MACK-BLACKWELL
Transportation Center

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THE IMPACTS OF WELFARE REFORM
ON RURAL PUBLIC TRANSPORTATION PATRONAGE

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TABLE OF CONTENTS

- Abstract
- Chapter 1: Introduction
- Chapter 2: Literature Review
- Chapter 3: Welfare-to-Work Legislation
- Chapter 4: Size of the Welfare Population Resulting from Welfare Reform
- Chapter 5: Characteristics of Rural Commuters
- Chapter 6: Findings
- Appendix: Survey Instrument

LIST OF TABLES

- Table 1: Percentage of State TANF Recipients Who Must Participate in Work Programs
- Table 2: AFDC/TANF Adult Cases for Oklahoma Counties by Transit Operator Service Area
- Table 3: New TANF Cases by Counties in Case Study Service Areas: 1995-1999
- Table 4: Household Composition by Mode of Travel to Work
- Table 5: Composite Measures of Transit and Economic Dependency
- Table 6: Logit Model Estimation Results

LIST OF FIGURES

- Figure 1: Measuring the Impact of Welfare Reform on Small Town and Rural Public Transportation Operators
- Figure 2: Case Study Service Areas
- Figure 3: Socioeconomic and Transportation Relationships
- Figure 4: Oklahoma Adult TANF Cases: 1990-1999
- Figure 5: Fifteen Month Forecasts of Oklahoma TANF Cases: April 1999 - June 2000
- Figure 6: Survey Population and Mode of Travel to Work
- Figure 7: Age Distribution of Commuter Population and Their Households
- Figure 8: Household Size of Survey Population

- Figure 9: Age Distribution of Commuter Households by Mode of Travel to Work
- Figure 10: Household Size by Mode of Travel to Work
- Figure 11: One Way Travel Time to Work by Mode in Minutes
- Figure 12: Auto Ownership per Household by Mode of Travel to Work
- Figure 13: Driving Age Population by Household by Mode of Travel to Work
- Figure 14: Reasons for Stopping to and From Work by Auto Users

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ABSTRACT

This study examines alternative means of forecasting rural public transportation patronage with explicit attention to persons likely to be affected by welfare to work requirements. Original data gathered on rural transit and auto commuters provides a basis for determining the influence of service quality and household characteristics on rural commute mode choice. Alternative specifications of a binary logit type model failed to produce a method deemed adequate for patronage forecasting. Significant variables included travel time (no distinction between in-vehicle and out-of-vehicle time found), travel cost, number of drivers in the household, the age of the commuter, and whether the commuter had ever received welfare benefits. Despite the lack of conclusive empirical results, we observed rural public transportation operators serving welfare to work clients.

CHAPTER ONE: INTRODUCTION

In 1996, the United States replaced its traditional welfare program, Aid to Families with Dependent Children (AFDC), with a new program called Temporary Assistance to Needy Families (TANF). TANF differs from AFDC in two important ways. First, TANF emphasizes moving clients into the workforce through job training and educational requirements. Second, TANF has a lifetime benefit. These changes are expected to reduce welfare costs in both the short and long term. To assure success, governments at all levels have initiated programs to prepare TANF's major client group, single mothers, to enter the workforce. Public transportation in rural areas is an example of such a service. Rural public transportation can provide reliable access to job training centers, employment sites, and daycare centers. The aggregate impact on small town and rural public transportation operators if even a small proportion of welfare-to-work households use public transportation could be quite significant.

Small town and rural public transportation operators and state departments of transportation lack empirical evidence upon which to develop programs and policies to assist welfare-to-work households. The list of information needs is long:

1. How and by how much is welfare reform likely to change current patronage?

2. What are the travel needs and patterns of TANF clients in the short and long term?

3. Will TANF increase the demand for rural transit sufficient to warrant redeployment of existing capacity or investments in additional capacity?

4. When will TANF impacts begin to occur?

A University of Oklahoma research team assembled to address these questions. We report our findings in this report. We used a case study approach which involved collection of primary data. We have determined that not all of the research questions can be satisfactorily answered. We also learned that local conditions can be so influential as to make it difficult to generalize from one service area to another.

Methodology

Although welfare-to-work requirements have a long history, 1996 legislation for the first time

imposed a lifetime maximum benefit, intended to compel welfare recipients to seek employment. Rural transit operators suspect this feature along with compulsory job training may produce patronage impacts sufficient to affect service planning. Testing this hypothesis requires patronage forecasting models sensitive to variables useful in distinguishing welfare and non-welfare populations, such as household sociodemographic composition and auto availability. Figure 1 illustrates how such a model could be used to estimate the patronage impact.

Our study used a case study approach and four operators. The Oklahoma based operators provide service in Arkansas, Oklahoma, and Missouri (see Figure 2). TANF clients are most likely to enter the workforce in low or semi-skilled occupations, exactly the kind of people who use rural transit to commute to work. We sought information on this cohort through personal on-board and workplace surveys at locations in Arkansas, Missouri, and Oklahoma. The survey instrument is included as Appendix A. Respondents provided detailed information on household composition, including the age and gender of head of household, ages and gender of children, and as well as data on commute patterns and auto availability. The data were organized into origin-destination matrices by zip codes. Travel times by transit, drive alone, and carpool were appended. Survey constraints restricted participation to those commuters who had a choice of transit or auto commuting.

Survey results indicate transit users are most likely to come from female headed households with four or more members. This cohort corresponds well to the welfare population; over one third of the survey respondents indicated having received welfare benefits at some time in the past.

Our intent in collecting this data was to develop a patronage forecasting model using data from two of the operators to estimate known patronage on the other two. If validated, the model could be applied to forecasts of the welfare population which will need to travel to work or training sites. The population of concern to rural transit operators are those persons currently enrolled in TANF who must engage in job training or seek employment. Each year a certain number of these people will leave the TANF program. Presumably most will enter the workforce, but in reality little is known about clients after they disenroll from the program. Assuming all or most of the disenrolled clients find employment, and all those who must participate in job training programs do so, the proportion using rural transit could be estimated. Our program impact model is depicted in Figure 3.

The welfare reform impact is the difference between patronage without welfare reform legislation and patronage with welfare reform. We plan a five year forecasting horizon.

FIGURE 1
Measuring the Impact of Welfare Reform
on Small Town and Rural Public Transportation Operators

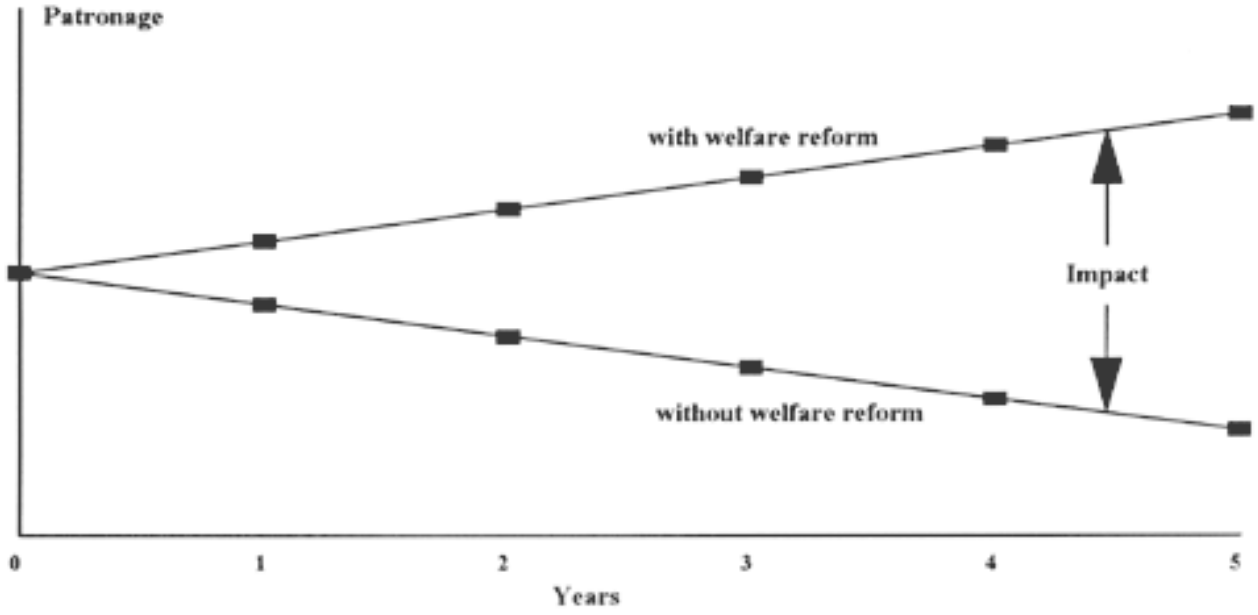
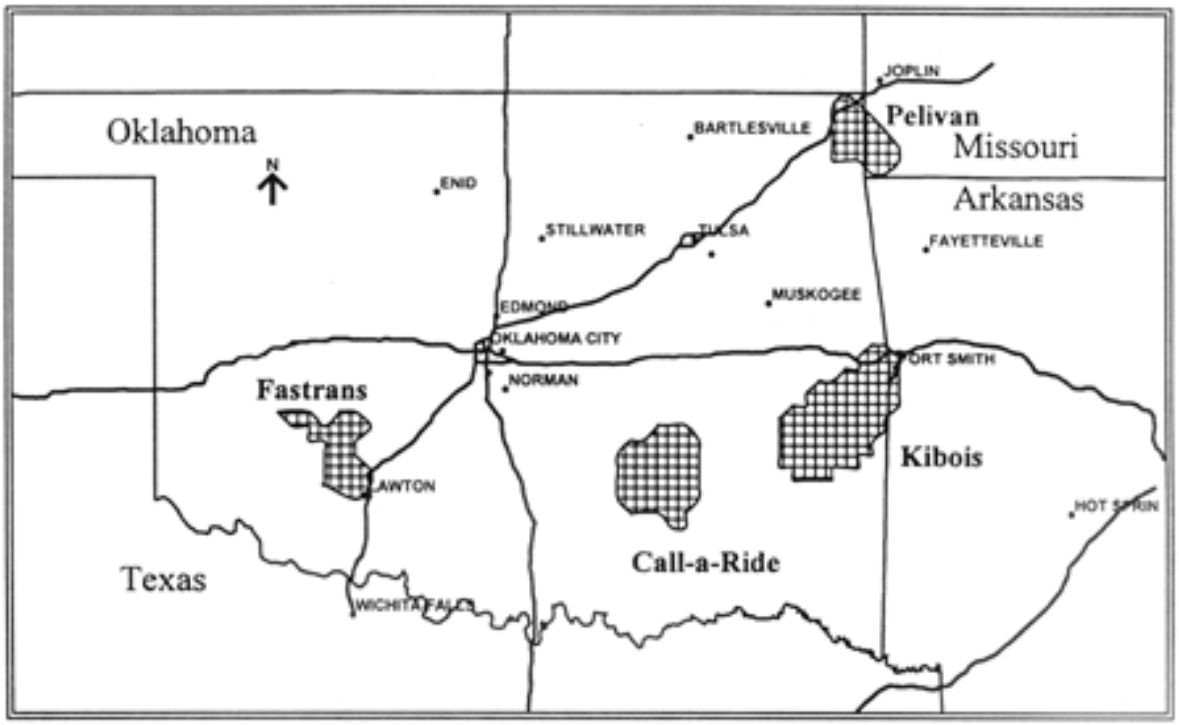
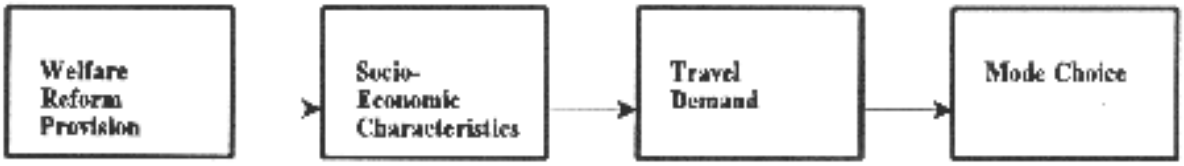


FIGURE 2
Case Study Service Areas



LEGEND: Call-a-Ride Public Transit, Ada OK; Fastrans, Carnegie, OK; Kibois Area Transit, Stigler, OK; Pelivan Transit, Big Cabin, OK.

FIGURE 3
Socioeconomic and Transportation Relationships



CHAPTER TWO: LITERATURE REVIEW

The literature search revealed no articles on the impacts of welfare reform on rural public transportation patronage. There are field articles on welfare reform, forecasting urban and rural public transportation patronage, and welfare reform impacts on urban public transportation. A separate chapter addresses welfare reform and rural welfare population characteristics. This chapter reviews materials related to patronage forecasting.

There are many studies of urban public transportation forecasting which are extensively reviewed elsewhere.[(1)] High urban densities make it possible to estimate transit patronage even when mode split is small. Planning agencies and transit operators conduct travel surveys to obtain data on household characteristics, the number, time, and duration of daily trips, mode of travel, origins and destinations, and vehicle occupancy. Using this data, planners construct mathematical models to simulate peak period travel by mode over highway and transit networks. The simulation process operates as illustrated in Figure 1.

This process is overly complex and data intensive for rural transit operators who can neither afford to collect the data nor the specialized knowledge required to employ sophisticated forecasting models. Rural operators nevertheless need patronage forecasts to plan their services. A variety of approaches have been attempted. One was to develop a urban type forecasting model using data collected from households throughout a state. If such a model were feasible, a state agency might maintain and operate the model for all operators. A later chapter describes The University of Oklahoma effort to develop such a model.

Smith (1977) describes his application of a direct demand model developed using Pennsylvania data to rural Wisconsin counties.[(2)] The model predicts round trip passengers per month as a function of level of transit service and total population able to access the service. While Smith found "... the demand estimates of the level-of-service model appear to be accurate enough for sizing the systems," he also concluded that the model form consistently over-estimated demand. Smith found that average round-trip passenger volume per month was inappropriate for operators with dramatic seasonal fluctuations.

Neumann and Byrne (1978) construct a rural transit forecasting model using a Poisson probability distribution.[(3)] Using passenger counts and surveys and census data, Neumann and Byrne developed trip rates based on total population within 1.21 kilometer (km) of a rural transit route and route length to predict total route patronage per day. Household income and auto ownership were not significant variables in predicting daily transit trips but were significant when predicting weekly patronage.

The Neumann and Byrne model has many interesting features. In both the daily and weekly versions, route length served as the transit level of service variable. The Poisson distribution in effect represented auto level of service. Socioeconomic differences were meaningful for weekly routes but not daily routes. A major drawback to the model is its level of aggregation. Total daily or weekly route patronage is too large a scale for route level analysis.

Schauer proposed three alternative methods of forecasting rural transit patronage depending on circumstances: trip generation rates, regression, and participation rates.[(4)] Trip generation rates can be applied to rural populations which do not currently have transit service to obtain rough estimates on likely patronage if service were introduced. Schauer published rates for several rural communities in Pennsylvania and New York. The rates varied from less than 0.25 to 10.00 annual

transit trips per capita. Regression models relate socioeconomic characteristics and transit level of service with transit patronage. These models require population and rider surveys.

Participation rates refer to trip rates applied to population subgroups known to be likely transit users, such as poverty and elderly households. Schauer recommends this approach for transit services focused on social service agencies. Participation rates could be expanded to include other potential users such as carless households and students.

Transit Cooperative Research Program (TCRP) Report 3 provides an operational version of the participation rates approach to demand forecasting.[(5)] Four subgroups comprise the service area population: social service agency clients, elderly, poor, and mobility impaired. Overlap among the groups is permitted. Transit level-of-service, expressed as vehicle-miles per year, and service area, expressed in square miles, also influence trip rates. The procedure is designed to predict changes in patronage resulting from changes in service. Forecasting future patronage necessitates forecasting socioeconomic and level-of-service variables.

TCRP Report 3 is designed to be used by transit operators. It contains worksheets to be completed in a particular sequence. Much of the socioeconomic data can be obtained from published census reports. The report includes default trip rates derived from surveys in various parts of the United States.

Andrade tested the accuracy of the TCRP Report 3 method by applying it to two Oklahoma rural transit markets with known patronage histories.[(6)] Andrade judged a forecast acceptable if it would not cause an operator to provide one too many or one too few transit vehicles. Her findings were mixed. In one of the applications the TCRP Report 3 forecast was well within the error tolerance. In the other, predicted patronage was high. Andrade's analysis raises questions about the transferability of trip rates and data definitions.

Attaluri, Seneviratne, and Javid developed nonlinear models for demand responsive and fixed route rural transit systems using data from operators in the west and southwest.[(7)] The researchers tested alternative model forms and combinations of variables. Socioeconomic variables included elderly, poverty, and mobility impaired households. Level of service variables included headways, bus-miles of service, and reservation time. Their best fixed route model explained 73% of variation in ridership. Variables included bus-miles of service (most significant), elderly population, and median rent. Their best demand responsive model performed worse, explaining only 60% of the variation. The researchers reported difficulties in collecting data.

None of these forecasting methods are satisfactory for agency use. They all fail three criteria for successful technology transfer. First, the mathematical models will appear mysterious to operators and many state agencies. Unless users understand the workings of a forecasting method, they will not embrace it. Second, the data required by the methods is difficult and expensive to collect. This is always a deterrent. Third, none of the research suggests the models can be transferred from one area to another without recalibration. The expense of recalibration will exceed the resources of most operators. Extensive use of patronage forecasting models will not occur until simple models calibrated to local conditions using easily obtained data are developed and deployed. Research to date is most useful in identifying the variables which explain patronage.

Chapter Notes

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2. Smith, Robert L., Jr., Evaluation of rural public transportation demand models that include level-of-service measures, *Transportation Research Record*, Vol. 638, pp. 49-51.

3. Neumann, Edward, and Bernard Byrne (1978), A Poisson model of rural transit ridership, *Transportation Research Record*, Vol. 661, pp. 21-27.

4. Schauer, Peter. Rural public transportation, *Public Transportation*, 2nd ed., Gray, George, and Lester A. Hoel, ed.s), Prentice Hall, 1992, pp. 407-442.

5. SG Associates, Inc., Leigh, Scott & Cleary, Inc., and C.M. Research, Inc.. *Workbook for*

Estimating Demand for Rural Public Transportation, Transit Cooperative Research Program, Report 3, Transportation Research Board, 1995.

6. Andrade, Patricia M.D. *Forecasting Demand for Rural Transit*, Masters Thesis, University of Oklahoma, 1999.

7. Attaluri, Prabhakar, Prianka Seneviratne, and Masoud Javid (1997), Modeling demand for public transit services in rural areas, *Journal of Transportation Engineering*, May/June, pp. 216-222.

CHAPTER THREE: WELFARE-TO-WORK LEGISLATION

The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWORA), commonly referred to as "welfare reform," contains a number of mandates for state social welfare programming that increase welfare recipients job training and work activities.[(1)] As a result of PRWORA, Temporary Assistance for Needy Families (TANF) replaced Aid to Families with Dependent Children (AFDC).

Under the new TANF program, categorical federal formula grants to states for AFDC were replaced by federal block grants for TANF. The block grants to the individual states are based upon previous federal expenditures for AFDC benefits and administration, Emergency Assistance (EA), and the Job Opportunities and Basic Skills Training Program (JOBS).[(2)] TANF was designed to increase the flexibility of states in operating their public assistance programs to needy families with children, with a limit of federal financial assistance to a family under TANF time limited to a cumulative total of 60 months (five years). States have flexibility in determining eligibility for TANF and the benefits recipients receive. TANF block grant funds may be used for any manner reasonably calculated to accomplish the purpose of TANF. In general, however, the states tend to follow broad eligibility standards which were set forth in the former AFDC program. Two critical features of eligibility are the presence of a needy child, and family income and resources.

To be eligible for TANF a needy minor child must be deprived of the support or care of at least one parent because that parent is deceased, incapacitated, absent from the home; and in the case of two-parent families, underemployment or unemployment. Eligibility ends when the youngest child in the family reaches majority age (age of majority is determined by state statute). In addition to each needy child, the parent (or other caretaker relative) may be eligible to receive TANF. States may provide cash assistance, use grant funds to make payments and/or provide job placement vouchers for employment placement services.

Work-Related Services

In addition to cash assistance, medical and child care, other direct and indirect benefits and services may be available. For example, states are allowed to subsidize public and private sector employment for recipients. Typically, subsidized employment refers to "cashing out" TANF and/or food stamp assistance and providing funds to employers who in turn pay wages to recipients.

States must perform assessments of recipients work capabilities, though no guidelines are specified by the federal agency. These assessments under the JOBS program (Title IV-F) ranged from states utilizing client self assessments to various testing procedures. Personal responsibility contracts for recipients on their work and career goals are at the option of the state. Examples of other job creation strategies already implemented or planned by the states include:

1. Providing tax credits and other employer incentives;

2. Creating industry partnerships and customized employment projects;

3. Developing interagency task forces or linkages, typically among welfare, workforce and economic development systems, for job creation, job development, or employer marketing;

4. Using workforce investment boards or councils;

5. Supporting entrepreneurial programs or small business loans;

6. Convening a statewide employer job summit;

7. Using one-stop career centers; and

8. Designing groups and positions responsible for soliciting employers to hire welfare recipients.

The arrangements for providing job related and support services vary from state to state. Under the JOBS program, some states utilized a caseworker approach with each caseworker responsible for basic services and monitoring a given number of AFDC cases. Other states utilized a case management approach for linking recipients to needed services. Another model is "outsourcing," or contracting out for purchase of needed services from private and other public services.

Maintenance-of-Effort
Maintenance-of-Effort (MOE) requires states to match at least 80 percent of their federal TANF grant to receive their full block allocations. The MOE will be reduced to 75 percent for states that meet the work-participation rate. The MOE is based on a state's FY 1994 spending on AFDC, JOBS, AFDC-related child care, and EA. A state's grant is reduced one dollar for each dollar that the state's spending falls below the required MOE.

Participation Rates
States also must meet standards for the participation of TANF recipients in work related activities, and this requirement is likely to have a significant impact on demand for transportation in both urban and rural areas. States must achieve minimum participation rates with respect to all families that include an adult or minor child head of household receiving assistance. Families not required to work in the first 24 months are counted in the work participation rate. The annual participation rate is the average of the participation rate for each month in the fiscal year. Not more than 20 percent of families may count toward the work rate by participating in vocational education. This includes a teen head of household in school or education directly related to employment. The incremental increases in work participation rates by year is shown in TABLE 1.

TABLE 1
Percentage of State TANF Recipients Who Must Participate in Work Programs

Fiscal Year	Two-Parent Families	All Families
1997	75	25
1998	75	30
1999	90	35
2000	90	40
2001	90	45
2002 and beyond	90	50

Source: Personal Responsibility and Work Opportunity Reconciliation Act of 1996, Public Law 104-193, 110 *Stat.* 2105.

Incentives and Penalties for States
Augmenting the requirements for increasing work participation rates for TANF recipients, states can benefit financially through performance bonus funding. Cash bonuses are available to "high-performing states" that meet the goals of the program in fiscal years 1998 to 2002. The financial penalties against states for failure to meet work participation rates result in a TANF grant reduction of 5 percent the first year. For consecutive failures, penalties rise by 2 percent each year, with a cap of a 21 percent reduction in the TANF block grant amount. The U.S. Department of Health and Human Services (DHHS) can reduce the penalty for missing the work participation rate based on the degree of noncompliance or if a state is in recession, provided that the state is

defined as "needy," based on contingency fund triggers.

Job Training and Work Requirements
Other requirements likely to have the effect of increasing demand for rural public transportation are the job training and work requirements. Adults (parents or relative care givers) in TANF cases are required to participate in work activities after receiving assistance for a maximum of two years (24 months). States may set a shorter time period, and in some states adult recipients are required to begin a work related activity immediately. Also required is participation in community service within two months of receiving benefits if adult recipients are not working.[(3)] A phased minimum number of work hours is set for 20 hours per week for FY 1997-98, graduating to 30 hours per week in FY 2000 and beyond. For two-parent families the cumulative work hour requirement (both able bodied parents) is 35 hours per week, and 20 hours for the caretaker spouse. Educational activities directly related to employment (or to complete high school or GED) is an allowable work activity, but not counted toward the first required 20 hours per week.[(4)] The particular allowable work activities are the following:

1. Unsubsidized employment;

2. Subsidized private-sector employment;

3. Subsidized public-sector employment;

4. Work experience, including work associated with refurbishing publicly assisted housing, only if sufficient private-sector employment is not available;

5. On-the-job-training;

6. Job-search and job-readiness assistance for up to six weeks. No more than four weeks may be consecutive. Individuals in states with unemployment at least 50 percent greater than the national average may participate for 12 weeks;

7. Community service programs;

8. Vocational education training, not to exceed 12 months for any one individual;

9. Job-skills training directly related to employment;

10. Education directly related to employment, in the case of a recipient who has not received a high-school diploma or certificate of high-school equivalency;

11. Satisfactory attendance at secondary school or course of study leading to general equivalency diploma (GED) in the case of a recipient who has not completed secondary school; and

12. Provision of child care services to an individual who is participating in a community service program.

Beyond the flexibility afforded states in setting eligibility standards, a number of other rules related to work activities apply:

1. If a two-parent family receives federally funded child care, both parents must work, with exceptions for parents of severely disabled children or parents who are themselves disabled;

2. A teen parent or head of household under age 20 will be counted as engaged in work if the recipient maintains satisfactory attendance at secondary school or the equivalent during the month or participates in education directly related to employment for at least the minimum average number of hours per week specified above;

3. States have the option to exempt single, custodial parents with a child under 1 year from the work requirement. A state may disregard the individual when determining participation rates. A parent may only receive this exemption for a total of 12 months, although the months do not have to be consecutive;

4. For all families (except teen head of household), the following activities do not count as allowable work activities toward meeting the first 20 hours (30 hours for two-parent families) of participation:

5. Job-skills training directly related to employment;

6. Education directly related to employment, in the case of a recipient who has not received a high-school diploma or certificate of high-school equivalency;

7. Satisfactory attendance at secondary school or course of study leading to general equivalency diploma (GED) in the case of a recipient who has not completed secondary school; and

8. The latter two educational activities do apply toward the required 20 hours for a teen parent head of household.

Sanctions. States may sanction recipients for failure to cooperate with the required work related activity standards. Sanctions may result in reduction of cash assistance grant, or even closure of the case. A state must reduce assistance to a family pro rata (or more at state option) for any period in which an adult member of the family refuses to engage in work as required under the TANF grant. The state may waive the penalty subject to good cause and other exceptions the state may establish. The state may also terminate assistance completely and terminate Medicaid for the individual whose cash assistance is terminated for failure to work. Minor children will continue to receive Medicaid. A state may not reduce or terminate assistance to a single parent with a child under age 6 if the parent proves that failure to participate in work is due to lack of child care.

Provisions and Penalties. States may elect to deny assistance to unmarried teen parents and their children. In states that do not deny assistance, unmarried teen parents of minor children are eligible for TANF only if they are living at home or in an approved, adult-supervised setting. Also, if the age of teen's child is 12 weeks of age or older the teen parent must participate in educational activities directed toward achieving a high-school diploma or GED, or participate in an alternative education or training program approved by the state.

Chapter Notes
1. Personal Responsibility and Work Opportunity Reconciliation Act of 1996, Public Law 104-193, 110 *Stat.* 2105.

2. The EA and JOBS programs were folded into TANF in 1996.

3. States may opt out of this community service requirement.

4. An exception is made for teen parents who have not finished high school or the equivalent.

CHAPTER FOUR: SIZE OF THE WELFARE POPULATION RESULTING FROM WELFARE REFORM

AFDC/TANF cases in Oklahoma mirrored the national trends of growing welfare populations from the mid 1980s and peaking in the 1992-1994 time period. Since then there have been steadily declining caseloads nationally and in Oklahoma as well. The phenomenon of dropping numbers on welfare has been experienced in both urban and rural Oklahoma counties. Data from the Oklahoma Department of Human Services (DHS) in Figure 4 charts the number of AFDC/TANF cases statewide for the month of May in each year from 1990 through 1999. Included in the chart are only those cases which have adult caretaker recipients (so-called adult cases) since it is this population for which there is potential for transit riders getting to and from work training sites. TANF cases with custodial parents are referred to as *adult* cases (with the needs of the custodial parent included in benefit payments) and children living with another caretaker (grandparents for example) are referred to as *child only* cases. In Oklahoma, two parent (unemployed parent cases) have been shifted out of the TANF program; assistance is provided solely through state funds. There is no single cause to the drop in AFDC/TANF cases, though a strong economy is seen as a

likely contributing factor both in the several years before and after welfare reform.

The analysis which follows examines the size of welfare populations for the rural counties which are covered by the rural public transit systems studied. A total of seven counties were primarily involved and include Caddo, Delaware, Kiowa, Latimer, LeFlore, Ottawa, and Pontotoc. AFDC/TANF cases are summed by transit system as follows: Delaware and Ottawa for Pelivan Transit; Latimer and LeFlore for KiBois Area Transit; Caddo and Kiowa for Fastrans; and Pontotoc for Call-a-Ride. As with the data in Figure 4, our analysis considers only adult AFDC/TANF cases. Table 5 shows adult TANF/AFDC cases for each month of May over the time period 1990-1999.

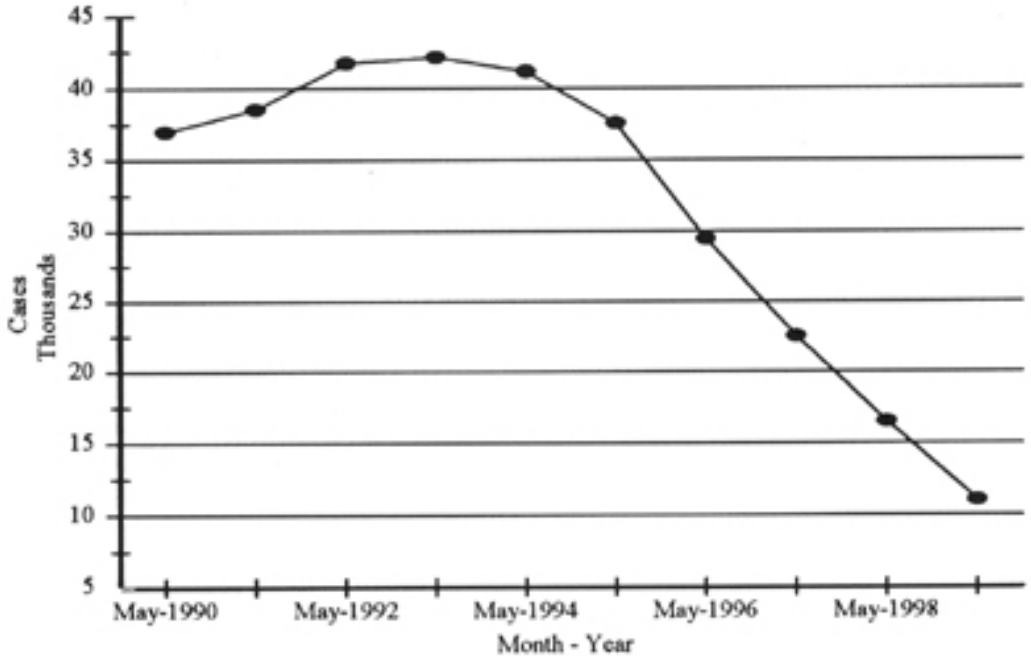
In 1996, Oklahoma DHS developed an econometric model for forecasting total cases on a statewide basis utilizing a number of demographic, economic, policy, and choice factors. This model predicted fewer cases than actually observed. In 1999, Oklahoma DHS decided to examine a time series model as a possible replacement for its econometric model. Time series, or ARIMA models are less data intensive than econometric models and can be more easily recalibrated. Figure 6 shows a Oklahoma DHS fifteen month forecast with high and low ranges for total state TANF cases. Aggregate statewide forecasts cover too large an area to be useful in rural public transportation planning: a few counties comprise most operator service areas.

We sought to forecast the potential number of TANF clients in each area studied as a variable relevant to demand for rural public transportation. Our efforts were frustrated by the dramatically declining case numbers reported above. In some Oklahoma counties, there are no TANF cases at all. Time series regression forecasts based on past history lead to negative numbers of TANF cases within two years in many counties.

A more complicated time series model might effectively forecast TANF cases at the county level. With a lower limit on TANF cases, a non-linear model could be developed which would show TANF cases declining at a decreasing rate, approaching the lower limit asymptotically. Given the low number of TANF cases at this time, we judge the effort required to develop such a model to exceed the benefits any added accuracy would yield.

Welfare populations decline because there are fewer case openings than closings. Nevertheless, new case openings represent potential additional demand for rural transit services. This pattern occurs in the service areas of the four operators we studied (Table 6). Rural public transportation also serves former TANF clients who commute by bus to work. This latter consideration is beyond the scope of our project, but would be worthy of further study.

FIGURE 4
Oklahoma Adult TANF Cases 1990-1999



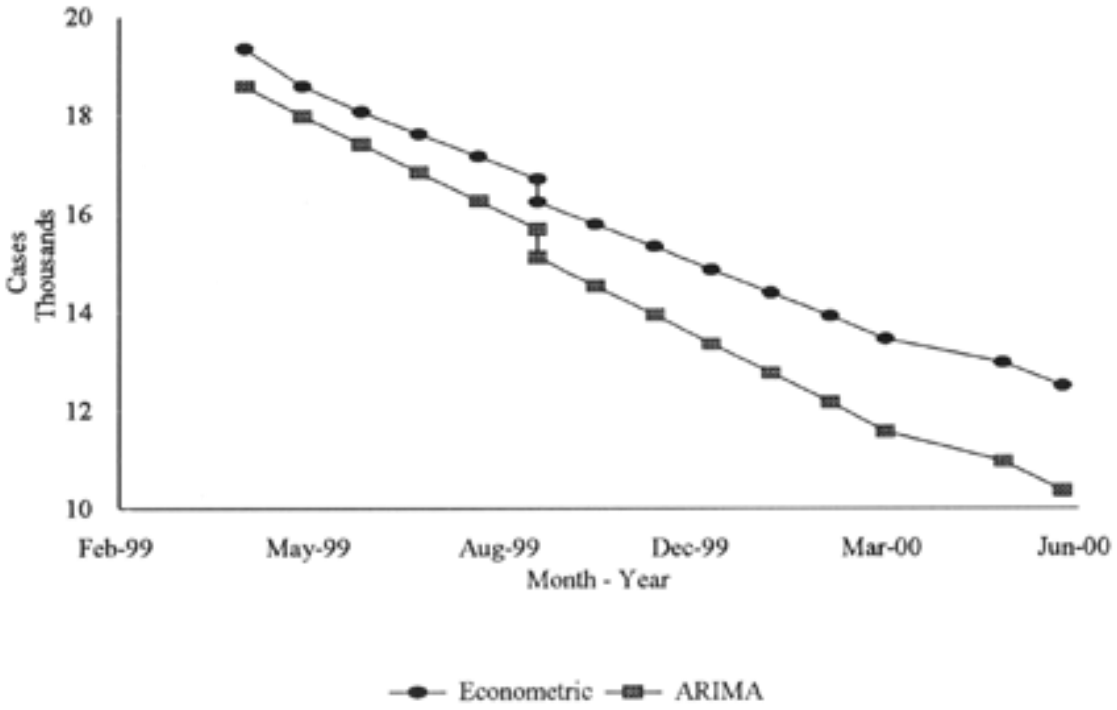
SOURCE: Oklahoma Department of Human Services

TABLE 2
AFDC/TANF Adult Cases for Oklahoma Counties
by Transit Operator Service Area: 1990-1996

Month Year	Counties			
	Latimer and LeFlore	Ottawa and Delaware	Caddo and Kiowa	Pontotoc
May 1990	883	703	818	466
May 1991	997	781	825	452
May 1992	1073	882	820	494
May 1993	1027	853	828	503
May 1994	1017	827	786	490
May 1995	889	703	736	442
May 1996	697	557	648	347
May 1997	580	461	468	289
May 1998	423	261	421	190
May 1999	219	153	300	106

SOURCE: Oklahoma Department of Human Services

FIGURE 5
Fifteen Month Forecasts of Oklahoma TANF Cases: April 1999 - June 2000



Source: Oklahoma Department of Human Services (with permission).
Note: Forecasts based on data available as of April 1999.

TABLE 3
New TANF Cases by Counties
in Case Study Service Areas: 1995-1998

Fiscal Year	Counties							
	Latimer and LeFlore		Ottawa and Delaware		Caddo and Kiowa		Pontotoc	
	Open	Close	Open	Close	Open	Close	Open	Close
1995	807	942	819	911	634	681	342	437
1996	733	933	725	764	634	693	350	419
1997	644	812	742	861	519	695	332	415
1998	536	682	555	701	574	646	282	407
1999	400	582	419	592	587	720	305	395

SOURCE: Oklahoma Department of Human Services

CHAPTER FIVE: CHARACTERISTICS OF RURAL TRANSPORTATION COMMUTERS

The TANF population consists mostly of young mothers with children. The father is absent from

the household. Our method called for collecting data on commuters which share characteristics with TANF households to determine those factors which account for mode choice. One candidate for forecasting transit patronage employs a logit type model.

Logit models are commonly used in urban transportation studies to predict mode choice. The model incorporates both socioeconomic and level of service variables. The binary form of the model, shown in Eq. (1) for non-transit commuters, applies in our study of rural commuters choosing between public transportation and all other modes.

$$p_{hm_2} = \frac{1}{1 + e^{U_{hm_1} - U_{hm_2}}} \qquad (1)$$

$$U_{hm} = \alpha + \beta_1 IVTT_m + \beta_2 OVTT_m + \beta_3 TC_m + \beta_4 S_{h_4} + \ldots + \beta_n S_{h_n} \qquad (2)$$

where

P	=	proportion
e	=	natural logarithm base
U	=	utility or characteristics of mode
IVTT	=	in-vehicle travel time
OVTT	=	out-of-vehicle travel time
TC	=	travel cost
S	=	socioeconomic characteristics of household
h	=	individual household
m	=	travel mode
α,B	=	calibration parameters
1,2	=	modes, in this case 1 = bus and 2 = all other travel modes

Commuter Survey

Primary data on commuter travel patterns and household characteristics are required for logit model calibration. The survey instrument in Appendix A was developed for this purpose. Four rural transit operators providing regular commuter service in Oklahoma, Arkansas, and Missouri (see Figure 2), permitted passenger interviews on board transit vehicles en route to work and educational sites. To reveal choice factors, we also interviewed commuters making the same trip as transit users via other modes. This data was obtained through on-site employee interviews at five worksites.

Survey participants were randomly selected from a common population (low income rural day and evening shift workers) distinguished only by mode of travel to work with public transportation an option. University of Oklahoma personnel interviewed transit users on board vehicles en route to work, and auto users in lunchrooms, offices, and break rooms, rewarding all participants with two dollars. Questions covered specific elements of worker commute trips, household socioeconomic characteristics, and auto availability. Eighty six usable surveys resulted. Fourteen of the surveys came from respondents who did not have transit service available.

The smallest reliable geographic unit for the survey was zip codes. Only commuters residing in specified zip codes participated in the survey to assure there was a mode choice available. All interviews occurred in April and May of 1998 and 1999 while primary and secondary schools were in session. Auto user travel cost was estimated by applying a fixed mileage charge of $0.30 per mile to the distance traveled.

Survey Population. Figure 4 shows the work trip mode choices made by survey participants. Approximately 80% of respondents worked full-time; the remainder were students. Almost

seventy five percent were female. Figure 5 shows the age distribution of commuters. Figure 6 illustrates the population's household size distribution. More than 70% of respondents reside in households with three or more people. Eighty seven percent of the population in worker households are less than forty years old.

Modal Comparisons. Auto, carpool, and transit commuters have similar age distributions (Figure 7) but come from households of quite different sizes (Figure 8). Transit commuter household size tends to be more evenly distributed than that of auto users where nearly two thirds reside in households of three or four persons. Transit user one way work trip travel times are much longer than those made by auto users, with nearly fifty percent of transit users spending more than an hour getting to work or school (Figure 9).

Transit Dependency. Long commute times discourage transit use, suggesting users lack other travel options. The survey confirms transit dependency but also reveals other influential factors. Figure 10 shows that 75% of auto user households have two or more autos compared with 22% of transit households. Nearly 30% of transit user households have no autos available for their use. Figure 11 indicates one third of transit user households have only one member of driving age.

Table 1 reports other commonly used measures of transit dependency. Very few transit and auto commuters reside in female headed households. Children are present in similar proportions. Over half of all auto commuters report making at least one non-work related stop on the way to or from work. Figure 12 lists the reasons given for these stops; carpooling with other household members accounts for 62%.

Model Development

Table 2 shows two composite ratios which distinguish transit user households from auto commuting households. The first statistic measures transit dependency as household population sixteen years of age and older divided by the number of autos in the household. The second ratio reflects economic dependency as household size divided by household workers. All the statistics in Table 2 are averages for the modes.

Appendix B contains the results of multiple efforts to fit the logit model described in Eq. (1) to the survey data. We sought to predict the proportion of commuters possessing certain socioeconomic characteristics who would choose transit when confronted by different levels of service. Eleven variables were examined. The first three measure level of service; the others describe household socioeconomic characteristics likely to influence mode choice.

1. In vehicle travel time (minutes);
2. out of vehicle travel time (minutes);
3. travel cost, in dollars per one-way trip;
4. household size (persons per household);
5. number of autos in the household;
6. number of drivers in the household (number of persons over 16 years of age);
7. number of persons in the household under the age of ten;
8. age of the commuter;
9. gender of the commuter;
10. the ratio of the number of autos in the household to the number of persons 16 years of age and older in the household; and
11. whether the commuter had been a TANF client within the past five years.

The five models which best fit the data are summarized in Table 3. Logit models can be evaluated in terms of their overall fit and the significance of individual parameters. Overall fit refers to the predictive ability of the model.[(1)] Table 3 contains three measures of overall fit: log likelihood, likelihood ratio, and likelihood ratio test. When comparing alternative models calibrated from the same data, the one with the largest log likelihood value would be superior. Log likelihood is always negative, so minimizing overall magnitude is equivalent to maximizing log likelihood. The likelihood ratio can also be used to evaluate competing models, with higher values preferred. The likelihood ratio test generates a statistic which is ^{2} distributed with degrees of freedom a function of the number of variables. Individual parameters are evaluated using a t-test.

All of the models are significant at the 99.9% level according to the likelihood ratio test. Model #5 provides the best overall fit, with the largest log likelihood value, log likelihood test value, and likelihood ratio. However, individual parameters are only significant at the 80% level. In terms of individual model parameters, models #1, #2, and #3 are all superior to model #5. The only socioeconomic variables which showed any significance were the number of household drivers, and age and gender of the commuter. The dummy variable indicating commuters who either currently receive TANF assistance or who had participated in the program within the past five years was also significant, but we conclude this to be an artifact of the data.

Variables which typically influence mode choice, such as the number of autos and household size, were not significant at any meaningful level. Neither was the presence of young children (less than ten years of age) which we thought would inhibit transit use.

Signs on the logit coefficients were at times illogical. As expected, mode choice varied inversely with travel time. We did not expect mode choice to vary inversely with travel cost, as indicated by the positive coefficient. The relationships between the OVTT and IVTT coefficients was also interesting. Urban studies suggest OVTT is about three times more costly to commuters than IVTT. Our results suggest rough parity. This may be due to the few transferring passengers in our survey population and door to door service. The constants are large and always negatively signed, indicating the auto mode remains preferred even under roughly equal travel times.

The survey data over sampled transit users, causing the constant to be biased. This bias is known and correctable as follows:[(2)]

$$E(\hat{\alpha}) = \alpha^{*} - \ln\left(\frac{A_i}{S_i}\right) \qquad (3)$$

where

$\hat{\alpha}$ = the estimated constant

α_i^* = the unbiased constant

A_i = the proportion in the population choosing alternative i (transit)

S_i = the proportion in the sample choosing alternative i

We did not effect this adjustment even though the relevant proportions are known. We judge none of the models to be a satisfactory fit due to insufficient observations in the sample. As we add observations to the database, we will recalibrate the model.

TABLE 4
Household Composition by Mode of Travel to Work

	Auto (%)	Transit (%)
Households w/members under five years old	22	23
Households w/members under eighteen years old	38	47
Female headed households*	0	11
Number of intermediate stops in daily round trip	54	0
*NOTE: No male over eighteen in household		

TABLE 5
Composite Measures of Transit and Economic Dependency

Dependency Ratio	Transit	Auto
(No. of autos per household)) (household members over 16)	0.57	1.06
(Household size)) (household workers)	0.73	1.00

TABLE 6
Logit Model Estimation Results

Variable	Model #1	Model #2	Model #3	Model #4	Model #5
IVTT	-0.213 (-2.67)	-0.182 (-2.38)	0.293 (-2.52)	-0.197 (-2.42)	-0.603 (-1.36)
OVTT	-0.102 (-1.70)	-0.140 (-1.84)	-.080 (-1.26)	-0.135 (-2.01)	-0.321 (-1.38)
TC	0.556 (1.84)	0.450 (1.36)	0.931 (1.35)	0.393 (1.107)	0.812 (1.46)
Drivers	-	-	-	-	5.187 (1.28)
Age	-	-	0.109 (1.43)	-	-
Gender	-	-	-	4.113 (0.96)	-
TANF	-	2.376 (1.45)	-	2.849 (1.70)	4.522 (1.37)
Constant	-1.769 (-2.50)	-2.535 (-2.49)	-6.069 (-1.83)	-6.55 (-1.47)	-17.08 (-1.38)
Likelihood Ratio	0.825	0.848	0.847	0.697	0.895
Likelihood Ratio Test	87.74 (3 df)	90.27 (4 df)	90.16 (4 df)	92.01 (5 df)	95.26 (5 df)
Log Likelihood	-9.400	-8.073	-8.130	-7.204	-5.580

NOTES: Computed *t* values are in parentheses. df = degrees of freedom. IVTT = in vehicle travel time. OVTT = out of vehicle travel time. TC = travel cost. Drivers = the number of household members over 15 years of age. Age = age of the commuter making the mode choice. Gender = gender of the commuter making the mode choice. TANF = dummy variable which is one if the commuter participated in the Temporary Aid to Needy Families program in the past five years. See text for complete variable definitions.

FIGURE 6
Survey Population Mode of Travel to Work

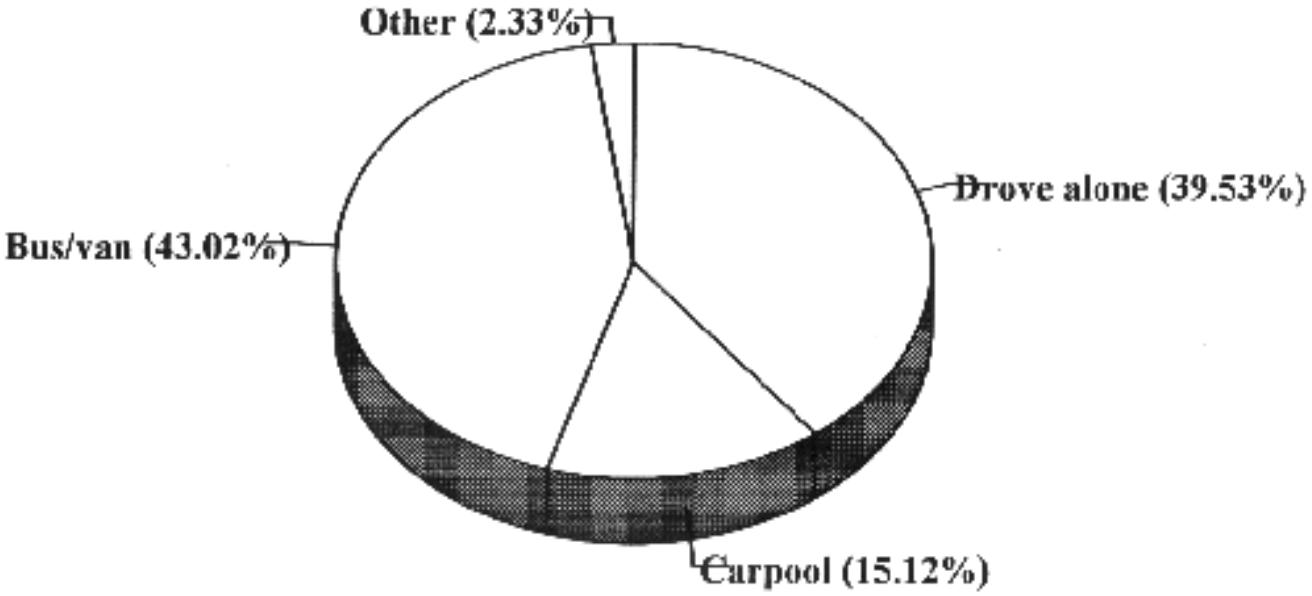


FIGURE 7
Age Distribution of Commuter Population and Their Households

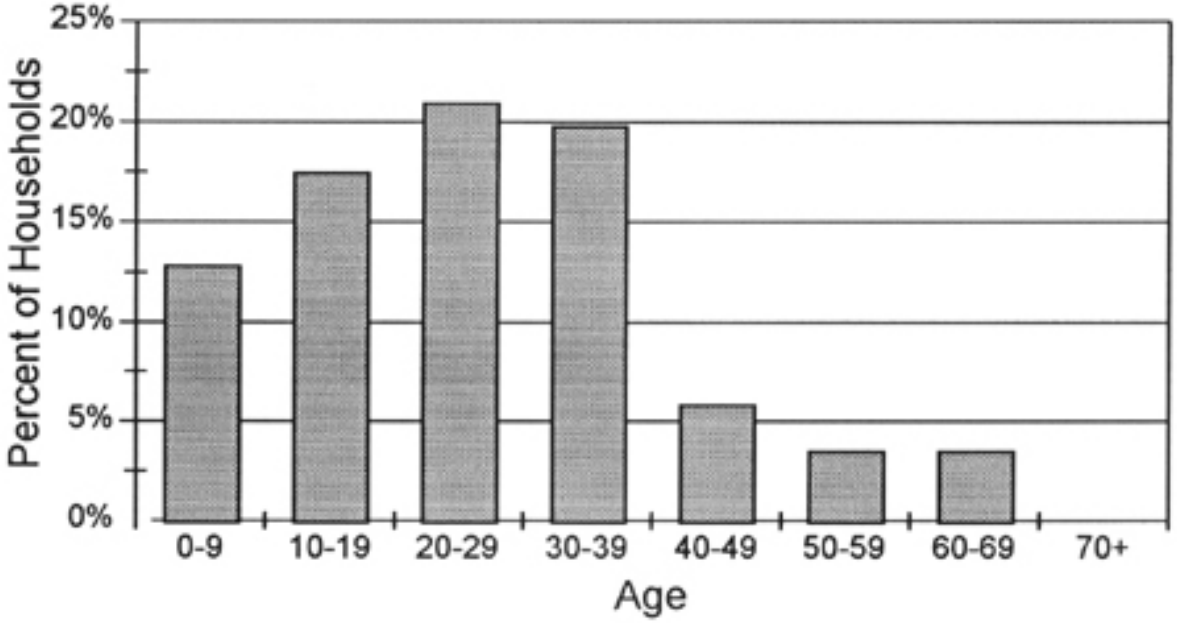


FIGURE 8
Household Size of Survey Population

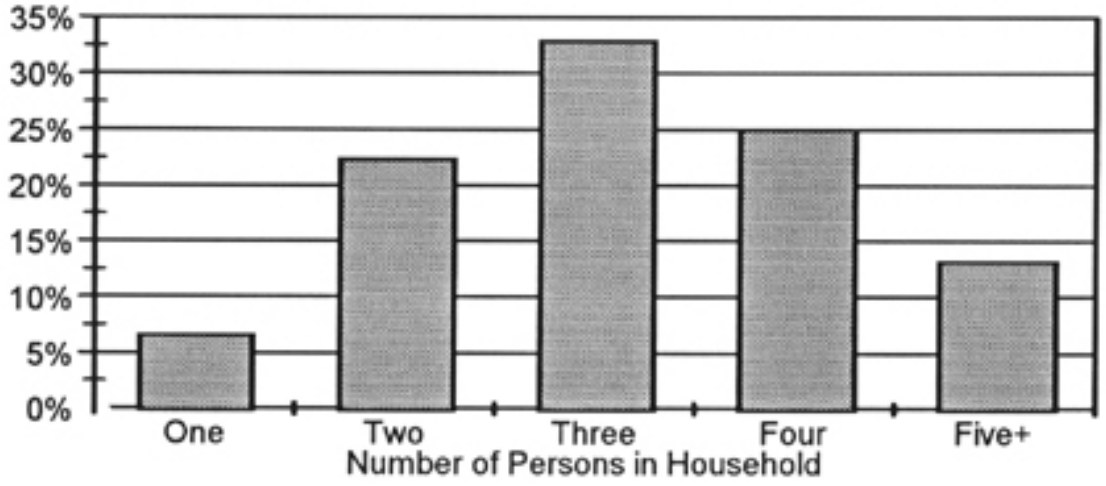


FIGURE 9
Age Distribution of Commuter Households
by Mode of Travel to Work

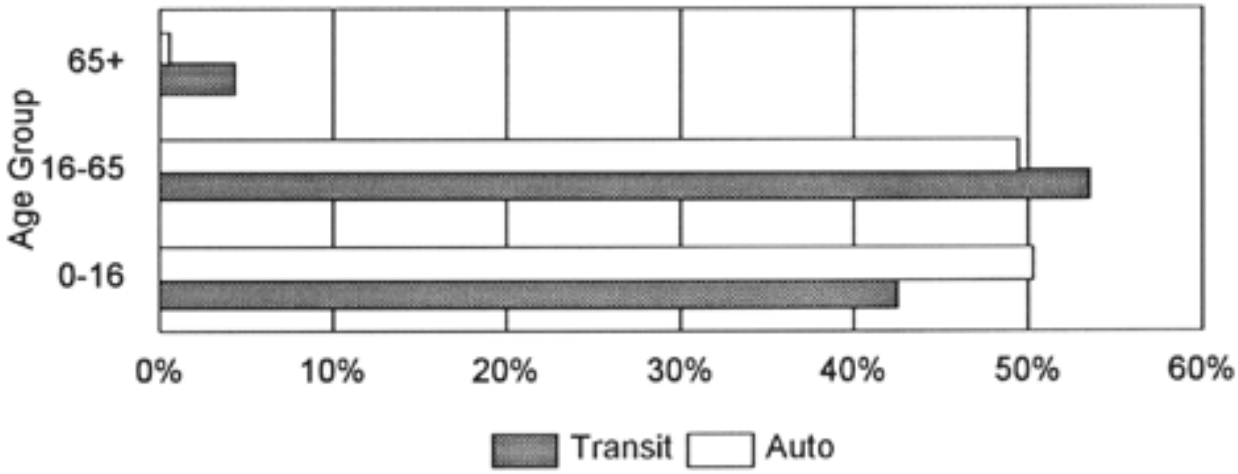


FIGURE 10
Household Size by Mode of Travel to Work

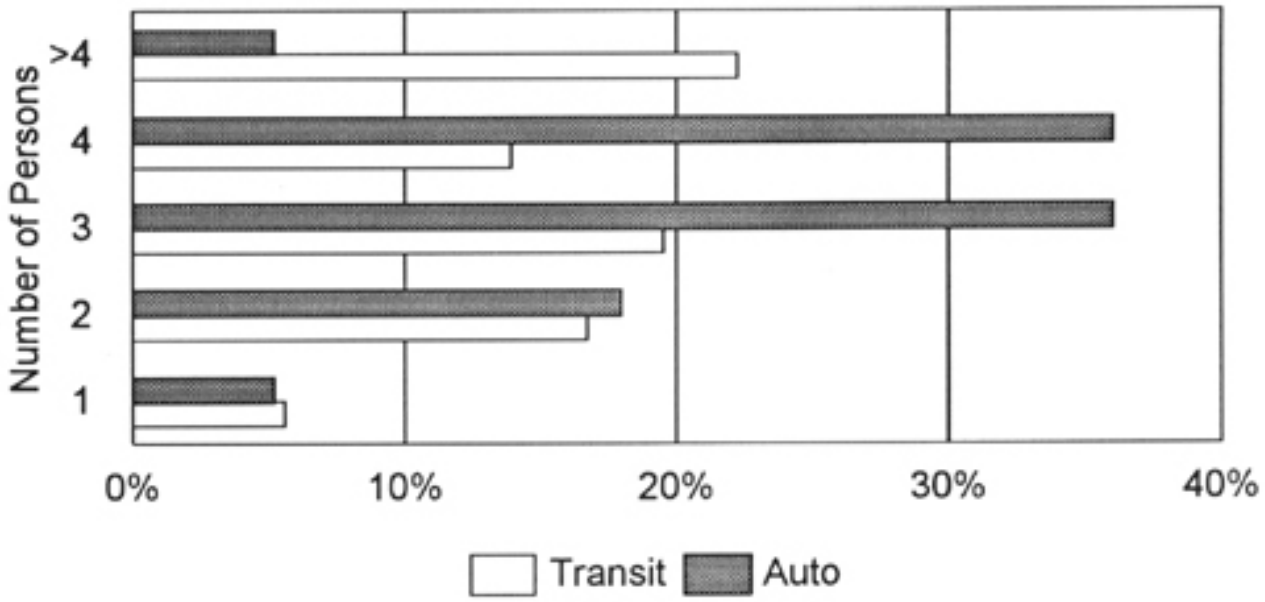


FIGURE 11
One Way Travel Time to Work by Mode in Minutes

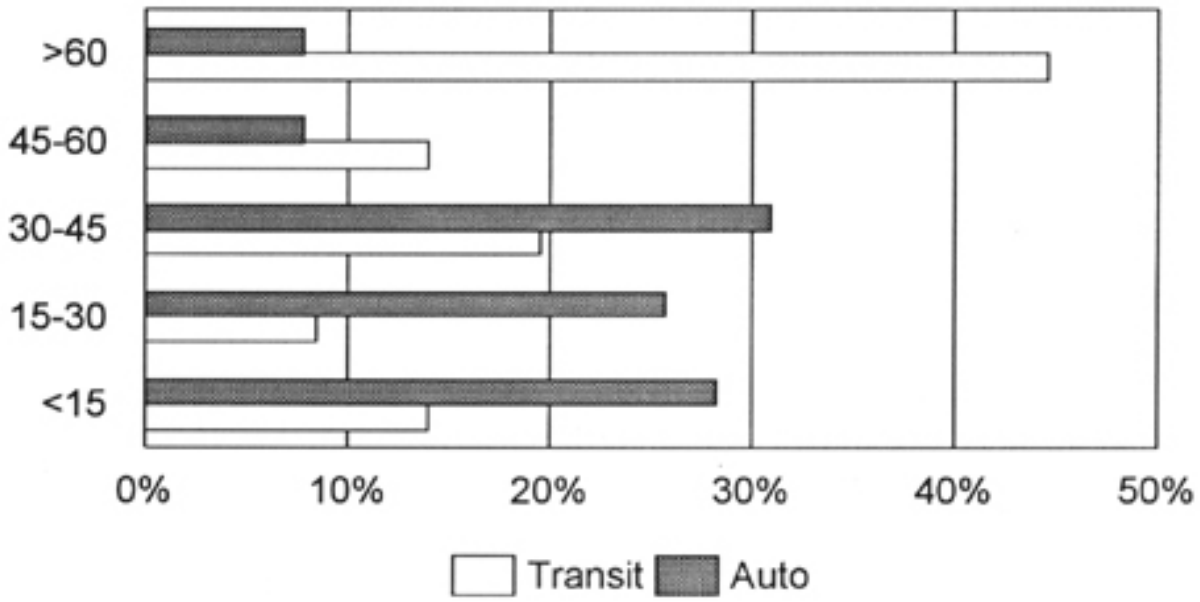


FIGURE 12
Auto Ownership per Household by Mode of Travel to Work

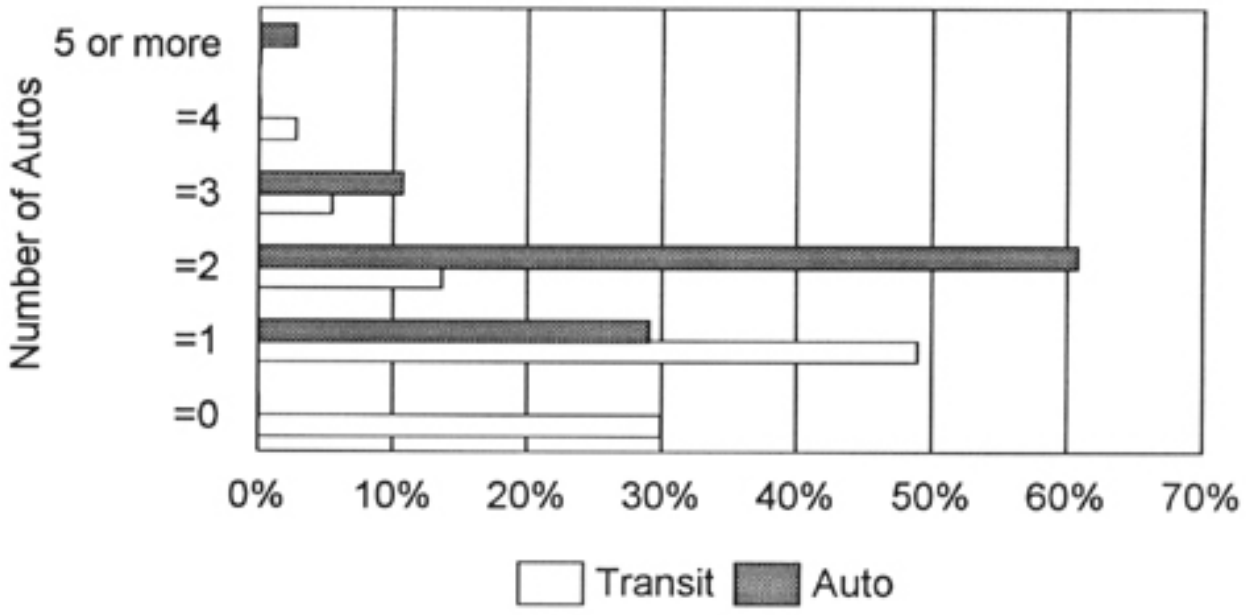


FIGURE 13
Driving Age Population by Household by Mode of Travel to Work

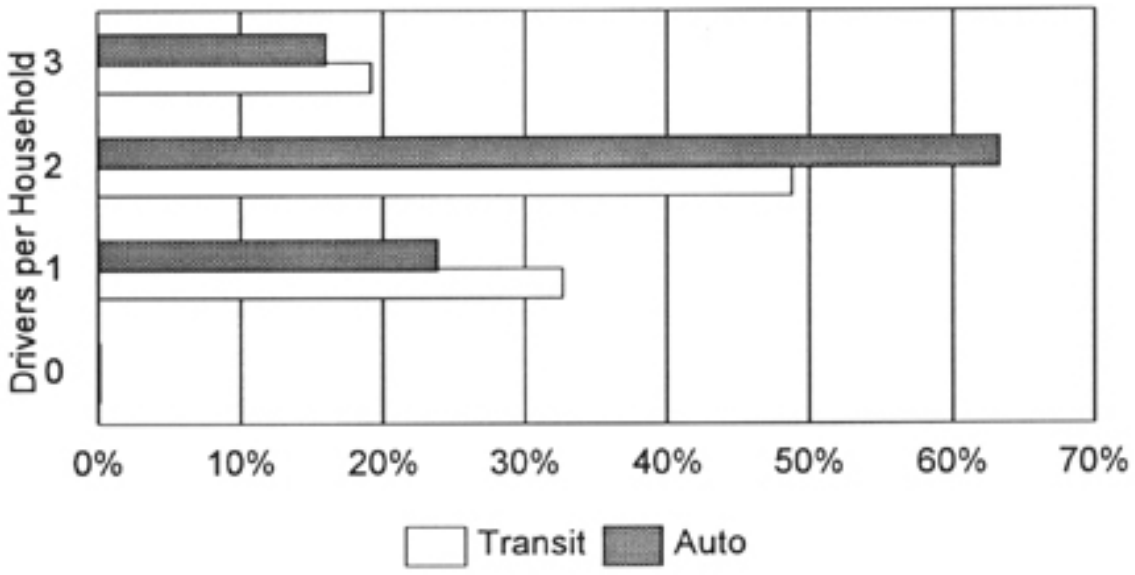
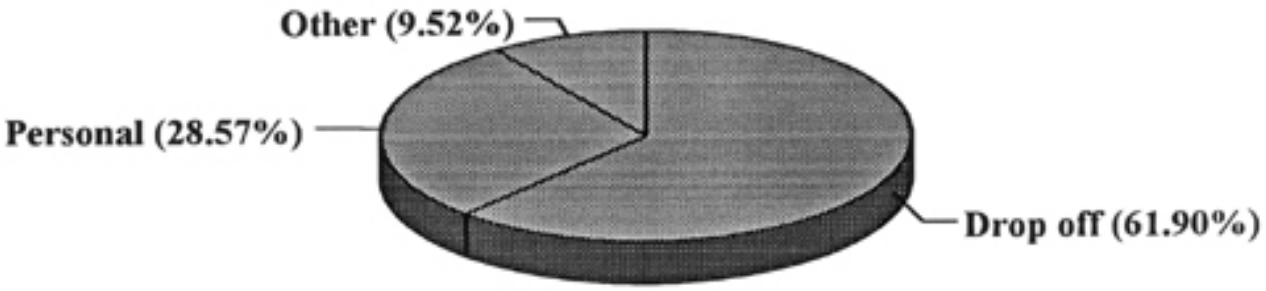


FIGURE 14
Reasons for Stopping To and/or From Work by Auto Users



Chapter Notes
1. Ben Akiva, Moshe, and Steven Lerman. *Discrete Choice Analysis*, MIT Press, 1985.
2. Train, Kenneth. *Qualitative Choice Analysis*, MIT Press, 1986.

CHAPTER SIX: FINDINGS

At the outset of this study we believed welfare reform would increase demand for rural public transportation. Our intuition was confirmed through direct observation. We saw rural public transportation systems serving TANF recipients engaged in meeting their educational and work requirements. We found passengers on regularly scheduled rural transit routes who had received TANF benefits at some time in the past but who are now holding regular full time jobs. However, we were unsuccessful in developing a method for quantifying this impact. We obtained encouraging results, suggesting some household characteristics which influence work and school trip mode choice, but the resulting models are not sufficiently validated to reliably predict either mode choice or patronage. Improving on these initial results will require more survey data. We still learned a great deal.

Rural public transportation reaches more TANF recipients when the state welfare agency subsidizes the service. State welfare agencies can award grants to assist rural transit operators in helping TANF recipients learn the job skills necessary to obtain gainful employment. We saw examples of these grants being used by rural operators to transport TANF recipients to educational sites. In only one case did we find TANF recipients and the general public riding the same bus, although we were told there were seasonal fluctuations in this patronage.

Rural public transportation can serve households with young children. We were surprised to find many transit riders from households with young children. We found two reasons why this was so. Some operators make a point of accommodating working and student mothers. At least one of the operators stops at child care providers while passengers drop off their children. This service adds $1.00 to their fare. Work schedules also seem to make child care less of an issue. Some riders work very late shifts, making it possible for two parent households to care for their own children. For TANF recipients in one parent households, however, child care can be a more significant problem and none of the work sites we observed had no on-site child care service.

Quantifying auto availability and reliability remains a major impediment to developing transit patronage forecasting models. None of the models we estimated found the number of autos in the household to be significant in explaining mode choice. In reality it is likely auto ownership influences rural commute mode choice, but we have not correctly specified auto availability. The proper specification is the number of *reliable* autos available for commuter use. Although we collected data on the model year and make of household vehicles, we have not found a way of summarizing these characteristics to produce a statistic which matches the desired specification.

Current TANF recipients and those who have received AFDC/TANF in the past five years (over 30 percent of study subjects) had fewer vehicles in their household than non-TANF recipients. Just under one-third of this group had no vehicle in the household, and those that did reported older

vehicles than other study subjects. Rural public transit appears a very viable option to this group where it is available.

Differences in urban and rural transit service affects the specification of logit type mode choice models. Urban mode choice models show a distinction between in-vehicle to out-of-vehicle travel time. Out-of-vehicle time exerts two to four times the influence on mode choice as does in-vehicle time. Our rural study shows rural commuters do not make this distinction. Out-of-vehicle time was either equally influential or less influential than in-vehicle time. We believe this results from the type of service typical of rural transit systems. Most passengers are picked up at their homes and delivered to the door of their destination. If they arrive early at their destination, they wait in a break room or student lounge. Passengers seldom wait at rural bus stops, and in those cases where they do it is usually in a car. There is no need in rural mode choice models to distinguish between in-vehicle and out-of-vehicle travel time unless the service type warrants it.

Monetary cost is as influential as service quality in rural commuter mode choice. Travel cost was a significant variable in some models. The coefficient sign was also correct, indicating as transit cost rises, transit mode share declines. After accounting for differences in magnitudes among the input variables (time in minutes and cost in dollars), the travel cost and travel time coefficients are approximately the same.

Rural transit operators with entrepreneurial attitudes can increase patronage through marketing and customized scheduling. Many of the commuter routes we examined had been operating for many years and were focused on a single destination. In these cases, operators organized bus routes and schedules around industries employing low wage workers drawn from a labor force scattered over large distances. Buses providing this service always carried a minimum of eight passengers and usually many more. Often the employer at the destination end partially subsidizes the service. In small rural communities operators informally recruit TANF recipients they know personally for work sites served.

Operators can overcome low aggregate population density in the service area. In our study, commuter rural transit routes served agricultural areas populated with scattered small villages. The routes were typically quite long, with one way travel times routinely exceeding one hour. Door to door service becomes practical if the small villages are not too numerous and a large employer exists somewhere within the region.

Gender can be an influencing factor in mode choice. We observed that the bus trip involves a significant opportunity for positive social interaction. We also discovered that the environment of mixed-gender trips can be imposing for a female rider in an otherwise male group, and likewise, a male in a female rider group. While TANF recipients are overwhelmingly female, only one fixed-site work route in our study involved all female riders.

The size of the TANF welfare population following welfare reform has not decreased demand for rural transit in the short run. The TANF welfare population has been decreasing both nationally and in Oklahoma. However, with continued TANF case openings, the incremental increase in required TANF work participation rates, and funding earmarked for transportation services to this population group, the impact of welfare reform will continue to increase demand for rural public transportation for the immediate future.

APPENDIX
SURVEY INSTRUMENT

RURAL PUBLIC TRANSIT WORK TRAVEL SURVEY

We are conducting this survey to determine the travel needs of Oklahoma residents to workplaces. We have a few questions to ask you about your commute to work today and about your

household. The survey should take about five minutes. Your answers will be confidential - your name will not appear anywhere on the survey form. In addition, we will pay you $2.00 for your participation.

PART 1: DETERMINING IF RESPONDENT IS QUALIFIED TO PARTICIPATE

1. What is the zip code at your home?
____ 73001 Albert
____ 73005 Anadarko
____ 73006 Apache
____ 73009 Binger
____ 73015 Carnegie
____ 73017 Cement
____ 73029 Cyril
____ 73033 Eakly
____ 73038 Fort Cobb
____ 73062 Mountain View
____ 73092 Verden
____ 73094 Washita

[IF NONE OF THE ABOVE, CANDIDATE IS DISQUALIFIED]

PART 2: CHARACTERISTICS OF TODAY'S COMMUTE

2. What time did you leave your house to go to work?

3. What time will you get home from work?

4. After you arrive at the plant, how much time did/will you have before your shift begins? (clock in?)

5. What time does/did your shift start?

6. How did/will you get to work?
____drove alone (1) [go to q. #7]
____carpool (2) [go to q. #8]
____bus/van (3) [go to q. #10]
____other (4) specify ____ [go to q. #13]

7. Did/will you on your way to work...
a. ____drop off/pick up children or spouse at school, work or daycare, or attend school or training yourself? (1)
b. ____attend to personal business? (2)
c. ____stop for any other reason today? (3) specify _____

[GO TO QUESTION #13]

Were/are you the driver?
8. ____yes (1) [go to q. #13]
____no (2)

Where did you meet your carpool?
9. ____I'm picked up at home
____I walk to a pickup point
____I get a ride to the pickup point
____Other (4), please specify _____

[GO TO QUESTION #13]

Were/are you the driver?
10. ____yes (1) [go to q. #13]
____no (2)

How did you meet your bus or van?
11. ____I drove to the pickup point (1)
____I'm picked up at home (2)
____I walked to the pickup point (3)
____I got a ride to the pickup point (4)
____Other (5), please specify _____

Where were you picked up (provide a precise location, e.g. home, Miami Civic Center parking lot, Buffalo Ranch, etc.)?
12.

PART 3: HOUSEHOLD CHARACTERISTICS

13. Describe the persons residing in the same home as yourself. Check all fields that apply. For (F), use codes following question. Person #1 should be the respondent.

(A) Person	(B) Age	(C) Gender	(D) Employed, Student, or in Daycare	(E)* Full or Part Time	(F) Transp to School, Work, or Daycare
1	____	____	____	____	____
2	____	____	____	____	____
3	____	____	____	____	____
4	____	____	____	____	____
5	____	____	____	____	____
6	____	____	____	____	____
7	____	____	____	____	____
8	____	____	____	____	____

1= I drive them
2= A member of my household drives them
3= They carpool
4= They walk
5= They drive themselves
6= School provides transportation
7= They ride their bicycle
8= Public transportation
*Full time= >36 hours/week

14. Describe the registered cars and trucks in your household which have current tags.

Vehicle	Make	Model	Year
1	____	____	____
2	____	____	____
3	____	____	____
4	____	____	____
5	____	____	____

15. Have you ever ridden the Pelivan bus to work?
____yes (1) [answer q. #16]
____no (2)

16. If you have stopped riding the bus, why?

17. Have you received AFDC and/or TANF assistance in the past five (5) years?
____yes (1)
____no (2)