A METHOD FOR ESTIMATING NET MIGRATION AND NET EMPLOYMENT EFFECTS OF PROJECT LOCATION USING POPULATION CENSUS DATA

G. K. Kripalani, Western Michigan University

INTRODUCTION

The location of a project in an area affects job opportunities facing different sex and occupational groups differently, depending upon the nature of industries affected by project location and the sex/skill composition of labor demanded in the affected industries. Change in job opportunities affects net migration to or from the area and consequently the population in the area. Such changes have an impact on the prospective or potential unemployment in the area. This impact is, however, different from the total change in employment due to project location on account of leakage of new job opportunities to potential or prospective net migrants. Further, net migration response to changes in job availability varies according to age, sex and type of labor involved. Hence, for studying employment and population changes as a consequence of the location of a project in an area, labor must be subdivided into reasonably broad homogeneous groups by sex, occupation and age.

The estimation procedure is centered on the assumptions that (a) human resources are less than perfectly mobile, (b) there exist net migration response differentials by age and sex, (c) migration response to changes in jobs is restricted to labor force members (job seekers) only, (d) non-labor-force members of the population do not migrate except as spouses and dependent children of migrating labor force members, (e) desired employment participation is a parameter which is unaffected by changes in job opportunities, and (f) the probability of a prospective unemployed person to become employed as job opportunities expand is a function of sex and age. The procedure analyzes actual employment data for two adjacent census points to study area's labor market's past allocation patterns of new job vacancies to determine relative preferences for various age and sex groups. These relative preferences and estimates of job seekers by age and sex provide a basis for deriving relative probability coefficients. Estimates of net migration response differentials are then used to estimate the 'leakage' of jobs to prospective net migrants and, hence, to determine net employment, net migration and net population effects of project location or withdrawal.

It is hypothesized that net migration of a group is related to the excess population of the group, where excess population is defined as the difference between the actual population and the desired population relative to the actual level of employment available to the group. The desired population is defined as that population which, relative to the actual jobs available to the group, would have the desired employment participation. Net migration response coefficient of the group is equal to the proportion of the excess population that will net migrate. The concept of desired employment participation corresponds to labor force participation rate but is considered preferable to the latter on account of the subjective character of the latter and for other reasons not fully elaborated here.[1]

Consider a group i and a time interval $(0, 1)$. If the group has survived population P_i^s at the end of the time interval at $t = 1$, employment E_i, the desired employment participation rate λ_i^*, then according to the above hypothesis, the number of net migrants of the group M_i will be given by

$$M_i = g_i(E_i/\lambda_i^* - P_i^s) \tag{1}$$

$$= g_i(E_i - E_i^*)/\lambda_i^* \tag{2}$$

where g_i denotes net migration response of the group and is equal to the proportion of the surplus population that will net migrate and $E_i^* = P_i^s \cdot \lambda_i^*$ denotes desired jobs relative to the group population P_i^s.

(1) may also be written as

$$M_i/P_i^s = g_i(E_i/P_i^s \lambda_i^* - 1) \tag{3}$$

or

$$\mu_i = g_i\left(\frac{E_i - E_i^*}{E_i^*}\right) = g_i\left(\frac{E_i}{E_i^*} - 1\right)$$

where $M_i/P_i^s = \mu_i$, the rate of net migration and $E_i^* = P_i^s \lambda_i^*$ = desired jobs. The real significance of this form of the model is that the net migration rate is proportional to the percentage deficit in jobs, a measure corresponding to 'potential' rate of unemployment in the without project situation.

If P_i is the actual population of the group at $t = 1$, the relationship between the actual population P_i and survived population P_i^s is given by

$$P_i = P_i^s(1 + \mu_i). \tag{4}$$

Substituting (3) into (4) we have

$$P_i = P_i^s(1 - g_i) + g_i E_i/\lambda_i^*. \tag{5}$$

g_i is a measure of the mobility of the group in question. $g_i = 1$ for a perfectly mobile group while $g_i = 0$ for a perfectly immobile group. When $g_i = 1$, $P_i = E_i / \lambda_i^*$ or the population at the end of the time interval at $t = 1$, is the desired population corresponding to the level of jobs at that time. For a perfectly immobile group $g_i = 0$, and the population at the end of the time interval at $t = 1$ is $P_i = P_i^s$ or the survived population.

A Property of the Proposed Model

A property of the proposed model relationship between net migration and surplus population (equation 1) or between net migration and job deficit (equation 2) is that when job opportunities available to a group increase as a result of the location of the project, net out-migration of the group is reduced or net inmigration increased; and hence in a net out-migration area a proportion of the new jobs is appropriated by those net migrants whose net out-migration has been withheld due to increased job opportunities in the area. An increase in job opportunities by ΔE_i would mean that the resultant net inmigration or withheld net out-migration is equal to

$$\Delta M_i = g_i \Delta E_i / \lambda_i^* . \tag{6}$$

It is reasonable to assume that these net out-migrants who would have net out-migrated from the area in the without-project situation but who now stay in the area in the with-project situation would do so only when they have the desired employment participation in the area. In other words, the jobs appropriated by these net migrants out of the ΔE_i addition jobs are given by

$$\Delta M_i \lambda_i^* = g_i \Delta E_i . \tag{7}$$

This means that the net reduction in the number of the unemployed in the area (assuming it to be a net out-migration, i.e., a job deficit area) is given by $(1 - g_i) \Delta E_i$ or the net reduction in the number of the unemployed per unit new job is given by

$$1 - g_i . \tag{8}$$

Now g_i is the coefficient of net migration response of a group. A perfectly mobile group has $g_i = 1$ and a perfectly immobile group has $g_i = 0$. The impact on the unemployed per unit job is thus greater for relatively more immobile groups than for these groups which are relatively more mobile.

Basis For Allocating Additional Jobs Due To The Project Among Age Groups

The preceding discussion on estimating the impact on the area's unemployed measured by the reduction in the number of the unemployed due to increase in job opportunities assumes that the additional jobs for the group as a result of the project is known. It is assumed here that total additional employment ascribable to the project (defined as the difference between employment in the with and without-project situations) is given in terms of sex separately for male and female categories.

Net migration response to job deficit or surplus population varies by age and sex and hence net employment effects of additional employment due to project will depend on how additional jobs for males and for females are distributed among age groups. The problem, therefore, is to find a suitable basis for allocating total additional jobs among age groups for each of these categories of labor.

The procedure outlined hereunder assumes that the employment, population, etc., situation in the project area in the without-project situation is given and known. The project is then superimposed on the area and its impact on variables of interest estimated. Further, the procedure outlined hereunder relates to an area which is assumed to be an area of net job deficit in both without-project and with-project situations. Appropriate procedures applicable to an area of net job surplus in the without-project situation or to an area of net job deficit in the without-project situation but which is expected to become an area of net job surplus in the with-project situation are not discussed here.

A critical question is involved in the choice of an appropriate method for allocating additional jobs among age groups. Does the labor market show differential preferences in allocating jobs by age or is the chance of a 'potential' (or prospective) unemployed person becoming employed the same for all age groups? Illustrative calculations with respect to some randomly chosen areas showed that the labor market displays significant selectivity differentials between age groups. Hence, the equal probability assumption was not considered reasonable. To estimate relative probabilities, a relative probability coefficient P_i is associated with each age i, so that the ratio of the probability of becoming employed of a job seeker in age group i to that of a job seeker in age group j is given by P_i / P_j. On this basis, the distribution of additional jobs among age groups will be based on the quantities $P_i S_i$ where

S_i = desired job vacancies or the number of job seekers and is equal to $E_i^* - E_i^h$ where

E_i^* = desired jobs by the age group i in the without-project situation:

E_i^h = number of persons in the age group i in continuous employment over the decade.

${}^oE_i$ = actual employment of the age group in the without-project situation.

In order to estimate P_i's, we may make use of available information on the actual distribution of job vacancies among age groups during the most recent decade, say (-1, 0) in the without-project situation. If ${}^oE_i$ and E_i^h are known, an appropriate basis for allocating additional jobs by age is given by the quantity

$$ {}^oE_i^v = {}^oE_i - E_i^h $$

Since P_i's are relative, they may be so defined that

$$ (9) \qquad \sum_i p_i S_i = \sum_i S_i . $$

We have

$$ (10) \qquad {}^oE_i^v \Big/ \sum_i {}^oE_i^v = p_i S_i \Big/ \sum_i p_i S_i . $$

Hence since by definition $\sum_i p_i S_i = \sum_i S_i$, we have

$$ (11) \qquad p_i S_i = \sum_i S_i \cdot {}^oE_i^v / \sum_i {}^oE_i^v . $$

P_i's can now be calculated since all the quantities in the above relationship are known.

A look at equation (11) will show that distribution of jobs on the basis of $P_i S_i$ is the same as the distribution on the basis of job vacancies filled in decade (-1, 0) in the without-project situation viz. ${}^oE_i^v$ since the quantity $\sum_i S_i / \sum_i {}^oE_i^v$ is the same for all age groups and does not affect the distribution over age groups. Thus, a basis which drops the equal probability assumption leads to a basis which provides that the distribution of additional jobs due to the project over age groups should be on the basis of the actual experience of decade (-1, 0) in the matter of distribution of job vacancies.

The total number of additional jobs taken up in the with-project situation by prospective net migrants who otherwise, in the without-project situation, would have "net out-migrated" from the area is given by

$$ (12) \qquad \sum_s \sum_i \left\{ \Delta E_i (f) \cdot g_i (f) \right\} $$

where the double summation refers to sex and age.

The quantity (12) represents net migration effects in terms of leakage of additional jobs to prospective migrants. Thus, the net employment effect is equal to the difference between total additional jobs due to the project and the jobs lost by leakage to prospective net migrants.

The net migration and net population effects of project location in terms of numbers of people consist of two components viz (1) prospective migrants who take up some of the additional jobs and (2) their dependent migrants. This quantity (2) represents dependent net migration of spouses and children of associated withheld prospective primary net migrants. The procedure for estimating this component of dependent net migration is not being discussed in this paper.

The procedure outlined above is applied as an illustration to the State of Wisconsin for the year 1970. Since a high proportion of an area's job seekers is among the young age groups and since relative net migration response coefficients for young age groups are high, generally a very significant proportion of new jobs will be appropriated by potential (now withheld) net out-migrants and a relatively small proportion of new jobs will accrue to the potential unemployed of the area. Calculations based on 100 additional jobs in each sex category show the following results:

Based on Wisconsin State (Per 100 additional jobs in the relevant sex)

Jobs Accruing to:	Males	Females
(a) "Potential" Net Migrants (Leakage of Jobs)	91.7	83.3
(b) "Potential" unemployed of the area who would have remained in the area as unemployed	8.3	16.7

For reasons of space, actual application of the procedure is done with respect to Wisconsin Males only. See Tables 1 through 3.

Footnotes

[1] The concept of desired employment participation was developed by George S. Tolley in a Ph. D. dissertation (unpublished). See Jansen (1966). In the present study, desired employment participation by age and sex is assumed to be the corresponding U. S. national labor force participation rate.

References

Battelle Memorial Institute, Columbus Laboratories. 1966. Final Report on a Dynamic Model of the Economy of the Susquehanna River Basin.

Industrial Relations Research Institute. 1966. Retraining and Migration as Factors in Regional Economic Development, (September), Madison, University of Wisconsin.

Jansen, E. F., Jr. 1966. Employment participation Behavioral Relationships. Unpublished Ph. D. thesis, Department of Economics, North Carolina State University, Raleigh, N. C.

Kripalani, G. K., 1970. Structural Unemployment in the Evaluation of Natural Resource Projects, pp. 85-120, in G. S. Tolley (Ed.), "Estimation of First Round and Selected Subsequent Income Effects of Water Resource Investments." Published as a Report, IWR Report 70-1, under Contract No. DA49-129-CIVENG-65-11 by the U. S. Army Engineer Institute for Water Resources, Department of the Army Corps of Engineers, Springfield, Virginia, 1970.

Mazek, W. F., 1966. The Efficacy of Labor Migration With Special Emphasis on Depressed Areas. Working Paper CWR 2, June. Institute for Urban and Regional Studies, Washington University, St. Louis, Missouri.

Somers, Gerald G., 1954. Labor Supply for Manufacturing in a Coal Area. Monthly Labor Review, (December), 1327-1330.

Code to Expanded Symbols -- Notation Used

Column	Symbol	Significance
Table 1.1		
(1)	i	Stands for age group.
(2)	P(i, m, 70)	Population of males aged i in 1970.
(3)	$SR_{10}(i, m, 70)$	10-year survival rate applicable to males aged i in 1970
(4)	$\lambda^*(i + 10, m, 80)$	Desired labor force participation rate assumed for males aged (i + 10) in 1980.
(5)	$E^*(i + 10, m, 80)$	Desired jobs for males aged (i + 10) in 1980. = (2) x (3) x (4).
Table 1.2		
(2)	E (i, m, 70)	Employed males aged i in 1970.
(3)	$SR_{10}(i, m, 70)$	10-year survival rate (same as in col. (3) of Table 1.1).
(4)	$E^s_{10}(i, m, 70)$	1980 survivors of employed males aged i in 1970(assumed to be persons in continuous employment over the 1970-80 decade as also in 1980) = (2) x (3).
Table 1.3		
(2)	$E^* (i + 10, m, 80)$	Desired jobs for males aged (i +10) in 1980 (same as col. (5) Table 1.1)
(3)	$E^s_{10} (i, m, 70)$	Persons in continuous employment over the 1970-80 decade (Col. (4) of Table 1.2)
(4)	JS (i + 10, m, 1980)	Job seekers, males aged (i + 10) in 1980 (Col. (2) - Col. (3))
(5)	P (i + 10, m, 1980)	Relative probability coefficient (Relative probability of an unemployed male aged (i + 10) in 1980, becoming employed if additional male job opportunities arose in the area).
(8)	g (i, m)	Net migration response coefficient for males aged i (These coefficients are calculated by race, sex and age in other studies and have been commented upon in Kripalani, G. K. (1970) See References).

TABLE 1.1

WISCONSIN - MALES

Estimation of Desired Jobs in 1980, Assuming No Outmigration During 1970-80 Decade--

Age Group in 1970	Population 1970 (000's)	10-Year Survival Rate	Labor Force Participation Rate	Desired Jobs 1980 (000's)	Age in 1980
i	P (i, m, 70)	SR_{10}(i, m, 70)	λ^*(i + 10, m, 80)	(2) (3) (4)	i + 10
(1)	(2)	(3)	(4)	(5)	(6)
0- 4	195.4	.995	-	-	10-14
5- 9	235.1	.994	-	-	15-19
10-14	242.4	.987	.800	191.4	20-24
15-19	218.1	.981	.942	201.6	25-29
20-24	158.1	.980	.966	149.6	30-34
25-29	135.1	.978	.964	127.3	35-39
30-34	115.8	.970	.964	108.3	40-44
35-39	111.6	.954	.964	101.6	45-49
40-44	121.2	.929	.940	105.8	50-54
45-49	119.5	.889	.903	95.9	55-59
50-54	112.7	.832	.768	72.0	60-64
55-59	104.8	.759	.405	32.2	65-69
60-64	90.4	.663	.239	14.3	70-74
65-69	72.7	.548	.145	5.8	75-79
70-74	56.9	.431	-	-	80-84
75-84	63.1	-	-	-	85-94
85+	14.0	-	-	-	95+
4-5	86.3	.995	.181	16.1	14-15
6-7	93.2	.994	.436	40.4	16-17
8-9	97.6	.992	.539	52.2	18-19

Sources: Col. (2) and Col. (4): 1970 Census of Population. Col. 13: Vital Statistics of U.S., Annual 1967.

TABLE 1.2

WISCONSIN - MALES

Estimation of Survivors in 1980 of Those Employed in 1970 (= Persons Assumed to be in Continuous Employment Over 1970-80 Decade--

Age Group	Employed in 1970 (000's)	10-Year Survival Rate	1980 Survivors of Those Employed in 1970 (000's)	Age in 1980
i	E(i, m, 70)	SR_{10}(i, m, 70)	(2). (3)	i + 10
(1)	(2)	(3)	(4)	(5)
14-15	16.4	.981	16.1	24-25
16-17	34.2	.981	33.6	26-27
18-19	46.1	.981	45.2	28-29
20-24	114.5	.980	112.2	30-34
25-29	122.5	.978	119.8	35-39
30-34	108.1	.970	104.9	40-44
35-39	105.5	.954	100.6	45-49
40-44	114.2	.929	106.1	50-54
45-49	110.6	.889	98.3	55-59
50-54	103.5	.832	86.1	60-64
55-59	92.1	.759	69.9	65-69
60-64	67.8	.663	45.0	70-74

(1)	(2)	(3)	(4)	(5)
65-69	28.2	.548	15.5	75-79
70-74	13.2	.431	5.7	80-84
75-84	7.6	-	-	85-94
85+	1.1	-	-	95+
4-5	0	.995	0	14-15
6-7	0	.994	0	16-17
8-9	0	.992	0	18-19

Sources: Col. (2) 1970 Census of Population. Col. (3) Vital Statistics of U.S., Annual 1967.

TABLE 1.3

WISCONSIN - MALES

Estimation of (a) Percent Distribution of 100 Additional Jobs by Age and (b) Jobs Taken up by Prospective Net Outmigrants and (c) Net Employment Effects. (Per 100 Additional Male Jobs.)

(Per 100 Additional Male Jobs)

Age in 1980	Desired Jobs 1980 (000's)	Persons in Continuous Employment 1970-80	Job Seekers 1980	Relative Probability Coefficient	Relative Weight for 100 Additional Jobs by Age	Percent Distribution of 100 Male Additional Jobs	Net Migration Response Coefficient	Jobs Taken by Potential Withheld Net Migrants (Labor Force)	Net Employment Effects
(i + 10)	@	@	@	@	(4).(5)	(6)/2.38	g(i,m)	(7) (8)	(7) -(9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
14-15	16.1	0	16.1	.80	12.9	5.00	.9249	4.92	0.08
16-17	40.4	0	40.9	.89	36.0	13.95	.9249	12.90	1.05
18-19	52.2	0	52.2	.60	31.3	12.13	.9249	11.22	0.91
20-24	191.4	8.1	183.3	.58	106.3	41.20	.9249	38.11	3.09
25-29	201.6	86.9	114.7	.45	51.6	20.00	.9027	18.05	1.95
30-34	149.6	108.4	41.2	.34	14.0	5.43	.8806	4.78	0.65
35-39	127.3	115.5	11.8	.26	3.1	1.20	.8204	0.98	0.22
40-44	108.3	101.1	7.2	.18	1.3	0.50	.8204	0.41	0.04
45-49	101.6	96.0	5.6	.13	0.7	0.27	.5886[a]	0.16	0.11
50-54	105.8	99.7	6.1	.07	0.4	0.16	.5886[a]	0.09	0.07
55-59	95.9	88.8	7.1	.04	0.3	0.12	.4716[b]	0.06	0.06
60-64	72.0	66.1	5.9	.01	0.1	0.04	.4716[b]	0.02	0.02
65+	52.3	41.3	11.0	-	0	0	0	0	0
Total	1,314.5	811.9	502.6	-	238.0	100.0	-	91.70	8.30

[a] Based on age group 45-54.

[b] Based on age group 55-64.

Sources: Col. (5): Estimated by graphical curve fitting to relevant observations by a procedure outlined in Corps of Engineers Study edited by Dr. G. S. Tolley. See G. K. Kripalani (1970) in "References."

Col. (8): See explanation under "Code."

@ For Cols. (2), (3), (4), (5) See "Code."