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SPATIAL AND SOCIOECONOMIC FACTORS INFLUENCING LABOR FORCE PARTICIPATION RATES

Roger Beck and J. Dean Jansma

INTRODUCTION

An economically viable rural American is generally accepted as a desirable national goal, but few policy guidelines or comprehensive programs for attaining this goal have been developed.¹ One reason for the current "piece-meal" approach in pursuing rural development goals is the lack of knowledge about basic economic interactions between the factors influencing the level and distribution of economic activities in rural areas. A second reason is the tendency to design rural development research and extension programs to attain quick payoffs which results in descriptive studies which emphasize what rather than why certain events are occurring in rural areas.

An additional concern is that studies of rural development policies and programs tend to focus on the land and capital inputs with only minimal concern for the labor input (Daft 1971). Yet, the need to examine factors affecting labor availability is important because the primary source of income for many rural residents is the sale of their labor services.² From a more aggregate perspective, Edwards and DePass (1975) found that an increase of 36 percent is required in the willingness of the nonmetropolitan population to join the labor force in order to attain balanced metropolitan and nonmetropolitan growth rates by 1990.

The objective of this paper is to report on research designed to investigate the relationships between labor availability and the level and distribution of economic activity in a rural area. The specific relationship being examined is the degree to which the labor force participa-

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¹ Numerous task forces, councils, conferences and government reports have emphasized the need for an economically strong and viable rural America, but few follow up with specific programs. See, for example, the Secretary of Agriculture's second annual report (1975) on Rural Development Goals and the U.S. Senate Committee Report (1971) on The Economic and Social Condition of Rural American in the 1970's.

² In 1969, wages and salaries provided 73.7 percent of total income for nonmetropolitan residents (Hines, et al.; 1975).

tion rate of the employable male population in a specific rural area is dependent on the access to employment opportunities and the socioeconomic characteristics of the residents of the area.

CONCEPTUAL MODEL

Traditionally, labor availability studies have concentrated on the socioeconomic characteristics of the people within the study area. The relationship between the spatial location of the residents and the numbers and kinds of employment opportunities has received much less attention.

A procedure for incorporating the effects of both socioeconomic and spatial characteristics in measuring labor availability is based on the regression model:

$$LFPR_i = c_0 + c_1 GAE_i + \sum_{k=2}^m c_k SEC_{ik}$$

where LFPR_i is labor force participation rate in area i, GAE is geographic access of people in i to employment opportunities, and SEC_{ik} is social and economic characteristics of people in i (Jansma and Goode 1976).

Geographic Access Variable:

The analytical basis for measuring geographic access to employment (GAE) is the gravity model. In this model the interaction between two points in space is positively related to the mass at the two points and negatively related to the distance between the points. It is assumed that an individual residing at place i is attracted by a job opportunity at a place j, including i = j, but increases in the distance between place i and place j reduce the magnitude of the attracting force.

It was hypothesized that the greater the level of geographic access to employment experienced by residents of an area, the greater the expected probability of an individual being a participant in the labor force, i.e., access to employment influences the labor force participation rate in a positive manner. This expectation is based on the premise that the employable popu-

³ In this study, the criterion for determining labor force participation is whether the individual was employed for 27 weeks or more. This criterion was used because: 1) it provides a measure of the employment record in determining association with the labor force; 2) a threshold value of 27 or more weeks assists in developing a measure of full employment; and 3) it permits comparisons of labor force participation rates based on secondary data sources. It is recognized that the term labor force participation rate has a specific meaning in labor economics -- being that portion of the population in the labor force whether or not they are employed. In subsequent studies, the term labor utilization has been used by the authors to portray the concept of labor availability.

lation will respond to job opportunities by offering their labor services.

As developed in a paper by Beck and Goode (1981), the geographic access to employment opportunities experienced by residents of community i is positively related to the excess demand for labor in community j and negatively related to the distance between community i and community j .

Operationalization of the concept of geographic access to employment (GAE) is expressed as a relationship of the form:

$$GAE_i = \sum_{j=1}^n \frac{E_j}{D_{ij}}$$

where GAE _{i} is the potential geographic access to employment experienced by residents of place i ; E_j is a measure of employment opportunities at the place of residence (when $i = j$) and other alternative places, $j=1, 2, 3, \dots, n$, and D_{ij} is a measure of distance between the place of residence and the place of employment, including $i=j$.

Empirical as well as conceptual alternatives are available for specifying the employment and distance components of the independent variable in the geographic access model. Two approaches for specifying the employment variable are: 1) an aggregate approach which measures all employment opportunities within a predetermined radius; and 2) an a priori approach in which the spatial parameters of employment opportunities are approximated by the current commuting behavior of the residents in the area. For example, the geographic access to employment of the residents of a specific minor civil division (MCD), can be based on either: 1) the total jobs available within a, say, 10-mile radius of the MCD; or 2) the current employment destination of residents of the MCD. The first method for measuring geographic access is discussed in a study by Jansma and Goode (1976); the second approach is followed in this study using information from survey data. Parenthetically, a comparison of the two approaches showed the two measures provided nearly identical results in terms of the spatial distri-

bution of employment opportunities. (Beck 1977, p. 150).

Alternative approaches are also available for specifying the distance component in the geographic access variable. Both approaches start with the concept of the distance between centroids (centers of mass for residences and employment locations) developed by Firk (1976).⁴ But, the question remaining is whether to use mileage or time as the relevant measure of distance. In this study, both units of measure are used in developing a proxy measure of distance as indicated in the following equation:

$$Y_{ij} = a + b_1 X_{ij} - b_2 X_{ij}^2 \quad 0 \leq x \leq 25 \text{ miles}$$

where Y_{ij} is the estimated commuting time in minutes between i and j , and X_{ij} is the straight line mileage between the centroids of i and j , including $i = j$.

A positive intercept indicates an allowance for start-up and arrival time, with the remainder of the equation suggesting that the time of commuting increases with distance, but at a decreasing rate. In summary, the geographic access to employment, as defined in this study, is dependent on: 1) the location of places with alternative employment opportunities at which work trips terminate and 2) a measure of distance between the residence and the employment destination of each employed resident.

Socioeconomic Variables:

Literature was reviewed which provided insights into the selection of relevant socioeconomic variables in this study (Beck, 1977). From this review, the human capital school would have suggested that those individuals with greater amounts of embodied human capital would provide prospective employers with skills in demand and thus, more likely to be a full participant in the labor force. An alternative school of thought argues that available jobs influence whether an individual is fully employed or not, and that given two individuals with equal amounts of human capital, one may be employed and the other not, based on the random chance of available jobs. This study, in a sense, combines these two concepts, suggesting that both elements (the requisite skills and the employment opportunity) were necessary.

For this study, 28 characteristics within six general categories -- sex, age, education, occupation, work experience and family income -- are used to provide the framework for assigning socioeconomic characteristics to each individual respondent. An advantage of using the individual as the unit of observation is that the place of residence, place of work, occupation, and industry of employment can be linked. For example, the probability of a male, age 26-45, with a high school education, residing in subarea i , being a full participant in the labor force, given that his occupation is machine operator, can be estimated.

ANALYTICAL APPROACH

Source of Data:

In 1976, a mail questionnaire, coded to in-

⁴ A detailed description of the procedures used in construction of the centroids is found in Firk's (1976) unpublished dissertation. Firk calculated both employment and population centroids. The employment centroids were developed from information contained in The 1969 Dun and Bradstreet Credit File on U.S. Business Firms. The employment data in this file associates the longitude and latitude of the place of business with the number of employees at that point. This permits a centroid to be calculated by weighting the number of employees by their location. Similarly, population centroids were calculated from the data developed from the Fifth Count Population Summary Tape, 1970 of the Bureau of the Census. The straight line distance between the population centroid and the employment centroid for an area is then used as the measure of distance.

dicating the MCD of the recipient, was sent to each household including renters and⁵ property owners in Wayne County, Pennsylvania. A total of 12,874 questionnaires were distributed and 2,235 were returned. The low response rate of 17.4 percent obviously raises the question of whether the information provided in the returned questionnaires is representative of all the residents of the county. More specifically, the concern is whether the respondents within a particular socioeconomic class are more or less likely to be participants in the labor force than would be the case for the population of that socioeconomic class. The question cannot be answered directly, but comparison of the means and distribution of the responses to the questionnaire with secondary data sources provides indirect measures of comparability (Table 1). For example, the aggregate labor force participation rate (LFPR) for Wayne County males reported in the 1970 census is remarkably similar to the⁶ overall mean LFPR derived from the survey data. Comparisons between the census and survey data were also made, to the extent possible, on each specific independent variable. The only major difference in the two data sources is a significant overrepresentation of individuals with four or more years of college. A third comparison was made between the survey data and the 1969 Dun and Bradstreet Credit File on U.S. Business Firms as a check on the distribution of employment locations within the county. The distribution of jobs by MCD from the Dun and Bradstreet sources were found to be generally comparable with the survey data, with the survey indicating a somewhat larger employment base -- especially in the more rural MCD's.⁷

Specification of the Variables

Empirical estimation of the geographic access to employment (GAE) variable is based on a summation of the number of employees working in each of the 28 MCD's in Wayne County, plus the out-commuters, divided by the distance between that MCD and the MCD of residence of the employee. The distance measurement is based on the combined effect of mileage and time as expressed in the regression equation of the form discussed previously. Separate distance equations were

computed for those working within the county ($y = 6.56 + 1.94x - 0.04x^2$) and those commuting to destinations outside the county ($y = 5.17 + 1.95x - 0.005x^2$). Estimates of specific levels of GAE are recorded in Figure 1 for each MCD in Wayne County.

The GAE estimates are generally consistent with the central place patterns discussed in the regional economics literature. The county seat of Wayne County, Honesdale, and the adjoining townships have the highest level of geographic access to employment. Thus, the GAE estimates indicate that employment opportunities gradually decrease as one moves further from the county's principal central place.

A dichotomous dependent variable was used in estimating the equation $Y = f(GAE_i, SE_{ik})$, where $y = 1$ if the individual was a full participant and 0 otherwise;

GAE_i is the level of GAE for the MCD of residence;

SE_{ik} is the set of socioeconomic characteristics possessed by the individual residing in MCD_i.

Thus, the dependent variable can be interpreted as the probability that a male resident is working 27 weeks or more (an arbitrary definition of fully participating in the labor market) when he possesses a set of socioeconomic characteristics and experiences a level of geographic access to employment based on the MCD of his residence.

EMPIRICAL ANALYSIS

An overall R^2 of 0.46 was estimated on the basis of ordinary least squares analysis. More importantly, all the regression coefficients are significant at the "one percent level" except for the independent variables associated with education and family income in the 10 to 15 thousand dollars range (Table 2). A discussion of each of the general categories of independent variables follows.

Age: The age variable was divided into four categories. The estimated impact of age on the probability of a Wayne County male being a full participant in the labor force was hypothesized to be lower for the 18 to 24 year-olds (not yet established in labor force) and those in the 65 years and older class (high percentage of retirees). The division of the 25 to 65 years of age category into two groups (25-45 and 46-65) is designed to check for differences in the level of attachment to the labor force.

The regression results indicate that the age variable is highly significant when the over 65 age category is deleted. A reformulation of the

⁵ Wayne County is a medium-sized rural county in the northeast corner of Pennsylvania consisting of 28 minor civil divisions (boroughs and townships) with a population of 29,581 in 1970. Mailing addresses were obtained from a merged listing of two tax roles in the county.

⁶ The LFPR data from the Census were 80.8 percent and 80.6 percent from survey data. It should be noted, however, that the Census data were collected in 1969 and the survey data in 1975.

⁷ The distribution of jobs by MCD from the primary and secondary data sources showed the total number of jobs from the survey data for the 28 MCD's was 1404. The secondary data showed a total of 5942 jobs for the MCD's. Thus, the survey data accounted for 24 percent of the jobs as indicated by the secondary data source.

⁸ The independent variable is significant at the one percent level in both equations, but the R^2 is substantially higher for the out-commuters (0.83) than for those commuting within Wayne County (0.22). A regression equation including all commuters was also estimated as $y = 10.99 + 1.39x - .0039x^2$, with an R^2 of 0.53. There is only a very small difference in the value of the geographic access variable when the commuting data are treated separately or combined.

Table 1. Socioeconomic Variables and Number of Responses Used in Estimating the Labor Force Participation Rate for Males Wayne County, Pennsylvania

<u>Age</u>			<u>Education</u>			<u>Occupational Experience</u>		
	<u>N</u>	<u>%</u>		<u>N</u>	<u>%</u>		<u>N</u>	<u>%</u>
A ₁ 18 to 24 years	111	5.7	E ₁ less than high school	415	21.4	X ₁ less than 5 years	272	14.0
A ₂ 25 to 45 years	751	38.7	E ₂ high school	613	31.6	X ₂ 5 to 10 years	397	20.5
A ₃ 46 to 65 years	659	34.0	E ₃ some college	423	21.8	X ₃ more than 10 years	988	50.9
A ₄ more than 65 years	311	16.0	E ₄ college graduate	368	19.0			
Missing Data	108	5.6	Missing Data	121	6.2	Missing Data	283	14.6
Total N	1940	100.0	Total N	1940	100.0	Total N	1940	100.0

<u>Occupation</u>			<u>Family Income</u>		
	<u>N</u>	<u>%</u>		<u>N</u>	<u>%</u>
O ₁ machine operator	122	6.3	M ₁ less than \$5,000	244	12.6
O ₂ craftsman	385	19.9	M ₂ \$5,000 to \$10,000	574	29.5
O ₃ clerical	37	1.9	M ₃ \$10,001 to \$15,000	444	22.9
O ₄ professional & technical	300	15.5	M ₄ \$15,001 to \$20,000	251	12.9
O ₅ manager	200	10.3	M ₅ \$20,001 to \$25,000	100	5.2
O ₆ truck driver	78	4.0	M ₆ more than \$25,000	124	6.4
O ₇ retail or wholesale trade	131	6.8	Missing data	203	10.5
O ₈ farmer	158	8.1	Total N	1940	100.0
O ₉ laborer	158	8.1			
O ₁₀ service worker	74	3.8			
Missing data	297	15.3	<u>Geographic Access to Employment</u>	<u>N</u>	<u>%</u>
Total N	1940	100.0		1940	100.0

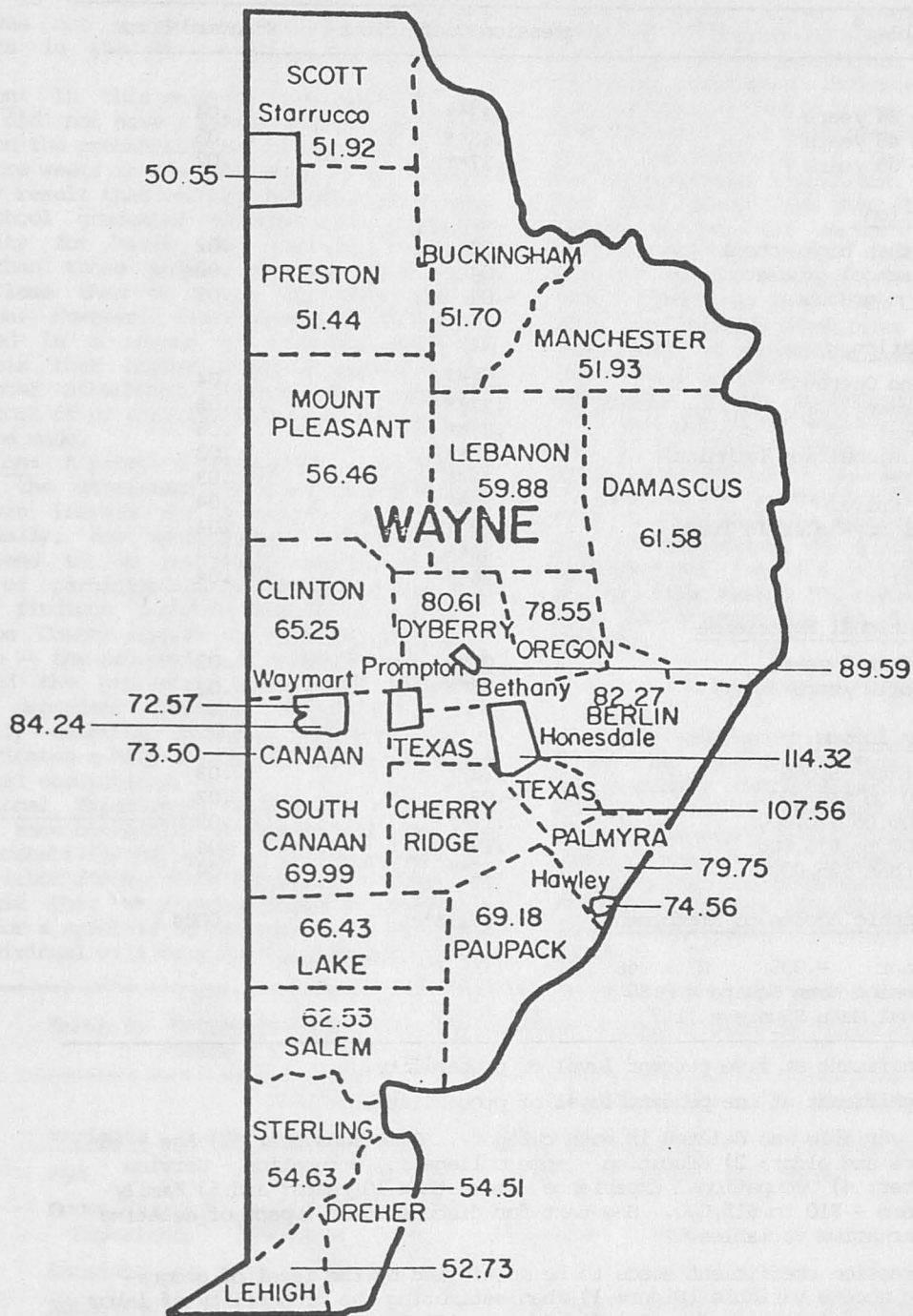


Figure I. Geographic Access to Employment Variable, Wayne County, Pa.

Table 2. Estimates of Wayne County Male Residents Working 27 or More Weeks by Socioeconomic Class and Level of Geographic Access to Employment

Variables ^a	Regression Coefficient	Standard Error
<u>Age</u>		
18 to 24 years	.33**	.04
25 to 45 years	.43**	.03
46 to 65 years	.37**	.02
<u>Education</u>		
Less than high school	-.02	.02
High school graduate	.04	.02
College graduate	-.04	.03
<u>Occupation</u>		
Machine Operator	.34**	.04
Craftsman	.27**	.03
Clerical	.29**	.06
Professional and Technical	.25**	.03
Manager	.29**	.03
Truck Driver	.29**	.04
Retail or Wholesale Trade	.29**	.04
Farmer	.44**	.03
Laborer	.26**	.04
<u>Occupational Experience</u>		
Less than 5 years	.08**	.03
Six to 10 years	.13**	.02
<u>Family Income</u>		
Less than \$5,000	-.22**	.03
\$5,000 to \$10,000	-.03	.02
\$15,000 to \$20,000	.12**	.03
\$20,000 to \$25,000	.19**	.04
More than \$25,000	.12**	.04
<u>Geographic Access to Employment</u> ^b	.0013**	.0004
Constant	-.005	
$R^2 = .46$		
Regression Mean Square = 8.65		
Residual Mean Square = .117		

* Significant at five percent level of probability.

** Significant at one percent level of probability.

^a One variable was deleted in each category. Deletions are: 1) Age - 66 years and older; 2) Education - some college; 3) Occupation - Service worker; 4) Occupational Experience - more than 10 years; and 5) Family income - \$10 to \$15,000. See text for discussion of impact of deleting alternative variables.

^b Regression coefficient needs to be multiplied by the level of geographic access variable (Figure 1) when estimating the probability of labor force participation for an individual residing in a specific MCD.

equation, with alternative age groups being deleted indicates that the male residents in the 18 to 24 age grouping were less likely (at the one percent level) to be full participants than those in the 25 to 45 and 46 to 65 age categories. There was not a significant difference between residents in the 25 to 45 and 46 to 65 age groups.

Education: In this analysis, the levels of education did not have a statistically significant effect on the probability of having been employed 27 or more weeks in the year prior to the survey. The only result that was of some interest is that high school graduates tended to have a greater propensity for having been employed 27 or more weeks than those people with education levels either less than or greater than that level of education. However, since this equation was not specified in a manner to test explicitly the hypothesis that higher levels of education lead to greater attachment to employment, statements in support of or contrary to human capital ideas cannot be made.

Occupation: A person's occupation is an indicator of the attainment of a set of skills that have been learned for a specific type of job. Conceptually, the availability of these skills would tend to be positively related to higher levels of participation in the labor force. Empirical findings based on data for male workers in Wayne County support this hypothesized relationship -- the occupational variables as a group increased the percentage of explained variation in the dependent variable. The process of sequentially deleting different occupation variables indicates a high degree of uniqueness in the individual occupations.

Occupational Experience: Additional time spent in the same occupation is expected to lead to a higher probability of being an active participant in the labor force. This hypothesis is based on the logic that as a person acquires the skills needed for a specific occupation, the more likely the individual will be a full participant of the

labor force. The empirical estimates for Wayne County males exhibit the expected pattern of a positive relationship between age and labor force participation rate.

Family Income: Higher levels of income can be expected to correspond with a higher probability of being a full participant in the labor force. Empirical estimates indicate the importance of the effects of family income from all sources on the probability of male residents of Wayne County fully participating in the labor force. There are statistically significant differences between the first group (less than \$5,000) and all other income groups, the second income class (\$5 to 10,000) and all other income classes, and the highest income category (over \$25,000) and the other income classes. Thus, even though working at a job obviously translates into family income, the level of income has differential effects on labor force attachments.

Geographic Access to Employment: The effect of this variable on the estimated probability of being a full participant in the labor force was positive as predicted, and was statistically significant at the one percent level of probability. This finding tends to support the assertion that for an individual, the qualifications for a job are important, but if a job opportunity is within a reasonable commute the chances of being a full-time participant in the labor market are enhanced.

APPLICATION OF RESULTS

The regression coefficients listed in Table 2 can be used to illustrate how differences in socioeconomic characteristics and level of geographic access to employment affect the estimated labor force participation (LFP) of the male residents of the county. Assume, for example, one is interested in the probable LFP rate of 18-24 year old men with less than five years of job experience. Some possible combinations are shown in Table 3.

Table 3: Estimated Labor Force Participation Probabilities for Three Hypothetical Cases

Variable	Individual 1		Individual 2		Individual 3	
	Var.	Spec. R. Coef.	Var.	Spec. R. Coef.	Var.	Spec. R. Coef.
Age	18-24	0.33	18-24	0.33	18-24	0.33
Occupation Experience	<5 years	0.08	<5 years	0.08	<5 years	0.08
Constant	--	-0.01	--	-0.01	--	-0.01
Education	<H.S.	-0.02	H.S. Grad.	0.04	College Grad.	-0.04
Occupation	Laborer	0.26	Craftsman	0.27	Manager	0.29
Family Income	<\$5,000	-0.22	\$5-10,000	-0.03	\$15-20,000	0.12
GAE*	Scott Twp.	0.07	Hawley	0.10	Honesdale	0.15
		0.49		0.78		0.92

* Computationally, the GAE for Scott Township (51.92 from Figure 1) is multiplied by 0.0013 to obtain the applicable coefficient of 0.07. Other coefficients are similarly determined.

In this example, individual 1, with his lack of skills, poverty level of income and residence in a remote rural area has an estimated probability of only 0.49 of being a full-time participant in the labor force. Conversely, a comparable estimate for individual 3, who is trained for a better occupation, has a higher family income and lives in the county seat town of Honesdale, has an estimated LFP of 0.92.

It should be noted that an example can be constructed where the estimated probability of being a full participant in the labor force is greater than 1.00 — a result of using ordinary least squares with a binary dependent variable.¹⁰ However, the absolute value of the measure of LFP for an individual is of less concern than the relative difference among individuals with differing socioeconomic and geographic access to employment characteristics.

SUMMARY

The availability of an "adequate supply of labor" is generally accepted as a prerequisite to rural economic development. The objective of this paper is to outline and implement empirically a procedure for initiating this process of measuring the availability of labor by estimating the importance of various factors in measuring the participation of individuals in the labor force.

The results indicate the importance of both the access to employment and socioeconomic characteristics variables. The estimates developed cannot be directly translated into the number of employees available to a prospective new employer in the county, but they do provide a better understanding of the basic forces affecting labor availability in a rural area. It should be noted that a procedure for incorporating demographic factors, spatial factors and rural commuting behavior has been suggested (Beck and Goode, 1981).

⁹ The importance of the family income variable in this example suggests the possibility of that variable serving as a proxy for employment. However, the absolute values of the simple correlations between various classes of family income and labor force participation ranged from 0.12 to 0.33.

¹⁰ It is recognized that using ordinary least squares to estimate this type of model specification leads to at least two problems: 1) the problem of nonconstant error variance which results in a loss of statistical efficiency, and 2) the problem that the estimated values for the dependent variables are not bounded between the interval 0 and 1. In effect, the procedure used here results in higher standard errors of the regression coefficients, that is, the regression coefficient is more likely to be declared not statistically differing from 0 when in fact it may differ from 0. A weighted least squares procedure to overcome these problems was used on a subset of these data with the two approaches providing similar results (Beck, 1977, p. 78).

This procedure could be implemented in a policy sense as a method of predicting changes in commuter flows in response to an increase in the number of jobs available in a specified community.

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