Work Location Estimation for Small Urban and Rural Areas

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A disaggregate specification for job search location choice is developed based on a binary logit structure. The proposed model includes a set of economic and a set of transportation level-of-service variables and can be used for implementing transportation and economic policies to improve service-area economic development. Transportation and socioeconomic data from four Minnesota towns—Cloquet, LeSueur, Austin, and Albert Lea—are used for model testing and validation. The proposed specification predicts job search destination choice correctly up to 77 percent. Despite substantial differences across test town pairs, parameter statistical significance generally increases with sample size and model predictive power is not strongly influenced by location of application. Travel conditions for the period of expected employment are found to play a role in determining location choice. For all communities studied, expected length of employment is the strongest determinant of choice.

Increasing budget deficits at the federal and state levels are likely to restrict mobility patterns significantly in small urban and rural areas over the coming years. Mobility restrictions combined with a scarcity of available jobs may contribute to a further worsening of the business climate in small communities. Transportation measures that can improve the efficiency and effectiveness of rural transit operations have recently been proposed (1), and data for evaluating the performance of such operations are now available (1-5).

A project (6) was recently undertaken to identify transportation policies that can also enhance mobility and to determine whether such policies will, in time, cause changes in service-area economic development. Objectives of the project included development of a set of specifications to estimate work mode choice, job search location choice, and enterprise location in rural areas. The specification set was used to simulate economic conditions in different areas of the United States over a 10-year period. Once the performance of the complete package was validated, new transportation policy scenarios were developed and expected economic impacts were analyzed and evaluated for the rural areas under study. Finally, transportation policies that would be expected to enhance area economic development were recommended. Results from the development and validation of demand specifications that estimate work mode choice have been reported in detail elsewhere (7). A model of job search location choice is developed and validated in this paper. Findings from enterprise location analysis and long-term policy evaluation will be presented in future papers.

There are a number of ways in which job search location choice could be treated. It could be modeled dependent on, independently of, or jointly with residential location choice. The first of these options was adopted in this study because dealing with unemployment rather than with relocation or migration was the primary interest of the project. The jobseeker's place the residence is therefore assumed to be predetermined.

The major objective of the job search model is that it be suitable for implementing level-of-service transportation policies and sensitive to long-term accessibility and economic changes that may take place in a community. This determination depends on certain basic criteria:

1. The ability of the model to estimate choice of destination for job search trips,
2. The inclusion of level-of-service independent variables for implementing transportation policies that can improve the economic impacts of a transportation system,
3. The inclusion of expected employment variables so that long-term changes in the local economy and perceived opportunities can be taken into account when destination choice is determined,
4. Data availability,
5. Model performance,
6. Causally justifiable independent variables, and
7. The potential for model transferability to other rural areas.

In addition, the model should make efficient use of data. Because of its known characteristics and advantages over aggregate methods, a disaggregate formulation has been adopted.

The development of the new model has led to two major findings: Travel conditions for the period of expected employment have been found to affect the determination of location choice, and expected length of employment is the strongest determinant of choice.

BACKGROUND

Previous research efforts in job location selection can be placed in one of three categories according to whether job location choice precedes, follows, or is made simultaneously with residential location choice. Consistent with monocentric spatial models (8), most economic models assume that job location selection occurs before residential location choice; hence, the latter depends on the former (9). This explanation ignores the possibility of changes in job location without changes in residential location, a case of particular interest in this study. The importance of such a job location decision has also been suggested by recent empirical evidence (10,11). A more complete discussion of each category of job location selection can be found elsewhere (9,12).

Recent work on the determination of workplace location has been performed by Tanner (13) and Hedges and Hopkin (14). Tanner introduced a model to evaluate the degree to which workplace and residential location are determined by such factors as travel costs, salaries, and rent. However, he assumed implicitly that, if people wanted a job in a certain area, they could obtain the job immediately and without search costs. As a result, people could choose exactly where they work.

In reality, people cannot choose exactly where they work. Instead they choose an area within which they look for work and then wait until the first acceptable job within that area is offered to them. Thus, it is partly chance that determines where a person works. Hedges and Hopkin (14) took this more realistic approach to workplace location. For a sample of 127 unemployed people in the greater Manchester, England, area, they found that their eventual workplace was affected by the availability of public transportation. Their findings include the following:

1. For some people, the range and intensity of the job search were limited by the nature of public transportation, mostly because of the cost of the search itself.
2. There is some evidence to suggest that, given the state of the labor market, the people who did not have problems in getting around to look for work were more likely to have found another job than those who did have problems.

Although Hedges and Hopkin took a more realistic approach to workplace location, their analysis was qualitative and they admit it cannot provide quantitative conclusions about how workplace location is determined.

A research effort by Tardiff and others (9) is more similar to the method followed here. However, the modeling system proposed does not treat unemployment and, as the authors acknowledge, their research is intentionally abstract. As a result it is not appropriate for examining the effects of policies, such as economic development policies, which were of the greatest interest in this project.

The model used in this research is built on a strong theoretical base but also provides quantitative conclusions about how people determine where to look for work, a decision considered to be one of the primary determinants of workplace location. Unlike previous models, it is particularly developed for applications in rural, small urban, and developing areas and has been applied to a number of such areas in the course of the study.

PROPOSED MODEL

Work location estimation should generally take into account two major determining factors: the set of locations where one looks for work and the number of job offers. As explained in detail in the study final report (6), in this research job offers were first modeled according to a Poisson process. Job search was then determined by the set of locations where one looks for work. It was assumed that the set of possible work locations may consist of a person's hometown only or the hometown and the nearest major town.

A binary logit model structure was used for job search location prediction. The statistical properties of the logit model and its successful application in analyzing discrete choice are well documented (15-17) and are not restated here. The particular form of the model used is

$$P(d{:}D_t) = \exp(X'_{dt}\theta) / \sum_{j \epsilon D_t} \exp(X'_{jt}\theta) \quad (1)$$

where

- $P(d{:}D_t)$ = probability of worker t selecting destination d from choice set D_t;
- X_{dt} = vector of independent variables for alternative d and worker t;
- θ = vector of coefficients estimated by using the maximum likelihood method, and
- D_t = choice set, which includes two options: (a) look for work in the hometown only or (b) look for work in the hometown and the nearby town.

VARIABLES AND DATA

The variables, represented by the elements of the X vector in Equation 1, may take several forms--some being the basic data, and others being combinations of the basic data. All variables and their expected coefficients are given in Table 1.

The basic variables are of two types: transportation-related and economic. The two transportation variables are (a) employment travel time (ETT) in hours per month, the perceived door-to-door time that a person would spend for the round trip to work when employed--i.e., after a job is found; and (b) employment out-of-pocket travel cost (EOPTC) in dollars per month, the perceived door-to-door, out-of-pocket cost to the employed person for the round trip to work.

Transportation policies can directly affect these variables. For example, the development of an Interstate highway between two rural towns will reduce the travel time required to commute between the two towns. Similarly, a transit system linking two communities would decrease the commuting cost.

The two basic economic variables are (a) employment income (EINC) in dollars per month, the expected income to be earned by a person when employed (EINC ≥ EWAG); and (b) employment time fraction (ETF), the fraction of the time horizon one expects to remain employed. For this work the time horizon, which is as far into the future as people plan for, is assumed to equal 36 months.

The ETF depends on the number of job opportunities available to a jobseeker. If one assumes that the jobseeker keeps a job he accepts until the end of his time horizon, the ETF will be

$$ETF = 1 - ETU/H \quad (2)$$

where ETU is the expected time of unemployment in months and H is the time horizon in months. When the time horizon is finite, as here,

$$ETU = 1/\lambda \; [1 - \exp(-\lambda H)] \quad (3)$$

where λ, the Poisson parameter, represents the number of job offers per jobseeker per unit of time. As the time horizon approaches infinity, ETU approaches $1/\lambda$. A detailed theoretical derivation of the above formula can be found in the study final report (6).

The value of the economic variables will vary with the decision on where to look for work. For example, a person looking for work only in the hometown may be forced to accept a lower-paying job, which decreases the EINC variable. That person will also have fewer job opportunities and will probably be unemployed longer than if he looked for work in other communities as well, which shortens the ETF variable.

Table 1. Definition of variables used in job search destination model.

Variable Code	Definition	Expected Sign of Coefficient
C	1 for searching in hometown and nearby community; 0 for searching in hometown only	
ETT	Employment travel time (hr/month)	Negative
EOPTC	Employment out-of-pocket travel cost ($/month)	Negative
EINC	Employment income ($/month)	Positive
ETF	Employment time fraction	Positive
EY	Employment income net of travel cost ($/month)	Positive
REY	Remaining employment income ($/month)	Positive
LY	Long-term income ($/month)	Positive
LTT	Long-term travel time (hr/month)	Negative
LEY	Long-term employment income ($/month)	Positive
LETT	Long-term employment travel time (hr/month)	Negative

Various combinations of the basic variables were also considered. Employment income net of travel cost (EY) in dollars per month is defined as

$$EY = EINC - EOPTC \quad (4)$$

Remaining employment income (REY) in dollars per month is

$$REY = EY - [(EWAG * ETT)/(3 * HPM)] \quad (5)$$

where HPM is the hours per month one expects to be employed and EWAG is the expected employment wage in dollars per month.

Long-term employment income (LEY) in dollars per month is

$$LEY = EFT * EY \quad (6)$$

Long-term unemployment income (LUY) in dollars per month is

$$LUY = UTF * UY \quad (7)$$

where UTF is the unemployment time fraction--i.e., the fraction of the time horizon one expects to be unemployed before finding a job--and UY is the unemployment income net of travel cost in dollars per month--i.e., the expected unemployment income to be earned before finding a job.

Long-term employment travel (LETT) in hours per month is defined as

$$LETT = ETF * ETT \quad (8)$$

Long-term unemployment travel time (LUTT) in hours per month is

$$LUTT = UTF * UTT \quad (9)$$

where UTT is the unemployment travel time in hours per month--i.e., time that a person would spend looking for work while unemployed until a job is found. Long-term income (LY) in dollars per month is

$$LY = LEY + LUY \quad (10)$$

Long-term travel time (LTT) in hours per month is

$$LTT = LETT + LUTT \quad (11)$$

Approximately 500 households from the rural towns of Cloquet, LeSueur, Austin, and Albert Lea, Minnesota, were contacted, and individual characteristics were recorded for those who were unemployed and/or actively looking for work. Sample demographic and socioeconomic characteristics are summarized in Table 2. These data were supplemented by information on level-of-service characteristics of the transportation service available in the above areas.

All unemployed included in the preceding sample had the choice of looking for work (a) in their hometown only or (b) both in their hometown and in a neighboring town. Unemployed Cloquet residents could travel to Duluth, a large urban area on the northeastern shore of Minnesota. LeSueur residents could go to neighboring St. Peters; both towns are located south of the Twin Cities metropolitan area. Austin and Albert Lea are both located in the extreme south near the Iowa-Minnesota border; residents of each town had the option of traveling to the other to look for work. Although there were certain similarities across city pairs, geographic, demographic, and economic differences were substantial. Once preliminary specifications were developed for each town or set of towns, these differences could be used to test the transferability potential of the final Minnesota specifications.

Table 2. Selected demographic and socioeconomic characteristics.

Characteristic	Cloquet	LeSueur	Austin	Albert Lea
Population[a]	12,000	4,200	23,000	19,200
Population growth, 1970-1980[a] (%)	5	12	-12	1
Annual household income ($)	19,190	20,120	20,670[a]	19,090[a]
People per household	2.9	3.8	4.1	4.0
Workers per household	1.4	2.4	1.5	1.6
Automobiles per household	1.6	2.1	1.3	1.3
Length of residence (years)	22	8.7	11	9.4
Own residence (%)	98	78	78	72
Below poverty (%)	6.5	4.2	7.3	5.2
Other city in pair	Duluth	St. Peters	Albert Lea	Austin

[a]Estimated.

Excluded from the final unemployed sample were (a) respondents to whom no transportation was available for commuting and (b) unemployed who indicated that they would consider moving to the nearby town if they were offered a job there. All members of the final sample were therefore able to use either their automobile or public transit to look for work; all intended to remain at their present residence and, if necessary, commute to their job location. Although the data treatment resulted in a decreased sample size, the improved quality of the treated sample contributed to greater significance and robustness in the estimated model parameters.

The final sample of observations was divided into three subsamples: 29 observations from Cloquet, 10 from LeSueur, and 9 from the Austin-Albert Lea pair. Disaggregate models were then developed for each subsample and for subsample combinations to allow evaluation of model transferability. Finally, a model was developed for the complete sample so that higher statistical significance could be obtained.

MODELS AND HYPOTHESES

Four types of models are considered. All models include two constants--one for Cloquet and one for the other three communities. Separate constants are used to account for the differences between Cloquet in northeastern Minnesota close to Duluth and the other communities studied in southeastern Minnesota. The four types of models are as follows:

1. Model type 1 includes LY and LTT in the X-vector. The central idea behind this model is that jobseekers are concerned not only with the income they will earn and the travel time they will incur when employed but also with their income and travel time while unemployed.
2. Model type 2 includes in the X-vector only LEY and LETT. Behind this model is the idea that jobseekers are primarily concerned with the income they will receive and the travel time they will incur when employed.
3. Model type 3 differs from model type 2 in that it separates the ETF factor from employment income and travel time per month. Thus, its X-vector includes EY and ETT, and, separately, ETF. The hypothesis behind model type 3 is that jobseekers consider the time spent until they find a job separate from their eventual wage and travel time.
4. Model type 4 is a revision of model type 3 in that EY and ETT are combined into one variable, REY. This variable reflects previous research

Table 3. Job search location choice models for rural Minnesota: intermediate models.

Item	Model C1	Model C2	Model C3[a]	Model C4[a]
Variable				
C[b]				
Coefficient	2.0	2.4	2.6	2.1
t-statistic	1.91	1.91	1.83	1.85
NC[c]				
Coefficient	1.5	1.7	1.9	1.6
t-statistic	1.32	1.28	1.23	1.13
LY				
Coefficient	0.00034	-	-	-
t-statistic	2.03	-	-	-
LTT				
Coefficient	-0.0050	-	-	-
t-statistic	-1.25	-	-	-
LEY				
Coefficient	-	0.00036	-	-
t-statistic	-	2.55	-	-
LETT				
Coefficient	-	-0.0021	-	-
t-statistic	-	-0.834	-	-
EY				
Coefficient	-	-	0.013	-
t-statistic	-	-	0.828	-
ETT				
Coefficient	-	-	-0.069	-
t-statistic	-	-	-0.654	-
ETF				
Coefficient	-	-	0.46	0.52
t-statistic	-	-	3.01	3.13
REY				
Coefficient		-	-	0.0082
t-statistic		-	-	1.44
Sum of chosen probabilities	32.37	34.04	35.23	35.16
$L^*(\hat{\theta})$[d]	-23.75	-21.82	-19.89	-20.09
$L^*(0)$[e]	-33.27	-33.27	-33.27	-33.27
$\rho^2 = 1 - [L^*(\hat{\theta})/L^*(0)]$	0.29	0.34	0.40	0.40

[a]Selected for testing and evaluation.
[b]Residents of Cloquet.
[c]Residents of LeSueur, Austin, and Albert Lea.
[d]Log likelihood of convergence.
[e]Log likelihood at zero.

(18-20) that indicated that the value of travel time to workers is one-third their wage.

The following hypotheses are tested by these models:

1. Transportation level-of-service affects job location choice.
2. Expected economic benefits affect job location choice.
3. Job location estimation specifications for small urban and rural areas have the potential for transferability.

DISCUSSION OF ESTIMATED COEFFICIENTS

Six basic disaggregate models for estimating job search destination choice were derived from the Minnesota data--two from the Cloquet sample (models A3 and A4), two from the LeSueur-Austin-Albert Lea sample (models B3 and B4), and two from the combined Minnesota sample (models C3 and C4). Before the final models are discussed, a review of the analysis and intermediate hypotheses and models is in order. The intermediate models being discussed are presented in Table 3.

The hypothesis that long-term economic and travel characteristics determine job search destination choice was tested first. Long-term income and long-term travel time in model C1 were derived by using the combined data sample. Because it was evident that considering only the employment-related part of each of the two variables would greatly simplify data needs for the model, model C2 considered that part only. Test results for the two models indicated that no significant improvement in explanatory power could be gained by adopting the more elaborate model C1. In addition, from a policy viewpoint, no major transportation policy implications would be missed by adopting the simpler model C2. Model C2 was therefore tentatively selected as the preferred model.

Although model C2 was simple in the number of independent variables, each variable was a combination of more basic ones. ETF was a factor common to each variable. It was desired to determine the role ETF played in altering the significance of each variable. Model C3 was formulated to test the significance of each of three characteristics--ETF, EY, and ETT. According to the specification of this model, job search destination choice is based on monthly income and travel time and, separately, on ETF. A comparison of models C3 and C2 revealed a drop in significance for EY, compared with LEY, and ETF emerged as the most significant determinant of choice.

ETF was chosen as one of the variables to be included in the final model. The remaining variables, EY and ETT, were combined into REY. The final model, model C4, was equivalent causally and for policy purposes to model C3. Its attractive characteristic is an increased statistical significance of each of its variables. Model C3, however, could still be useful for recognizing the individual importance of each independent variable and for computing individual variable statistics. With more data the significance of its variables could also increase. Both models C3 and C4 are recommended for policy analysis.

For both estimated coefficients of model C4, significance improved when the sample size increased. In Table 4, models A4 (Cloquet data), AB4 (Cloquet, Austin, and Albert Lea), and C4 (combined Minnesota) are presented to demonstrate the improvement. High unemployment in Cloquet probably accounts for the perceived lack of importance of REY in that town. From tests of models A1 and A2 it could be argued that Cloquet residents make job search decisions based on long-term objectives. However, they are concerned about long-term employment income and associated work-trip travel time only as separate entities, and long-term employment income is of overriding importance in making a job search destination choice.

For the convenience of prospective model users, two alternative models, models 3 and 4, were derived for each town. The two models are presented in Table 5 for Cloquet (A3 and A4), for LeSueur, Austin, and Albert Lea (B3 and B4), and for the combined sample (C3 and C4). Both models include ETF. Model 3 also includes EY and ETT individually, whereas model 4 adopts a combination of the two--i.e., REY.

As Table 5 indicates, ETF is the most significant independent variable. Its importance remains almost unchanged for different rural areas. For Cloquet, it is the only significant determinant of choice. One plausible explanation of this phenomenon is that

Table 4. Job search location choice models for rural Minnesota: improvement in estimated model coefficients.

Item	Cloquet			Cloquet-Austin-Albert Lea,	Combined Minnesota,
	Model A1	Model A2	Model A4	Model AB4	Model C4
Variable					
C					
Coefficient	2.9	4.4	1.1	1.6	2.1
t-statistic	1.64	1.7	0.789	1.25	1.85
NC					
Coefficient	-	-	-	0.39	1.6
t-statistic	-	-	-	0.210	1.13
LY					
Coefficient	0.00049	-	-	-	-
t-statistic	1.73	-	-	-	-
LTT					
Coefficient	-0.0051	-	-	-	-
t-statistic	-0.770	-	-	-	-
LEY					
Coefficient	-	0.00068	-	-	-
t-statistic	-	2.43	-	-	-
LETT					
Coefficient	-	-0.0051	-	-	-
t-statistic	-	-1.03	-	-	-
ETF					
Coefficient	-	-	0.49	0.54	0.52
t-statistic	-	-	2.61	2.86	3.13
REY					
Coefficient	-	-	0.0024	0.0053	0.0082
t-statistic	-	-	0.306	0.801	1.44
Sum of chosen probabilities	19.78	22.40	21.60	27.81	35.16
$L^*(\hat{\theta})$	-13.73	-10.24	-11.60	-15.92	-20.09
$L^*(0)$	-20.10	-20.10	-20.10	-26.34	-33.27
ρ^2	0.32	0.49	0.45	0.40	0.40

Table 5. Job search location choice models for rural Minnesota: effect of alternative models developed for each town.

Item	Cloquet		LeSueur-Austin-Albert Lea		Combined Minnesota	
	Model A3	Model A4	Model B3	Model B4	Model C3	Model C4
Variable						
C						
Coefficient	3.0	1.1	-	-	2.6	2.1
t-statistic	1.13	0.789	-	-	1.83	1.85
NC						
Coefficient	-	-	1.7	2.7	1.9	1.6
t-statistic	-	-	1.00	1.31	1.23	1.13
EY						
Coefficient	0.010	-	0.015	-	0.013	-
t-statistic	0.374	-	0.784	-	0.828	-
ETT						
Coefficient	-0.11	-	-0.031	-	-0.069	-
t-statistic	-0.704	-	-0.210	-	-0.654	-
ETF						
Coefficient	0.49	0.49	0.41	0.56	0.46	0.52
t-statistic	2.50	2.61	1.61	1.86	3.01	3.13
REY						
Coefficient	-	0.0024	-	0.012	-	0.0082
t-statistic	-	0.306	-	1.48	-	1.44
Sum of chosen probabilities	21.97	21.60	13.33	13.81	35.23	35.16
$L^*(\hat{\theta})$	-11.04	-11.60	-8.77	-8.12	-19.89	-20.09
$L^*(0)$	-20.10	-20.10	-13.17	-13.17	-33.27	-33.27
ρ^2	0.45	0.42	0.33	0.38	0.40	0.40

Cloquet residents, as their length of residence indicates, are not mobile and are more interested in security than in a high salary. This was not the case in the other three Minnesota communities examined in the study.

MODEL TESTING AND EVALUATION

In testing the destination estimation models, three data sets were used. These can be summarized as follows:

Data Set	Location	Sample Size
1	Cloquet	29
2	LeSueur	10
3	Austin-Albert Lea	9

Because of their small size, data sets 2 and 3 could only be used in combination. Seven estimation models were tested: Cloquet models A2, A3, and A4; LeSueur-Austin-Albert Lea models B3 and B4; and combined Minnesota models C3 and C4. The correct prediction percentage was used as a performance indicator. This indicator is presented for the seven models in Table 6. Higher percentages indicate better model performance.

The performance of each of the four basic models--A3, A4, B3, and B4--was evaluated in two ways. Each model was tested with data from the town where that model was developed, and then each was validated with data from a different town. For example, Cloquet models A3 and A4, estimated by using data from Cloquet, were first tested on Cloquet data set 1. This resulted in 76 and 74 percent correct prediction, as indicated in Table 7. The two models were then validated on LeSueur-Austin-Albert Lea data set 2-3, and the result was 74 and 73 percent correct prediction.

From the performance evaluation it is concluded that specifications developed from Cloquet data predict job search destination choice made by Cloquet residents up to 77 percent correctly and the choice made by LeSueur-Austin-Albert Lea residents up to 74 percent correctly. Specifications developed from LeSueur-Austin-Albert Lea data predict the choice of residents of those towns up to 73 percent correctly and are as successful in predicting the choice made by Cloquet residents. Finally, specifications C3 and C4, developed by using the complete Minnesota data, correctly predict 73 percent of combined Minnesota behavior.

In brief, the predictive power of the basic models is not strongy affected by the area chosen for model application in spite of substantial differences across towns and across data sets in Minnesota, which indicates a potential for model transferability. To be sure, this potential is a function of the stability of the new models. As Tables 4 and 5 indicate, whereas the stability of REY could be improved with more data, EY and ETF (the most significant variable) do exhibit stable performance. In Table 4 it can also be seen that, for both variables in the final models (variables ETF and REY in models A4, AB4, and C4), statistical significance increases with sample size while parameter values remain well within one order of magnitude across samples.

Table 6. Estimation performance of seven destination models.

Data Set	Estimation Model	Correct Prediction (%)
Cloquet (1)	Cloquet A2	77
	Cloquet A3	76
	Cloquet A4	74
	LeSueur-Austin-Albert Lea B3	71
	LeSueur-Austin-Albert Lea B4	73
LeSueur-Austin-Albert Lea (2 and 3)	Cloquet A3	74
	Cloquet A4	73
	LeSueur-Austin-Albert Lea B3	70
	LeSueur-Austin-Albert Lea B4	73
Combined Minnesota (1, 2, and 3)	Combined Minnesota C3	73
	Combined MInnesota C4	73

Table 7. Transportation policy alternatives for Cloquet unemployed seeking a job in Duluth.

Policy Alternative	Definition
Base case	Conditions existing in Minnesota in 1981
1	Travel cost for round trip to Duluth doubles
2	Low-fare public transit and gas coupons result in 50 percent decrease in travel cost
3	Fifty percent increase in travel time accompanies 50 percent decrease in travel cost
4	Public transit for round trip to Duluth offered free of charge

APPLICATION TO TRANSPORTATION POLICY EVALUATION

The purpose of this section is to demonstrate how the disaggregate specifications developed in this study can be used to evaluate the estimated impacts of various transportation policy alternatives on job search location choice and area economic development. This analysis deals with the varying effects that a range of transportation options would have on the unemployed residing in Cloquet and facing the choice of looking for work in Cloquet only or both in Cloquet and in Duluth. The complete disaggregate data from the Cloquet sample are used in this application. If fully disaggregate data were not available, a similar analysis could be performed by estimating the policy impacts on particular segments of the Cloquet population.

A simple example is presented first. The combined Minnesota model (C4) is applied to a typical unemployed Cloquet resident and two choice probabilities--P_1, the probability of seeking a job in Cloquet only, and P_2, the probability of seeking a job in Cloquet and Duluth--are computed. For simplicity, the economic conditions of Cloquet and Duluth are treated as approximately the same, which was the situation at the time of the study.

$$P_2 = 1/\{1 + \exp[-2.1 + 0.0082(REY_1 - REY_2) + 0.52(ETF_1 - ETF_2)]\} = 0.83 \quad (12)$$

where, for i = 1, 2, $REY_i = EY_i - [EWAG_i/3(HPM_i)](ETT_i)$ and

$$EY_i = EINC_i - EOPTC_i,$$
$$ETF_i = 1 - ETU_i/H_i,$$
$$ETU_i = [1 - \exp(-\lambda_i^* H_i)]/\lambda_i^*,$$
$$\lambda_1^* = \lambda_1,$$
$$\lambda_2^* = \lambda_1 + \lambda_2, \text{ and}$$
$$\lambda_i = (\text{job openings rate})_i (\text{jobs})_i/\text{jobseekers}_i.$$

The following values were used in this example: job openings $rate_1$ = job openings $rate_2$ = 0.026 job openings/month/job; $(jobs/jobseekers)_1$ = 12.9; $(jobs/jobseekers)_2$ = 13.5; $H_1 = H_2$ = 36 months; $EINC_1 = EINC_2$ = \$913/month; $EOPTC_1$ = \$26.7/month; $EOPTC_2$ = \$93.1/month; $EWAG_1 = EWAG_2$ = \$780/month; ETT_1 = 8.8 min; ETT_2 = 20.8 min; and $HPM_1 = HPM_2$ = 154 hr/month.

For the purposes of this example, it is concluded that 16 percent of the unemployed residing in Cloquet look for work in their hometown only, thus missing out on job openings that exist in the neighboring town.

Sample mean values by choice for the characteristics necessary for probability estimation are as follows:

	Sample Mean	
Characteristic	Cloquet	Cloquet-Duluth
EINC	716	975
ETT_1	9.55	8.55
ETT_2	24.4	19.7
$EOPTC_1$	19.9	28.9
$EOPTC_2$	99.8	91.0
HPM	139	159
EWAG	531	859

The Poisson parameter and the actual and estimated choice distributions are as follows ($\lambda^*_{Cloquet} = \lambda_1$ and $\lambda^*_{Cloquet\text{-}Duluth} = \lambda_1 + \lambda_2$):

Item	Cloquet	Cloquet-Duluth
λ^*	0.335	0.686
Sample size		
Actual	7/29	22/29
Estimated	6/29	23/29

For example, on average, those who chose to look for work only in Cloquet expected a wage of $531/month and those who chose to look for work in both Cloquet and Duluth expected a wage of $859/month.

For the Cloquet sample, four policy alternatives were chosen and compared with the base case. These alternatives are representative of the range of options that could be considered in connection with economic development programs in depressed rural areas. The alternatives are summarized in Table 7. The table below gives the estimated probability of seeking a job only in the hometown for each policy alternative:

Policy Alternative	Probability
Base case	0.20
1	0.33
2	0.15
3	0.17
4	0.10

From these transportation policy impacts, it is concluded that changes in out-of-pocket travel cost affect the likelihood that an unemployed person will find a job. For example, the Cloquet unemployed are 65 percent more likely to confine their job search to Cloquet if travel cost to Duluth doubles. On the other hand, the likelihood decreases by 50 percent if free transit to Duluth is offered. The sensitivity to travel time is much lower.

The policy impact results can then be used to develop further economic estimates. For example, a 10 percent unemployment rate in Cloquet currently implies approximately 400 unemployed residents in that Minnesota town. In the base-case scenario, 320 of these are seeking a job in Duluth as well as in Cloquet. The number of people expected to find a job in Duluth in one month is 112 (λ_2 * 320 where $\lambda_2 = 0.351$). With free transit, the corresponding number is 126 in the first month.

As explained in detail in the study final report (6), the major short-term impacts of transportation improvements on economic development take place during the first 12 months of the period in which the new policy is in effect. An employment gain of 14 individuals in the first month implies, assuming a straight-line impact decrease, an approximate total effect of 84 extra Cloquet residents finding a job. Therefore, unemployment in Cloquet decreases from 10 to 7.9 percent within a year as a direct result of free transit. To be sure, this is only a short-term effect and will be modified by an expansion of the Duluth economy and a less favorable business climate in Cloquet in the long term (6).

This interpretation of policy impacts assumes that, once the decision to include Duluth in the job search is made, there are no changes in the intensity and effectiveness of the job search. However, indications are that, in the absence of public transit, both intensity and effectiveness suffer (6, 14). In particular, job search was typically less intensive for Duluth than for Cloquet. On the other hand, the continuing presence of public transit may increase the intensity and effectiveness of the search. In light of these findings, the policy impacts discussed previously may underestimate or overestimate actual impacts.

CONCLUSIONS

A disaggregate specification was developed to estimate job search destination choice. The inclusion of policy-relevant variables makes it possible to use the model to determine the steady-state impact of transportation policies on economic characteristics. The inclusion of economic variables makes it possible to take into account long-term changes in the local economy in determining destination choice.

All parameters were found to have the expected sign. Although parameter values did not change appreciably across models developed for different towns, their statistical significance generally increased as the sample size increased. Travel conditions for the period of expected employment were found to play a role in determining job search destination choice. For all communities studied, expected length of employment was the strongest determinant of choice.

From the model performance evaluation it was concluded that the proposed specification predicts job search destination choice up to 77 percent correctly. Despite substantial differences across test town pairs, the predictive power of the model was not strongly affected by the area chosen for model application, which indicates a potential for model transferability.

It was demonstrated that the new specification can be used to evaluate the estimated impacts of various transportation policy options on job search location choice and area economic development. For example, it was determined that Cloquet unemployed are 50 percent less likely to confine their job search to their hometown if free transit to nearby Duluth is offered. Unemployment in Cloquet would, then, fall from 10 to 7.9 percent in the short term. To be sure, the short-term effects would be modified by an expansion of the Duluth economy and a less favorable business climate in Cloquet in the long term.

The proposed binary choice model is applicable to transportation policy analysis for town pairs and has been developed and validated by using data from various towns in Minnesota. The model could easily be extended, via multinomial logit, to apply to a greater number of interacting towns. Finally, the transferability of the model could be tested by using data from other states. Although such tests were not part of this paper, inferences on model transferability could be made by examining the transferability tests of a larger planning package (6), which includes the job search model.

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