) benefits must be computed based on forecasts of land use, population, and patterns of economic activity. In this context, developing forecasts of the size of the pool of otherwise-unemployed workforce would not appear to pose any greater challenge than the forecasts of other economic variables which are routinely done.

c. Problems of Defining Underutilized Labor

Part of the disagreement surrounding the concept of employment benefits is the result of skepticism of some that "otherwise unemployed" construction workers exist at all. Critics of the concept of employment benefits claim that estimates of previous unemployment overlook or fail to take into account normal construction industry factors which influence unemployment in predictable ways.

The construction employment cycle is marked by dramatic seasonality. Workers know about the first quarter trough and plan on being unemployed during this time. A recent Department of Labor report estimates that seasonality as a factor in construction unemployment has been decreasing in importance. However, the report estimates that as much as 15 percent of unemployment may be due to seasonal factors (Department of Labor, 1979).

In addition to seasonality, construction employment in some crafts is marked by relatively easy entry. Workers have the option of taking self-imposed "vacations" by simply quitting a job and resuming employment when they choose to do so. Such "discretionary unemployment" has nothing to do with the structural unemployment which the concept of lower opportunity costs of labor addresses.

Another issue in operationally defining otherwise unemployed workers is addressing the "what if" question of the without-project condition. As pointed out by Eckstein (1958) and as reemphasized by Epley and Green (1974), the appropriate test to determine the opportunity cost associated with underutilized labor is the employment status of the workforce "with" as compared to "without" the project. That is, the crucial issue for calculating employment benefits is not in demonstrating that labor was underutilized prior to the project, but in demonstrating that it would have remained underutilized had the construction project not been undertaken.

While this is the way this issue is often posed, it is impossible to determine whether an individual worker would have remained unemployed had the Corps project not been built. Focusing attention on individual workers may be missplaced. Rather, the more important question would appear to be: "is there a pool of unemployed labor available to take jobs - how has the size of this pool changed over time and in relation to National trends?" The issue, then, becomes not so much the status of individual workers in a without-project-condition, but the presence of a locally available pool of unemployed labor. This concept has been developed most extensively by Haveman and Krutilla (1968).

In their study Haveman and Krutilla (1968) make the following assumptions about the covariation of unemployment and the use of idle resources: The higher the rate of unemployment, the greater the expectation (a) that an otherwise unemployed worker will appear at the hiring window when an incremental job is being filled and (b) that employers requiring additional labor will hire from the pool of unemployed rather than decrease their output or work their existing labor forces overtime. The synthetic function presented in Figure 1 shows a set of three possible reaction patterns to secure the estimates of the percentage of labor drawn from the idle pool: Upper-bound (H), lower-bound (L) and Intermediate (I) functions. These functions represent the infinite possible reaction patterns hypothesized by Haveman and Krutilla (1968) to link level of unemployment and the use of the idle labor pool. The lines "H", "L" and "I" are various portions of sine functions, mathematically expressed as follows:

$$L = 1.0 - \cos(\frac{\_}{2} \times \frac{r - r_f}{r_n - r_f})$$

$$H = \sin(\frac{\_}{2} \times \frac{r - r_f}{r_n - r_f})$$

$$I = .5x[\sin(\; \times \frac{r - r_f}{r_n - r_f} - \frac{\_}{2}) + 1]$$

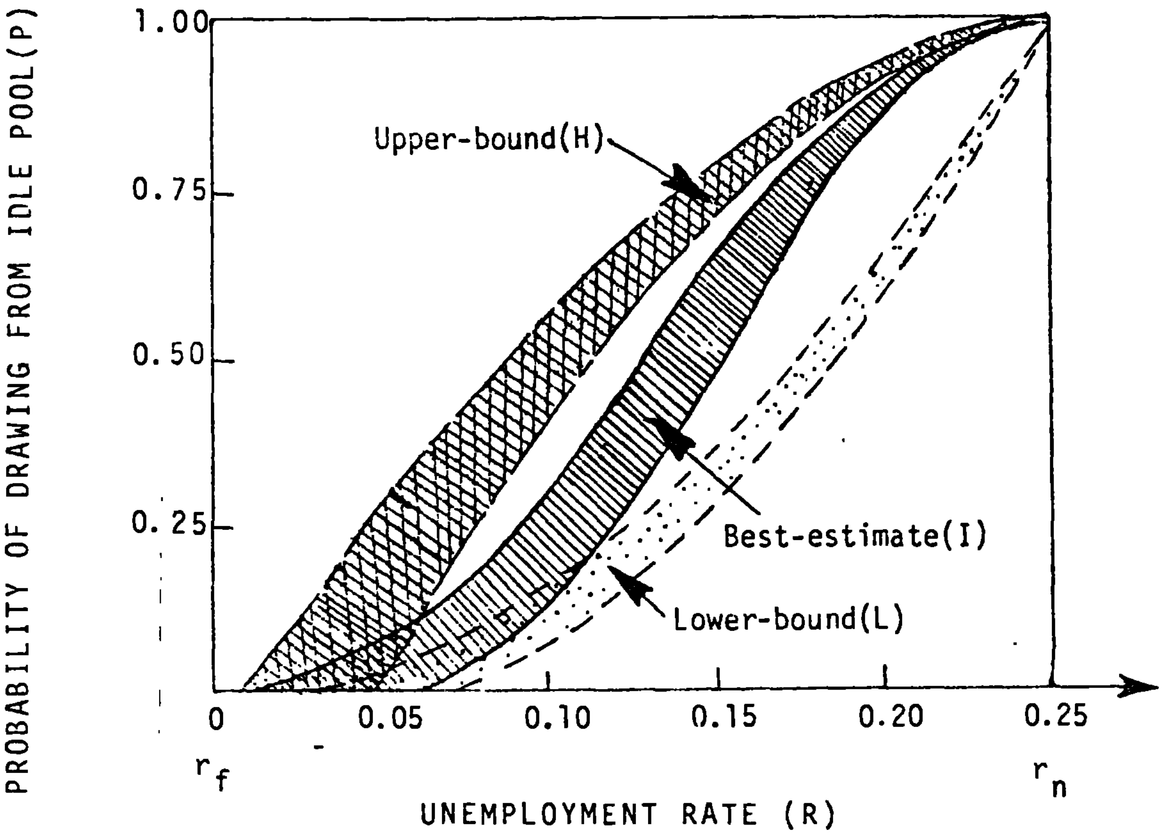

Figure 1. Labor response functions

Where Y_H, Y_L, and Y_I represent values of each function of upper-bound, lower-bound, and intermediate curves; and

r = rate of unemployment

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

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

On the abscissa of Figure 1, the range of unemployment (r) existing at a point in time has been plotted. The ordinate measures the proportion of the increment of demand for a factor which will be supplied from the unutilized labor pool, Y. The points labeled r_f are taken to be the rate of unemployment associated with "full employment", and the points labeled r_n signify the rate of unemployment at which an increment of factor demand would be entirely supplied from otherwise unutilized labor resources.

Economic expectations of labor's response are consistent with the sinusoidal shape of the family of intermediate or "best-estimate" (I) probability functions shown in Figure 1. That is, it is recognized that at low levels of unemployment (near full employment), additional demands for labor will be satisfied totally or nearly so by the diversion of employed labor. As the unemployment rates increase, however, the unemployed labor pool will begin to satisfy the additional labor demands, slowly at first, then at an increasingly rapid rate. When unemployment rates reach critical levels, the additional labor demands will be completely satisfied by the unemployed labor pool.

Haveman and Krutilla (1968) in elaborating their assumptions readily admit "that this area has not been studied in the depth necessary for the establishment of empirically specified response functions relating the rate of unemployment and the probability of satisfying the increment in demand with a unit of unemployed labor" (p. 71). Surprisingly, there have been few attempts reported in the literature to develop labor response functions which are empirically derived. Kim (1972) notes: "Empirical information about the reaction patterns of various factors of production to incremental demand for them is not available . . . however . . . it is expected that there is a positive relationship between the rate of idleness of the factors of production and the probability of employing these factors to satisfy the increased demand . . ." (p. 107).

In summary, the major issues in using employment benefits include: (1) Whether or not to allow this category of benefits in project evaluation benefit/cost calculations. It was found that economic theory is in consistent agreement with the legitimacy of the concept, but that disagreement centers more on philosophical orientation; (2) The ability to forecast the availability of underutilized labor resources in a project area. While difficulties are inherent in all forecasting, it appears that this task is no more difficult than forecasts routinely made for other variables considered in plan formulation activities; (3) Separating "real" underutilized labor from those voluntarily unemployed or because of seasonal factors; and determining the employment status of underutilized labor "with" versus "without" the project. As noted, since this latter task is impossible, some alternative measurement procedure must be employed to identify the extent to which "otherwise unemployed" labor is employed in construction projects. The relationship, elaborated by Haveman and Krutilla (1968) between the presence of an unemployed labor pool and the probability of drawing from that pool for labor for construction projects was seen to offer one means of addressing this issue.

The next section describes IWR research on the topic of the use of otherwise unemployed labor at Corps construction projects and discusses how the major issues in operationally defining the concept were addressed. Findings from IWR research are presented, and general approaches to calculating employment benefits derived from the research are described.

3. IWR Research on the Use of Otherwise Unemployed Labor on Corps Construction Projects.

Two research studies have been conducted on the issue of the use of otherwise unemployed labor at Corps construction projects by IWR. The first, the Construction Workforce Survey (CWS), was a study of the workforce at 51 projects conducted in 1979 (Dunning, 1981). Over 65 percent of the construction workforce employed at the projects responded to a self-administered questionnaire and reported their employment status prior to beginning work on the Corps construction project, as well as other personal and demographic information. The data base developed from this survey contains 4,089 complete responses from workers at a cross section of Corps projects in various stages of completion and localities in varied local labor force conditions. The second research study was a secondary analysis of the data generated in the Construction Workforce Survey (Duncan, 1982). The goal of this latter research was to determine if empirically based labor response functions like those presented by Haveman and Krutilla (1968) could be developed using the survey data. These studies and their findings are discussed in greater detail in the following two sections.

a. Construction Workforce Survey

It has been shown that several critical methodological issues must be addressed in operationalizing the concept of "otherwise unemployed" workers. Fundamentally these issues relate to differentiating workers unemployed because of structural factors from those unemployed because of seasonal or other reasons, and also developing a means to address the issue of the unemployment status of workers under "without project" conditions. The methodological approach followed in the Construction Workforce Survey for operationally defining the concept of otherwise unemployed workers is briefly presented below. A fuller elaboration can be found in the IWR report on the workforce survey (Dunning, 1981).

For the Construction Workforce Survey workers were asked if they had been unemployed before taking the job on the Corps of Engineers project. Workers answering affirmatively were then asked to report the total number of working days they were unemployed for the six weeks prior to beginning the work at the Corps project. For the purposes of the IWR study, a work-week consisted of five days, making a total of 30 days of unemployment in a six-week period the maximum. Responses from workers reporting greater than 30 days unemployment were coded as 30. The measurement procedure did not apply an official definition of unemployment, such as is used by the Department of Labor, but instead relied on the assumption that the individual could accurately define his own unemployment status. This approach has been used in other studies measuring unemployment (Thompson, 1965).

Using this measure 39.6 percent of the 4,089 workers reported previous unemployment. To derive a measure of those otherwise unemployed, however, necessitated removing the discretionary and seasonal components in this reported unemployment. Discretionary unemployment was factored out by defining as unemployed only those workers reporting 11 or more days of unemployment. Thus, workers reporting unemployment of two weeks or less, were considered as "on vacation" or between jobs. When this total was removed, reported unemployment averaged 33.4 percent of the workforce.

Seasonality was removed, using a methodology discussed in the IWR report. Briefly, this procedure involved comparing unemployment of workers hired in the first three quarters of the year with unemployment of workers hired in the fourth quarter. The assumption was that reported unemployment of workers hired in the fourth quarter would not be due to seasonal factors since the construction season would have been underway at least six months. The difference between average unemployment of the first three quarters and fourth-quarter unemployment formed a measure of seasonal influences. It was found that unemployment was overstated for unskilled workers an average of 21 percent and for skilled workers 24 percent. White-collar worker unemployment, however, displayed little seasonal variation. This procedure yielded an overall measurement of otherwise unemployed workers of 26.4 percent of the workforce.

Another issue in operationally defining otherwise unemployed workers is addressing the "what if" question of the without-project condition. If there were no project, is it reasonable to assume that the workers who reported previous unemployment would continue in this status? Once again, instead of focusing on individual workers the more important issue would appear to concern the presence of a pool of unemployed labor available to take jobs and documenting the relationship between the size of this pool and the use of otherwise unemployed workers. The issue, then, becomes not so much the status of individual workers in a without-condition, but the presence of a locally available pool of unemployed labor.[1] As noted in the previous section, this concept has been developed most extensively by Haveman and Krutilla (1968).

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[1]In part, this logic seems to have permeated earlier guidance that employment benefits be restricted to EDA-designated counties. Such areas are designated on the basis of severe and persistent unemployment. A pool of unemployed persons, thus, was already documented by EDA.

Table 1. Coefficients for Estimating the Use of Otherwise Unemployed Workers on Corps Projects.

	Local Workers		
Location of Project	Unskilled	Skilled	White Collar
EDA areas ~~with high~~ regional unemployment	42.7	32.8	22.1
EDA areas with low regional unemployment and Non EDA areas	32.0	25.7	22.1
	Non-local Workers		
All areas	32.0	21.3	22.1

In the IWR study, it was found that projects located in EDA-designated areas, generally speaking, had higher proportions of otherwise unemployed workers than projects located in non-EDA areas. However, all projects had substantial proportions of otherwise-unemployed workers employed. In this context it appears that the crucial determinant of the proportion of otherwise-unemployed workers is the health of a local economy represented in the unemployment rate. For the CWS Study a moderately strong positive association between the proportion of otherwise unemployed used on projects and the unemployment rate was found (re. 54). Table 1, abstracted from the IWR report of the survey, summarizes the results of the analysis linking the proportion of otherwise unemployed labor used on Corps projects to regional unemployment rates. For local workers, projects located in EDA areas which also had high unemployment rates at the time of survey showed significantly higher proportions of otherwise unemployed construction workers than did other projects. Projects located in EDA areas with lower unemployment rates (below 6 percent) at the time of the survey and projects located in counties without EDA designation had lower proportions of otherwise-unemployed workers. The proportion of otherwise unemployed non-local workers (workers who moved into the project area to work on the project) displayed little variation with respect to regional unemployment rates or EDA status. Table 1 summarizes the results of the analysis performed on the data. The research suggests that in conditions of other than a fully-employed economy, all project areas are likely to draw on a pool of unemployed labor resources. Table 1 is a first approximation of the degree to which projects are likely to do so.

In summary, the Construction Worker Survey indicated that a substantial proportion of the Corps of Engineers workforce had been unemployed prior to assuming employment. The research showed that previous unemployment is most strongly associated with a project's being located in a region with high unemployment and with the use of local, as opposed to non-local, labor. These results support the hypotheses derived from Haveman and Krutilla (1968) of a relationship between the rate of unemployment and the use of otherwise unemployed labor resources on construction projects.

A major weakness of the Construction Worker Survey insofar as yielding labor response curves like those hypothesized by Haveman and Krutilla (1968) is concerned, however, is that only one measure of regional unemployment was obtained (April 1979) while workers were hired onto the projects over a span of many months. The regional unemployment variable used in the Construction Workforce Survey analysis may not, therefore, accurately reflect regional unemployment levels at the time workers were hired onto projects. The second IWR research study was therefore initiated with the purpose of augmenting the survey data with a more comprehensive data collection of unemployment rates of project areas.

b. Labor Response Study

The major issue in the second research study was whether a relationship between general levels of unemployment and the use of otherwise unemployed workers at Corps projects existed. For this study, regional unemployment totals for the 24 months preceding the time of survey for each of the 51

Table 2

Project Unemployment Information
Data Collection Format

Month	Q	X	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Y	Y_1	Y_2	. . . .	Y_9	EDA Status
Time of Survey																	
1																	
2																	
3																	
4																	
5																	
6																	
.																	
.																	
.																	
.																	
.																	
.																	
24																	

Where:

Q = regional unemployment rate
X = number of workers hired
X_1= number of unskilled workers hired
X_2= number of skilled workers hired
X_3= number of white collar workers hired
X_4= number of local unskilled workers hired
X_5= number of local skilled workers hired
X_6= number of local white collar workers hired
X_7= number of nonlocal unskilled workers hired
X_8= number of nonlocal skilled workers hired
X_9= number of nonlocal white collar workers hired

Y = number of workers who were previously unemployed
Y_1= number of unskilled workers previously unemployed
Y_2= number of skilled workers previously unemployed
Y_3= number of white collar workers previously unemployed
Y_4= number of local unskilled workers previously unemployed
Y_5= number of local skilled workers previously unemployed
Y_6= number of local white collar workers previously unemployed
Y_7= number of nonlocal unskilled workers previously unemployed
Y_8= number of nonlocal skilled workers previously unemployed
Y_9= number of nonlocal white collar workers previously unemployed

projects surveyed were developed by obtaining monthly unemployment totals and labor force size figures for each county comprising a regional labor shed area and aggregating those figures to obtain a regional unemployment rate for each of the 24 months. Tables for each of the 51 projects in the CWS data base were generated like those shown in Table 2 linking regional unemployment rates for specific months to numbers of workers hired, and numbers of workers who were previously unemployed. Rows in the tables with the same regional unemployment rates (Q) were grouped among the 51 projects yielding the various categories of total unemployment arranged by labor shed unemployment values. In addition influence of the EDA status of the project, as well as the regional location of the project, were also analyzed.

These time-series data enabled a more thorough test of the Haveman-Krutilla hypotheses. Basically the test procedure involved comparing the observed value of the proportion of workers who were unemployed at specific levels of regional unemployment with the predicted values of the probability of drawing workers from the unemployed pool of labor at specific levels of unemployment given the three labor response functions postulated by Haveman and Krutilla and shown earlier in Figure 1. A series of t-tests on the differences between observed and predicted values was performed for the overall set of data, as well as for the important subclasses of the workforce - local, non-local, occupational, subgroups, and combinations of these variables.

Computed across the entire sample, the observed data appeared to fit the Intermediate Haveman and Krutilla labor function ($M = .0059$), $t = .61$, $p > 54$. This result should be taken with considerable caution however. Separate t-tests of the hypothesis that the means of the observed and predicted probabilities were equal for the various occupation, locality, and occupation and locality combinations revealed large differences between predicted and observed values. Further inspection of t-test results indicated that several individual projects (all workers grouped together) contributed most to the closeness of fit between observed and predicted curves.

The boundary response functions were substituted for the intermediate or "best estimate" function in order to induce a better fit of the observed data. The upper-bound function (H) shown in Figure 1 was found to be grossly deficient as a predictive probability curve for the observed data. The lower-bound function is the most conservative of the three reaction patterns to link unemployment rate and the probability of using idle labor according to the Haveman and Krutilla (1968) model. That is, demands for labor will be satisfied at a consistently more gradual pace as the unemployment rate increases. Although this lower-bound assumption did not find support for the entire worker sample grouped together, there were numerous instances where the mean differences between the observed and predicted values were quite small.

In brief, the pattern of results overall of the test of fit between the empirical data and the theoretical functions supported the Haveman and Krutilla (1968) expectations of a positive relationship between the rate of unemployment and the probability of employing otherwise unemployed workers on Corps projects. The closeness of fit however, seems to be differentially affected by locality, occupation, individual project, and project characteristic dimensions. The demands for idle labor resources, in general, appear to be supplied at a consistently more deliberate pace as the project labor shed employment rate increases. That is, of the three functions chosen by Haveman and Krutilla (1968) to represent the infinite possible reaction patterns to link two extreme reference points,the Intermediate, and more so, the Lower-Bound Function (at the project level) provides a better fit for the observed data.

In light of the uneven findings concerning the relationship between the Haveman-Krutilla labor response functions, and the actual data, a regression analyses was performed on the variables. For the first analysis the dependent variables were the proportion of previously unemployed workers for the entire sample, and the various subdivisions of locality, occupation, region, and EDA status. Independent variables included the labor shed unemployment rate for the months in which workers were hired, the EDA status, and the region.

The regression analysis for this group of variables showed that the regional unemployment variable explained very little of the variation in the dependent variables. Explained variance was only on the order of 2 to 16 percent for the various dependent variables considered. These findings, once again, in general, support the mixed results obtained in the explicit test of the Haveman-Krutilla functions. That is, while there is <u>some</u> relationship between the probability of drawing idle resources from the unemployed labor pool and the level of unemployment this relationship is not as straightforward as the Haveman-Krutilla labor functions would suggest. Instead it is likely that many other variables affect the entry or access of unemployed labor into jobs no matter what the general level of unemployment may be.

A second group of regression analysis were performed using as dependent variables the actual numbers of previously unemployed workers instead of the proportion of such workers. In addition, the number of workers hired during a particular month was added to the group of independent variables already named.

This group of regression equations produced close fits between predicted and actual numbers of previously unemployed workers hired onto Corps projects. The dominant independent variable in each equation was the number of workers hired during the months.

The regression equations for the dependent variables of total unemployment, local skilled unemployment, local unskilled unemployment, local white collar unemployment, and non-local unemployment for each occupational category are presented in Table 3. A variable composed of the number of workers hired multiplied by the labor shed unemployment rate proved significant in the equations. This variable indicates that the effect of the number hired on the explained variance in predicting previous unemployment of workers changes at different levels of regional unemployment rates. Table 3 shows that this interaction effect is significant for the entire sample, for local unskilled, local white collar, and non-local skilled workforce groups. It is also noteworthy that the variables of EDA status and region fail to contribute to the explanatory power of any of the equations.

Table 3. Regression Equations Estimating Number of Previously Unemployed Workers.

Dependent Variable	Number Hired	Interaction Number Hired* Unemployment Rate	Region	EDA	Intercept	R^2	F
			Independent Variables				
1. All previously unemployed	.326*	1.5*	.098	-.149	-.299	.90	1445
2. All local unemployed	.248*	1.5	.424	-1.43	-.364	.87	117
3. Local skilled unemployed	.300*	.589	.180	-0.012	-.522	.85	603
4. Local unskilled unemployed	.212*	1.83*	-.033	-.009	.267	.55	77
5. Local white collar unemployed	.025	2.56*	.027	-.217	.173	.35	22
6. All non-local unemployed	.09*	.011	.306	-.899	1.42	.60	15
7. Non-local skilled unemployed	.019	1.13*	.031	-.234	.331	.61	9
8. Non-local unskilled Unemployed	.111*	-.685	.036	-.153	.363	.08	3
9. Non-local white collar unemployed	-.034	1.53	-.02	.017	.245	.08	4

* = significant at .05 or greater

Once again the results of this group of regression analyses supports the findings already presented: in general, as unemployment increases there is a somewhat greater tendency for more construction workers - in particular local unskilled, and white collar, and non-local skilled workers - to have been previously unemployed. While a clear empirical relationship between several levels of unemployment and the use of previously unemployed workers at Corps construction projects has been shown, it is equally clear that other factors moderate this relationship. Within the confines of the research reported here the nature of such factors cannot be identified. However, it can be speculated that variables such as the absolute size of the pool of unemployed labor represented by unemployment rate and the relationship between construction unemployment and general unemployment in the particular labor market area could independently affect the basic relationship between unemployment levels and the use of previously unemployed workers. For example, in a regional area having a labor force of 300,000, an employment rate of seven percent yields an unemployed labor pool of 21,000. If a Corps project hires 500 workers it is likely that the unemployed pool numerically could supply the workforce, just as it could if the unemployment rate were three percent (9,000 unemployed) or 10 percent (30,000 unemployed). Thus it is likely that the size differential between the unemployed labor pool and the size of most Corps construction projects inhibits the strong relationship predicted by Haveman and Krutilla.

The goal of the labor response research was to explore the relationship between regional unemployment rates and the use of previously unemployed workers at Corps construction projects. The objective of this research was to identify the basic relationships in order to construct labor response functions for use in employment benefits computations. The research has shown that the basic relationship between the covariation of unemployment and use of idle resources as hypothesized by Haveman and Krutilla is present; however, not in as straightforward a manner as is implied by their synthetic labor response functions. Regression analyses have yielded a series of equations which in general fit the data quite well. These equations form a basis for predicting the use of otherwise unemployed workers at Corps projects.

c. Summary

Two studies have been undertaken by IWR to investigate the use of otherwise unemployed labor at Corps construction projects. Using a cross-sectional approach the analysis of construction workforce survey data established that the use of otherwise unemployed workers was most strongly associated with projects located in regions having high unemployment, and the use of local as opposed to non-local labor. In order to more fully investigate the relationship between regional unemployment and the use of previously unemployed workers a study using time-series data was undertaken. This study confirmed that an empirical relationship between regional unemployment rates and the use of previously unemployed workers does exist; however, the study showed that this relationship is not as straightforward as hypothesized by Haveman and Krutilla. The consistent relationship shown in the analysis suggests that unemployment observed among construction workers is not capricious, but is due to structural factors in the economy. Had the unemployment experience been the result of voluntary decisions or seasonal influences alone no such relationship between regional unemployment rates and the number of those hired onto Corps projects who were previously unemployed should have been apparent.

The relationship observed substantiates the approach presented earlier in this paper to operationally defining the concept of "otherwise unemployed" workers. Given this relationship, it is not necessary to speculate whether or not an individual worker would have remained unemployed in the absence of a project; rather, it is only necessary to establish that a pool of unemployed labor is available for employment on construction projects. The coefficients and equations developed in the IWR research provide a basis for estimating the number of otherwise unemployed workers likely to be supplied by this pool.

The primary components for performing an employment benefit analysis have now been presented. Principle methodological and conceptual issues regarding the measurement of otherwise unemployed workers have been addressed. The next section presents recommended procedures for actually calculating such benefits using the IWR research.

4. Employment Benefits Calculations Using IWR Research Findings

This section presents the derivation of employment benefits using first, the procedure outlined in the IWR research report 81-R05 (Dunning, 1981), and second modifying the procedure on the basis of additional research employing time-series data (Duncan, 1982).

a. Construction Workforce Survey Analysis Procedure

Inputs needed to develop employment benefit estimates are as follows:

- Number of workers by skill designation
- Locality of workforce by skill
- Location of project in terms of:

  County EDA status

  Regional unemployment rate

Each of these information inputs is discussed in greater detail below.

(1) Number of Workers

An estimate of the number of workers to be employed on the construction project forms the base for calculating employment benefits. A number of sources for developing these estimates are available. Among them are statistics maintained by the Bureau of Labor Statistics and the Bureau of Reclamation on the ratio of total dollar amounts of construction for various types of heavy construction activities and man-years of labor (Bingham, 1978; Bureau of Reclamation, 1980); and detailed statistics on construction project labor requirements compiled by F.W. Dodge Co. and made available in labor estimates produced by the Department of Labor's Construction Labor Demand System (Department of Labor, 1977).

(2) Locality of Workforce

IWR research has shown that the previous unemployment of the workforce varies according to the variable of locality of the workforce. Accordingly, the proportion of the workforce which is local and that which is likely to be non-local should be estimated. A regression equation developed in the CWS (Dunning, 1981) provides such an estimation of total numbers of non-local workers. In addition an estimate of the occupational skill distribution of the non-local workforce can be obtained from this report. The CWS indicates that for the national survey the non-local workforce was composed of 15.1 percent unskilled workers; 59.2 percent skilled and 25.7 percent white collar workers.

(3) Location of Project

Two inputs are required. First, the EDA status of the county in which the project is to be constructed should be determined. Second, a regional labor shed for the project should be constructed using the procedure described in Section 1.3.1 of the CWS (Dunning, 1981). Unemployment rates for this region can then be obtained from state employment or labor statistics departments.

The information and estimate developed above can then be used in conjunction with the appropriate coefficients shown in Table 1 of this paper to develop estimates of previously unemployed workers. Appropriate wage rates can be multiplied by these workers to yield estimates of employment benefits.

For example, assume a reservoir is to be constructed; assume a three-year construction schedule. Labor requirements of construction are: year 1 = 250; year 2 = 700; year 3 = 300 workers.

The estimated occupational distribution of workers is as follows:

	Construction Year 1	Construction Year 2	Construction Year 3
Unskilled	55	154	66
Skilled	160	448	192
White Collar	35	98	42
TOTAL	250	700	300

(4) To compute employment benefits, perform the following steps:

a. Locality of Workforce

(1) Estimate total non-local workers, using regression equation:

Number year 1 = .213 (PEAK*) -8.9 = 44
year 2 = = 140
year 3 = = 64

*where PEAK = number of workers required for construction year.

(2) Estimate occupational breakdown of non-local workers.

	Construction Year		
	1	2	3
Number Unskilled Non-local = 15.1% X Total	7	21	10
Number Skilled Non-local = 59.2% X Total	26	83	38
Number White Collar Non-local = 25.7% X Total	11	36	16
Total Non-local Workers	44	140	64

(3) Subtract non-local workers from total estimated distribution to obtain occupational breakdown of local workers.

	Construction Year		
	1	2	3
Unskilled	48	133	56
Skilled	134	365	154
White collar	24	62	26
Total Local Workers	206	560	236

b. Location of Project

(1) EDA status: Assume county is located in EDA-designated area.

(2) Regional unemployment rate:

c. Compute previous unemployment

(1) Estimate previously unemployed local workers.

Year 1	Total local workers		Values from Table 1		Number Previously Unemployed
Unskilled	48	*	.427	=	21
Skilled	134	*	.328	=	44
White Collar	24	*	.221	=	5

(2) Estimate previously unemployed non-local workers

Year 1	Total non-local workers		Values from Table 1		Number Previously Unemployed
Unskilled	7	*	.320	=	2
Skilled	26	*	.213	=	6 White Collar
	11	*	.221	=	2

(3) Repeat (1) and (2) above for construction years 2 and 3.

d. Final Fstimate of Otherwise Unemployed Workers

	Construction Year		
	1	2	3
Unskilled	23	64	27
Skilled	50	137	59
White Collar	7	21	9
Total	80	222	95

e. Compute a wage bill for previously unemployed workers. Assume an "average wage" for occupational skill levels of $8.00/hr., unskilled; $13.00/hr. skilled; $12.00/hr. white collar.

(1) Wage bill, year 1 = x+y+z where
x = total number of unskilled workers previously unemployed * year 1 annual wage unskilled
= 23 * $16,640 = $382,720
y = Total number of skilled workers previously unemployed * year 1 annual wage skilled
= 50 * $27,040 = $1,352,000
z = Total number of white collar workers previously unemployed * year 1 annual wage white collar
= 7 * $24,960 = $174,720
x+y+z = $1,909,440

(2) Compute wage bill for years 2 and 3 in same manner

(3) Compute total wage bill for previously unemployed workers by summing wage bills for years 1 through 3

f. Compute interest on wages paid to previously unemployed workers. (Compute as described in EM 1160-2-101).

g. Compute Average Annual Employment Penefits

(1) Total employment benefits = total wage bill + total interest on wages

(2) Average annual benefits = total employment benefits * amortization factor. Total wage bill in this example = $9,549,280, total interest on wages = $887,190. Amortization factor is .075914 assuming a 50 year project life at 7-5/8% discount rate.
Average Annual Employment Benefits = $792,274.

b. Labor Response Analysis Procedure

Basic inputs needed are as follows:

- o Number of workers by skill designation
- o Locality of workforce by skill
- o Forecast of unemployment rate of project area labor shed at time of construction

Requirements for the first two inputs are exactly the same as presented in section 4a, and will not be discussed again. The third input requires some estimate of the project area labor shed unemployment rate at the time of project construction be made. The procedure for defining the project area labor shed is presented in the Construction Workforce Survey (Dunning, 1981) and involves the identification of the counties within a 50 mile radius of the corps project. Forecasting an unemployment rate for this labor shed could be accomplished in numerous ways using standard forecasting techniques. One method would be to obtain yearly average unemployment rates over a number of years and use the average of these figures as an estimate. Other, more complex techniques could employ fitting curves to historical data, auto regressive or moving average techniques, or using ratios of project labor shed unemployment rates to national rates to step-down national unemployment forecasts produced by various macro models.

(1) Obtain inputs

a. Number of workers by skill designation:
Assume the same as in 4a

	Construction Year		
	1	2	3
Unskilled	55	154	66
Skilled	160	448	192
White Collar	35	98	42
TOTAL	250	700	300

b. Locality of workforce.
Assume the same as in 4a

Local	Construction Year		
	1	2	3
Unskilled	48	133	56
Skilled	134	365	154
White Collar	24	62	26
TOTAL	206	560	236

Non-Local

	Construction Year		
	1	2	3
Unskilled	7	21	10
Skilled	26	83	38
White Collar	11	36	16
TOTAL	44	140	64

c. Project Labor shed Unemployment Rate
Assume 6.9 percent

(2) Compute Previous Unemployment

a. Local Unskilled Workers: Using regression equation derived from Table 3

year 1 =
.212(48) + 1.83 (48*.069) + .267 = 17
year 2 = 47
year 3 = 20

b. Local Skilled Workers: Using regression equation derived from Table 3

year 1 =
.30(134) - .522 = 40
year 2 = 110
year 3 = 46

c. Local White Collar: Using regression equation derived from Table 3

year 1 =
.025(24) + 2.56(24*.069) + 1.73 = 2
year 2 = 6
year 3 = 3

d. Non-local Workers: While the regression equations for local workers of unskilled, skilled and white collar occupational specialties yielded explained variance coefficients of sufficient size to warrant their use, for non-local workers coefficients of determination for unskilled and white collar workers were too low. Instead the overall regression equation predicting total otherwise unemployed non-local workers is used. Once an estimate of total otherwise unemployed workers has been made, judgments about the distribution by occupational specialty can be made.

e. Skill Classification of Non-Local Unemployed:

The CWS indicated that for the national survey the non-local workforce was composed of 15 percent unskilled, 59 percent skilled, and 26 percent white collar workers. These estimates are used to disaggregate the estimates of otherwise unemployed non-local workers.

	Construction Year		
	1	2	3
Unskilled (15%)	1	3	1
Skilled (59%)	3	10	5
White Collar (26%)	1	2	2
TOTAL (100%)	5	15	8

f. Deseasonalize Estimates: The estimates of numbers of otherwise unemployed workers used on the Corps project still contain unemployment produced by seasonal factors. Multiplying the estimated number of otherwise unemployed skilled and unskilled workers by .79 will result in deseasonalized estimates. The figure of .79 is derived from the average amplitude of seasonal influence as developed in IWR 81-R05.

$$.79 = 1 - 8.4/39.6$$

As noted in this report white collar unemployment displayed no seasonal variation.

g. Final Estimate of Otherwise Unemployed Workers:

Construction Year	1	2	3
Unskilled	14	40	17
Skilled	34	95	40
White Collar	3	8	5
TOTAL	51	143	62

(3) Compute Wage Bill: computed as in e on page 30. Total wage bill for construction years 1 through 3 equals $6,150,560.

(4) Compute interest on wages: computed as in f on page 31. Total interest on wages equals $576,070.

(5) Compute Average Annual Benefits: Total wage bill plus interest on wages amortized at 7 5/8 percent discount rate over 50 years life yields average annual employment benefits of $510,645.

c. Test of Procedures

The process of ordinary least squares regression will always result in some improvement in ability to explain the variation in data which were used to fit the regression line over and above the explanation provided by the mean and variance of the data. In practical applications or regression analyses for predictive purposes it is seldom likely that the exact combination of variable values used to devise the original equation will be encountered. As a predictive tool employing data not used in determining the regression line it may or may not be true that the equation offers an improvement in explaining variation in the data.

It would be helpful, therefore, if the power of regression equations developed could be tested on data not included in the computation of the equations. To accomplish this test, data on the number of unemployed workers from seven projects from the North Atlantic and New England divisions which were collected in the construction worker survey pretest were compared with predictions generated by the regression equations, as well as with estimates made using the procedure developed in the IWR 81-R05 research report.

Table 4 presents these comparisons. The testing procedure compares the estimates of the number of otherwise unemployed workers by occupational category with the actual number. Deviations from the actual number are squared, and summed for the seven projects. As the table shows the procedure devised in IWR 81-R05 produced estimates of numbers of otherwise unemployed workers which were closer to actual values reported for all three occupational categories.

It should be emphasized that the data used to perform the comparison was developed through a pre-test of the construction worker survey questionnaire. The pre-test utilized somewhat different distribution strategies than were employed in the actual survey, and had a significantly lower response rate than did the national survey. In addition the pre-test was confined to only one region of the country. These factors should be considered in evaluating the results obtained. Nevertheless, the results suggest that the estimation procedure developed in IWR 81-R05 is more robust than the procedure developed through time-series analysis.

d. Summary

Two methods for computing employment benefits have been illustrated. Each method is based on the construction worker survey data. Approach a, developed using a cross-sectional analysis of the data yields somewhat higher estimated employment benefits ($792,274) compared with approach b ($510,645) which was developed using a time series analysis of the same data. A comparison of the procedures using data obtained during the pre-test of the construction worker questionnaire suggests that procedure a provides a better estimated of the use of otherwise unemployed workers at Corps projects. This conclusion however, must be tempered in light of the nature of the data used to perform the comparison. It is clear a more rigorous comparison of the approaches need to be performed.

Table 4. Comparison of Estimates of Otherwise Unemployed Workers
Produced by Alternate Estimation Procedures

	No. of Unskilled Otherwise Unemployed					No. of Skilled Otherwise Unemployed					No. of White Collar Otherwise Unemployed				
	Estimated by 82-R05			Estimated by Time Series Regressions		Estimated by 81-R05			Estimated by Time Series Regressions		Estimated by 81-R05			Estimated by Time Series Regressions	
Project	Actual	N	Dev^2	N	Dev^2	Actual	N	Dev^2	N	Dev^2	Actual	N	Dev^2	N	Dev^2
Yonkers	4	4	0	3	1	8	5	9	3	25	0	1	1	2	4
Bloomington	11	11	0	8	9	32	30	4	20	100	4	4	0	4	0
Blue Marsh	5	3	4	2	9	12	16	16	13	1	3	2	1	3	0
Cowanesque	12	15	9	9	9	42	36	36	17	625	4	3	1	4	0
Tioga-Hammond	9	11	4	7	4	29	23	36	15	196	0	2	4	3	9
Park River	2	2	0	2	0	6	5	1	4	4	0	0	0	0	0
ΣDev^2			17		32			102		995			7		13
mean Dev^2			2.8		5.3			17		165			1.2		2.2

5. Continuing Research Efforts

Research into the use of otherwise unemployed workers on Corps projects has resulted in the development of several procedures for estimating employment benefits. While the research has provided answers to some sets of questions, it has raised new questions or permitted more refined questions to be asked. This section describes research currently underway to provide a better understanding of the employment effects of Corps construction projects, and outlines several areas for additional research inquiry.

a. Research Underway

(1) User Manual

While the analyses pursued in the IWR research have yielded benefit estimation procedures, it is likely that raw data from the construction workforce survey and other secondary data collection efforts could be used in a variety of ways if they were easily available. For example, users could choose to perform basic employment benefit analyses using data from similar projects or projects in the same geographic locale to see if estimates more sensitive to particular project circumstances could be derived. Accordingly, work is currently underway to develop a user manual for accessing the various data bases which have been developed in the course of the research. These data bases will be mounted on the Corps central computer system and will be accessible for field analysis and use.

(2) Trickle-Down Benefits Research

In addition to the direct employment effects of public works projects on "otherwise unemployed" workers, it is likely that construction projects may create other employment opportunities. These opportunities may take several forms. Employment opportunities may be broadened by an expansion in economic activity produced by construction projects. Such effects include direct, induced or secondary employment effects and refer to an increase in jobs in supply and service industries, which is stimulated by increased demand for goods and services by contractors and workforces.

Another category of employment activities may be created by the vacancies which employed workers create if they elect to obtain employment on construction projects. Vacancies created by workers may allow a "domino-effect" chain reaction of employment upgrading as employed workers move forward to take higher paying jobs. Differences between wages associated with such movements become measures of changes in productivity and measures of underemployment. At some point in this process an otherwise unemployed worker can enter the chain and a reduction in the pool of unemployed labor results. This category of employment opportunities, then, may include both underemployment and unemployment effects.

This class of employment opportunities associated with job vacancies created by a construction project is referred to as trickle-down employment effects. To date, such effects have not been well-documented in the literature, and theoretical and practical problems concerning the operationalization and measurement of these concepts remain to be solved. Currently research is underway to address these difficulties and to empirically measure the trickle-down effects of Corps civil works construction projects. The scope of the research on this issue is limited, being confined to a case study approach to test the utility of a measurement approach employing secondary data.

b. Areas Where Additional Research is Needed

(1) Test of Employment Benefits Procedures

IWR research on the use of otherwise unemployed labor at Corps construction projects has resulted in the creation methods for estimating the proportion of otherwise unemployed workers used on Corps projects. In addition to the IWR methods the Bureau of Reclamation and Department of Agriculture have methods for estimating the use of such workers on their projects. Each method yields different estimates of the number of otherwise unemployed workers, and consequently different estimates of employment benefits. Differences are not trivial. Using the hypothetical example, the difference between the approaches presented in this paper amounted to $281,629 or 36 percent of the larger estimate.

While the methods based on IWR research have the most grounding in empirical data, additional testing of these methods would be quite valuable. A controlled test of the several available estimating procedures is likely to yield valuable information concerning the accuracy of the procedures.

To accomplish such a test it is proposed that a replication constructon workforce survey be performed at 10-15 Corps construction projects. The survey would employ the questionnaire utilized in the 1979 survey with possible updating where necessary. Instead of being handed out to all workers in the field, however, the survey would be distributed to new workers as they are hired as part of initial processing. This method should be less costly, and less cumbersome for Corps and contractors.

Predicted values of otherwise unemployed workers derived from each of the estimating procedures would be compared with actual values obtained. Absolute and relative errors of the methods would be computed, and subject to various analyses of variance operations to determine major sources of error in each method. An assessment of the most accurate method would be made. In addition, possible strategies for reworking or upgrading procedures would be developed as a result of the analyses.

(2) Creation of an Employment Benefits Model

The process of deriving employment benefits is somewhat complex, involving a number of steps. A computerized model of the process would greatly speed the calculation of employment benefits. Such a model would be micro-computer based, and would be designed for use as a stand alone system, and also capable of being integrated into a larger community impact assessment model. It is anticipated the model would have built-in defaults based on IWR research, but would allow users to input additional data, and modify major assumptions.

(3) Effectiveness of Policy Options for Use of Construction Projects as Local Development Stimulus.

Large construction projects can sometimes create negative socio-economic effects. Many of the negative social impacts are produced by the influx of workers building the project. Increases in population produced by importing workers and their families have a number of direct socio-economic consequences for local communities. Demand for housing and other community services such as roads, sewers, and schools is likely to be increased. In-migrating populations may differ from the local population in age composition, education and income levels, and values. Such differences can lead to conflicts among "old timers" and "newcomers".

Construction projects can also impact local economies by pumping in large sums of money. Wages provided by the project and to some degree local expenditures for equipment and supplies may induce expansion of local businesses. Such growth may create secondary employment opportunities and thus spur additional population increases. This rapid economic expansion of local communities in response to the infusion of people and money is the "boom" which has often been followed by the "bust" upon completion of the construction project. Such precipitous decline in the economy of local areas has significant consequences for the entire social system. Considerable study has been devoted to developing ways to anticipate the types and magnitudes of socio-economic changes associated with large scale development projects.

Most community impact studies have focused on the negative impacts of a project on fiscal base and community structure. While this aspect of community assessment is valuable, other analyses could be performed on the impact of construction projects on local areas which decision-makers would find equally valuable. Such analyses would address the issue of how local communities could obtain the most benefit from the employment and income stimulus a large construction project provides.

Current socio-economic assessments do not provide decision-makers with information to address this issue. The proposed research would develop information on how a construction project could be used most effectively to stimulate long term local development. Specifically, the research would study the impact of the following policy options on local socio-economic conditions:

a. Phasing of Construction: Construction scheduling typically resembles a normal curve, having a "peak" period of construction activity. During peak conditions, shortages of local labor are most likely to occur, producing an influx of workers and increased demand for short-term housing and services. Alternate construction schedules are possible to broaden and lower the worker demand curve.

b. Use of Local Workers: As a general rule research has shown the greater the proportion of non-local workers employed on projects, the greater the negative socio-economic impacts. Policy options are available to increase the number of local workers hired on projects. Options include hiring quotas as well as training programs.

A full discussion of issues relating to the implementation of various policy options regarding phasing of construction and use of local workers would be performed. For example, one policy to increase use of local workers is to institute training programs for local workers. An issue here is which local workers to train. Options include programs for the unskilled unemployed or programs for the relatively skilled underemployed. Under the replacement labor hypothesis, currently under research at IWR, the latter option may yield greater results since the "jump" from relatively skilled to skilled construction occupations may not be as great as that from unskilled to the skilled positions. The positions vacated could then be filled by the unemployed.

Any consideration of policy options would also have to be evaluated within the context of existing community institutional arrangements and infrastructure capabilities. Such factors are likely to be important intervening variables capable of affecting the viability of policy options.

(4) Determinants of Local/Non-Local Workforce Composition

The distribution of local/non-local workers on Corps construction projects has important implications for both employment benefit calculations, and for community impact assessment purposes. Non-local workers have been shown to have different unemployment experience than local workers. In addition, studies have indicated the greater the proportion of non-local workers, the greater the negative social impacts with which local communities may be faced.

The current procedure for estimating the use of non-local workers on constructions projects is a regression equation developed from the 1979 Construction Worker Survey. This equation indicates that the number of non-local workers is a ratio of project size. No social or economic characteristics were found which explained variation in use of non-local workers.

The proposed research seeks to develop a procedure for estimating the non-local workforce, which incorporates more powerful explanatory variables. Additional analyses of the CWS data will be performed. In addition, several current labor forecasting studies would be examined. Several models would be developed to estimate the number of non-local workers on projects. These models would be tested at projects surveyed for the test of employment benefits procedures.

The product of the research would be a revised estimating equation for non-local workers, and a short technical report on the research.

c. Summary

Employment benefits research accomplished thus far has raised new questions and has made it possible to ask more refined questions about the employment effects of Corps projects. To address such questions a number of research projects are currently underway. These projects are oriented to allowing field users greater access to the data obtained from the research, as well as investigating the indirect employment effects of Corps projects. In addition, several new research topics have been suggested. The proposed research is oriented to strengthening and streamlining benefit estimation procedures, and broadening our knowledge of how to use policies to achieve greater positive employment effects from Corps construction projects.

6. Conclusion

The purpose of this paper has been to report on the status of employment benefits research being conducted at IWR. Several theoretical and measurement issues which complicate the research were discussed. The manner in which these issues have been addressed by IWR has been described. Two research studies completed thus far have produced two approaches for estimating employment benefits. As noted, it cannot conclusively be determined which of the methods is the superior; however, a comparison of the methods using data collected for projects during the pre-test of the construction workforce survey suggests that the procedure developed in IWR 81-R05 provides estimates which are closer to actual values than the alternate procedure developed using time-series data.

Continuing research and development activities on the employment effects of Corps projects now underway as well as proposed were briefly described. These activities include the creation of user manuals to allow field access to all research data; the initiation of a testing program to systematically test and analyze benefit estimate procedures derived from on-going research; and a program to evaluate the impact of various construction policies on employment generation. In addition to the research on direct employment effects, it was noted that research into the indirect or "trickle-down" employment effects of Corps construction projects is underway. This research is focused on identifying a measurement procedure for determining the extent to which vacancies created by employed workers who take construction positions at Corps projects are filled by unemployed workers.

In summary, the on-going program of employment benefit research at IWR has provided a better understanding of the complex phenomena associated with construction unemployment and the use of unemployed workers on Corps projects. The research has provided empirically-based methods for estimating employment benefits of Corps construction projects. These estimates will better document the contribution that Corps projects make to national and regional development and socio-economic well-being. In addition, the continuing and proposed research offers the promise of increasing our ability to use Corps projects to enhance the positive impact they can make on regional development.

References

Bingham, B. 1978. U.S. Civil Works Construction Shows Decrease in Required Labor. Monthly Labor Review. October.

Chalmers, J. 1977. Construction Worker Survey. Report prepared for Bureau of Reclamation, Denver, Colorado. Mt. West Research, Tempe, AZ.

Chalmers, J. and R. Threadgill. 1981. Evaluation of Underutilized Resources in Water-Resources Development. Water Resources Research, 17 455-461.

Department of Labor. 1977. Construction Labor Demand System. Employment Standards Administration, Washington, D.C.

Department of Labor. 1979. Seasonal and Cyclical Fluctuations in Construction Activity, Employment and Unemployment. Employment Standards Administration, Washington, D.C.

Duncan, B. 1982. Labor Response Functions Linking Regional Unemployment Rates to the Proportion of Previously Unemployed Workers Employed at Corps Construction Projects. Unpublished research report. Institute for Water Resources, Ft. Belvoir, VA.

Dunning, C. 1981. Report of Survey of Corps of Engineer Construction Workforce. IWR Research Report 81-R05; Ft. Belvoir, VA.

Eckstein, O. 1958. Water Resources Development: The Economics of Project Evaluation. Cambridge, Harvard University Press.

Haveman, R. and J. Krutilla. 1968. Unemployment, Idle Capacity, and the Evaluation of Public Expenditures. Resources for the Future, Baltimore, MD.

Kim, U. 1972. Measuring and Analyzing the Impact of Employment Generation Benefits of a Public Water Resource Development Project in Appalachia. U.S. Army Corps of Engineers, Institute for Water Resources, Ft. Belvoir, VA.

Knetsch, J., R. Haveman, C. Howe, J. Krutilla, and M. Brewer, 1968. Federal Natural Resources Development: Basic Issues in Benefit and Cost Measurement. Natural Resources Policy Center, The George Washington University, Washington, D.C.

Sulvetta, A. and N. Thompson. 1975. An Evaluation of the Public Works Impact Program. Economic Development Administration. PB 263 098, Washington, D.C.

Thompson, W. 1965. A Preface to Urban Economics. Resources for the Future. Johns Hopkins Press. Baltimore.