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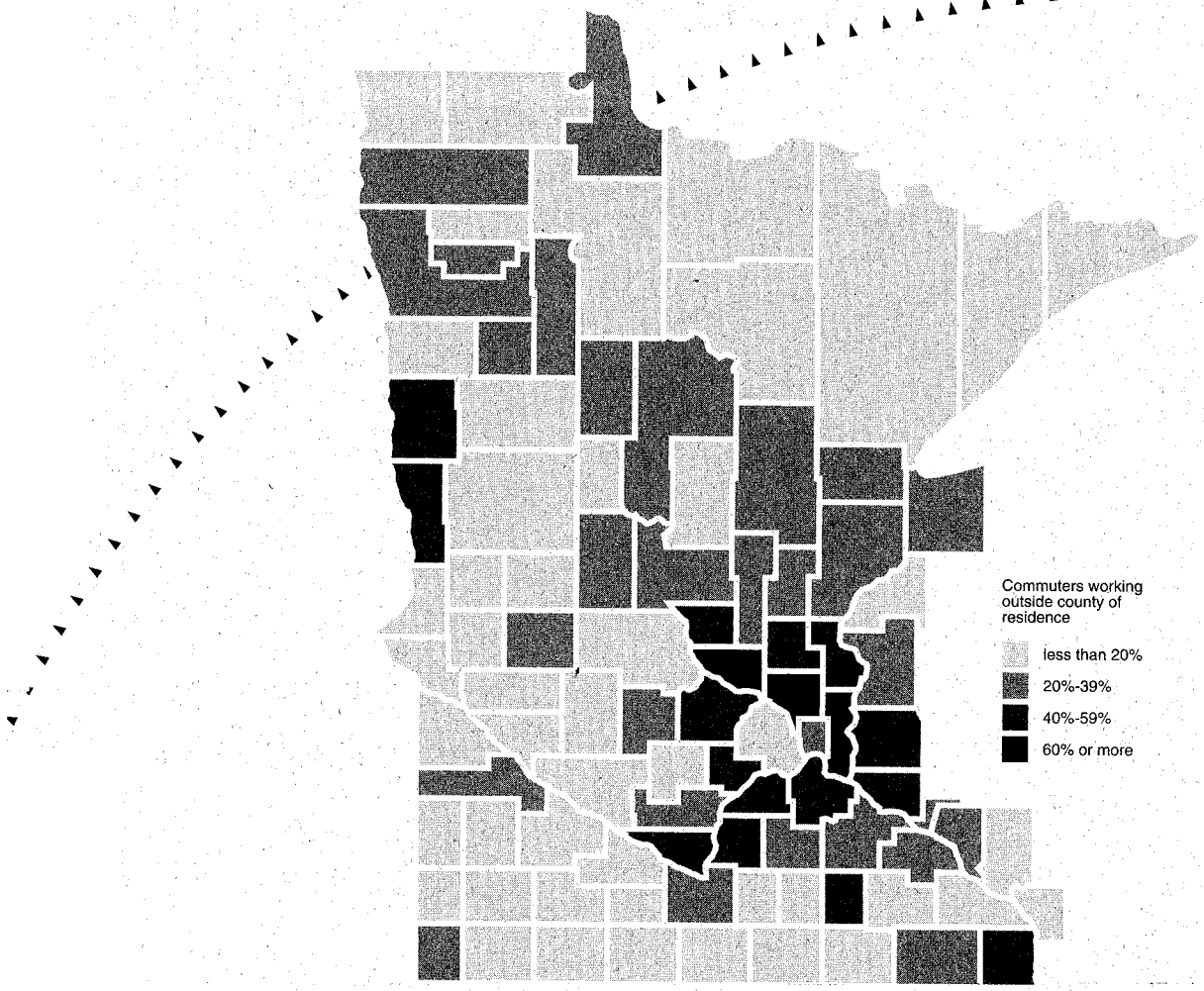

Data Sources for Use in Conducting Travel Behavior Research: A Case Study of Reverse Commuting Among Low-Income Residents of Minneapolis

UNIVERSITY OF MINNESOTA
CENTER FOR TRANSPORTATION STUDIES

Funding Acknowledgements

This report is one of four research papers funded by a one-year grant from the Minnesota Department of Transportation. Additional support was provided by a computing grant from the University of Minnesota's Computing and Information Services.

Technical Report Documentation Page

1. Report No.	2.	3. Recipient's Accession No.
MN/RC - 94/26		

4. Title and Subtitle	5. Report Date
Data Sources for Use in Conducting Travel Behavior Research: A Case Study of Reverse Commuting Among Low-Income Residents of Minneapolis	August 1994
	6.

7. Author(s)	8. Performing Organization Report No.
Melissa J. Loughlin, Elvin K. Wyly and John S. Adams	

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
Department of Geography University of Minnesota 414 Social Sciences 267 19th Avenue South Minneapolis, MN 55455	11. Contract(C) or Grant(G) No. (C) Mn/DOT 70731 TOC 114

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Minnesota Department of Transportation Office of Research Administration 200 Ford Building-Mail Stop 330 117 University Avenue St. Paul, Mn. 55155	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This study demonstrates applicability of two distinct data sources for travel behavior research. Questions relating to reverse-commuting are raised with respect to all working residents, and working residents in low-income households located in Minneapolis.

Census of Population and Housing, 1990 Public Use Microdata Sample (PUMS) and the Twin Cities Metropolitan Council Travel Behavior Inventory (TBI) provide details on aspects of commute and travel patterns. Examining organization and methods of analysis appropriate to determining particular travel-related information presents a unique perspective on the advantages and shortcomings of each data set.

PUMS data provide detailed household and work-journey information. To answer reverse-commuting questions posed in this study, we consider household income, worker occupation, state and Public Use Microdata Area of employment, number of persons in each household, means of transportation used for the journey to work, and work journey duration.

TBI data contain a wealth of information on both the work journey and other trips, but lack the depth of socioeconomic data available in the PUMS file. The value of TBI data in responding to this series of questions lies in the details about trip location and purpose.

17. Document Analysis/Descriptors	18. Availability Statement
Journey-to-Work Commuting Employment	No restrictions. This document is available through the National Technical Information Services, Springfield, Va. 22161

19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	50	

Data Sources for Use in Conducting Travel Behavior Research: A Case Study of Reverse Commuting among Low-Income Residents of Minneapolis

Final Report

prepared by

Melissa J. Loughlin, Elvin K. Wyly and John S. Adams*

August 1994

Submitted to

Minnesota Department of Transportation
Office of Research Administration
200 Ford Building, 117 University Avenue
St. Paul, MN 55155

*Melissa J. Loughlin and Elvin K. Wyly are doctoral students in the Department of Geography, University of Minnesota. John S. Adams is Professor of Geography, Planning, and Public Affairs at the University of Minnesota.

ACKNOWLEDGEMENTS

This research was supported by grants from the Minnesota Department of Transportation and the University of Minnesota Center for Transportation Studies. Computing resources were provided by a research grant from Computer and Information Services (CIS) at the University of Minnesota. Wendy Treadwell, at the University of Minnesota's Machine-Readable Data Center, extracted the data contained in this report from tapes of the Census Public Use Microdata Samples.

Technical advice and assistance in the course of the research and preparation of this report were provided by Stephen Alderson, Kathy Briscoe, Ron Cassellius, Judy Ellison, Perry Plank, Charles Reiter, and Gerry Weiss. Opinions expressed in the report, as well as any errors of fact, are the sole responsibility of the authors.

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EXECUTIVE SUMMARY

This study examines the applicability of two data sources to travel behavior research. the strengths and weaknesses of the Public Use Microdata Sample produced by the Bureau of the Census in combination with the Travel Behavior Inventory conducted by the Metropolitan Council are demonstrated through a case study identifying reverse commuting patterns among residents of Minneapolis. Data on occupation type, employment and non-work trip location, and transportation means among low-income and other working residents of Minneapolis indicate the geographic distribution of transportation demand. Results indicate that the two data sets used together complement one another to provide a more complete picture of travel behavior among Minneapolis residents.

INTRODUCTION

Researchers studying the need for and availability of transportation services and infrastructure in the Twin Cities metropolitan area have two dominant data sources available to them that offer information relevant to planning and policy issues. First, the 1990 Public Use Microdata Sample (PUMS) from the U.S. Census of Population and Housing includes socioeconomic and structural attributes for the entire nation based on responses to the long form questionnaire of the U.S. Census. The PUMS file is particularly useful for metropolitan-area oriented research because the geographically-delineated units of analysis are relatively small in densely populated areas. Secondly, in addition to census data, researchers studying travel patterns in the Twin Cities area can make use of results from a comprehensive Travel Behavior Inventory (TBI) undertaken in 1990 by the Metropolitan Council of the Twin Cities. The results of the Council's TBI contain a wealth of information on a broad range of trip types, and include specific location information allowing the researcher to map results to enhance analysis.

The roughly simultaneous timing of the PUMS and TBI provides a unique opportunity for researchers to consider the results of each in conjunction with the other. Joint analysis allows the researcher to obtain a clearer understanding of the transportation patterns of specific segments of the population, of particular geographic areas within the Twin Cities metropolitan area, or both.

This study explains the benefits of both data sources, and offers an example of how the research process might be organized in order to maximize the effectiveness of joint analysis. Both data sets are applied to questions about reverse commuting patterns among Minneapolis residents, with special attention to working residents living in low-income households. While the focus of this project is to demonstrate the usefulness of PUMS and TBI data for transportation behavior research conducted on the Twin Cities, the results provided by the case study shed light on an issue of particular concern to transportation planners today.

I. TWO COMPLEMENTARY DATA SOURCES FOR TRANSPORTATION ANALYSIS

PUMS and TBI data reflect different aspects of transportation-related issues. The PUMS is rich in socioeconomic details of households and household members, but lacks geographic specificity to a degree useful for most purposes. The TBI provides exceptionally accurate location and trip information without investigating the characteristics of those individuals involved. This section examines the strengths and limitations of both data sets.

A. THE PUBLIC-USE MICRODATA SAMPLE

Public-Use Microdata Samples have been created from the past several decennial censuses, and the Bureau of the Census is cooperating with academic researchers to create PUMS for earlier censuses back to the 19th century. This often overlooked source of information has two major advantages: the breadth of attributes included, and the sample's widespread availability. Disadvantages include limits to geographic detail, and a lack of data on any travel other than work-bound commuting.

The PUMS includes over 200 attributes for each individual in each household sampled. Each household record includes (1) housing structure details ranging from plumbing and number of rooms, to type of structure; (2) household economic characteristics such as income and mortgage payments; and (3) person records for each household member. Because the full sample is publicly available, the researcher can query it for the appropriate combination of characteristics relevant to the questions posed. For example, the reverse-commuting questions outlined in the following sections are studied for all working residents of the City of Minneapolis, and for working residents from low-income households in the city. The database can be sorted still further, depending on the needs and nature of the project. One might choose

to examine differences in average number of automobiles available to households of different racial groups, or compare the propensity for persons of certain income levels to select one means of transit over another. Such fine detail cannot be extracted from the data included in census tabular summary reports [1].

The PUMS originates uniformly throughout the nation. The 1990 long-form census questionnaire was distributed to approximately one in six households in every state. The information returned on these questionnaires is the source of the PUMS data. Then the returns were systematically sampled to create PUMS files representing 1 percent and 5 percent of the nation's households and household members. The PUMS are published in different versions. One version focuses on the entire U.S. population. Another version provides samples for the various states and substate areas within them, including metropolitan statistical areas. Therefore, comparative PUMS data can be obtained for the Twin Cities area and for metropolitan areas outside of Minnesota. Depending on the frame of reference desired for a specific study, this feature of the PUMS is a necessity for standardized comparison among places.

While different versions of PUMS are available, the 1 percent sample is most relevant here because its geographic units of analysis are aligned with the metropolitan statistical area (MSA) borders throughout the nation. Thus, a combination of Public-Use Microdata Areas (PUMAs) comprise the area within the metropolitan statistical areas. This alignment of PUMAs and MSAs standardizes the areas for which data are available--the major reason joint analysis of PUMS and TBI data is possible with some degree of specificity.

Much of the detailed information on households and household members included in the PUMS sample is personal and therefore must be handled with care and published by the Bureau of the Census in ways that protect confidentiality. PUMA boundaries are based on populations of 100,000 individuals or more in order to protect the privacy of persons enumerated. Densely populated areas are subdivided into two or more PUMAs to maximize geographic detail while protecting confidentiality. Twenty-nine PUMAs make up the 1 percent

sample areas for Minnesota: of these, half comprise the Minnesota portion of the Twin Cities Metropolitan Statistical Area. Therefore, greater geographic specificity is available in analyzing one or all of the metropolitan area PUMAs than can be obtained for analyzing PUMAs that include rural counties. Metropolitan area-based analysis is especially appropriate for PUMS data.

Using the PUMS means trading off geographical detail in exchange for multiple-attribute household and individual records. For some research purposes, however, a PUMA is simply not an appropriate areal unit for analysis. Depending on population density, a PUMA can include hundreds of square miles of a sparsely settled county, or it can cover one or more counties. At the other extreme, a PUMA may cover an area as small as Minneapolis's 55 square miles. For issues requiring a highly localized focus, the geographic detail available from census tract-level data may be required.

The second major limitation to PUMS applicability to transportation behavior research is that the census data collected include only work-related travel. The long-form questionnaire asks about work-journey length, timing, and means. Place of work information is limited to county of employment: thus, we can see how many persons within each PUMA travel to other counties, PUMAs or states, but no further detail can be extracted because of sensitivity issues mentioned above. Thus, using PUMS data alone allows study only of *commuting* behavior rather than of *travel* behavior.

B. THE TRAVEL BEHAVIOR INVENTORY

Like the PUMS, the Metropolitan Council's TBI also exhibits strengths and weaknesses important to its usefulness for travel behavior research. The TBI's inclusion of non-work related travel rectifies the PUMS topical limitations with regard to non-work related trips. In fact, the inclusion of shopping and other non-work related trip details is a major strength of the TBI.

TBI data are divided into trip, person, and household records. For each trip recorded, origin and destination purpose and location as well as the means and time of travel used are available. Trip information is recorded by traffic assignment zone (TAZ)--geographic units designated prior to but adjusted during the inventory. These TAZs are more similar in size to census tracts than are PUMAs, and thus allow a far greater level of geographical detail. Thus, not only are the TBI data based on a more complete cross-section of travel, they include locational detail that can be usefully mapped to demonstrate spatial patterns among the transportation characteristics examined. These are the most important advantages of the Travel Behavior Inventory data.

Limitations to the use of the TBI for certain types of inquiry reflect the distinctive strengths of the PUMS. The household and person data included in the TBI are not as thorough as those available in the PUMS. There are sampling issues of particular concern for the TBI that can limit the precision of estimates generated from these files. While the TBI is based on an overall 1 percent sample of metropolitan area population, equal sampling was impossible among various population groups. For example, low-income central-city residents failed to respond to the same extent as did the more economically secure residents of suburban areas [2].

Unlike the PUMS, the TBI is locally-based, with design and preparation by the Metropolitan Council. Travel behavior studies conducted in other cities nationwide are not standardized with efforts in Minnesota. While this issue is irrelevant for studies examining that area alone, it cannot be ignored if comparability to studies executed elsewhere is important to a specific research question.

The case study examined in the following section reflects the importance of considering the strengths and weaknesses of both the TBI and PUMS data in the design of a successful research project.

II. REVERSE-COMMUTING BY MINNEAPOLIS RESIDENTS

The extent of data that are available at the researcher's fingertips today and the ease with which we have access to them call for careful consideration of the issues, questions, and methods of analysis in the earliest stages of project design. There is no shortage of interesting and pertinent issues to be studied. For effective analysis, however, specific goals and consideration of study scope are crucial.

A. IDENTIFYING THE ISSUE

Minnesota and Twin Cities area commuting patterns have diffused considerably in the past thirty years [3]. As a result, questions arise whether the traditional distribution of transportation infrastructure and services will continue to meet the metropolitan area's needs in the future. Numerous questions about a jobs-housing imbalance stem from this issue.

This case study examines the prevalence of reverse-commuting by Minneapolis residents--that is, how widespread is the phenomenon of central-city to suburb commuting. Given the wealth of data available within the PUMS and TBI, it is necessary to determine what part of the issue is appropriate to investigate to gain an overall understanding of the nature of reverse commuting patterns--specifically who they involve and why?

B. FORMULATING THE QUESTIONS

Five concise questions are determined to address aspects of the reverse-commuting issue. They are:

1. Where do workers living in Minneapolis work?
2. How prevalent is reverse commuting among Minneapolis's working residents?

3. What travel behavior patterns are common among Minneapolis's working residents?

4. What occupations draw reverse commuters out of Minneapolis for employment?

5. What means of transportation do reverse commuters use, and how much time do they spend in the work journey?

Each of these questions can be addressed using either PUMS or TBI data. In the case of workplace location, both sources can be applied. However, the PUMS data supply only the PUMA of work and of residence, whereas the TBI gives the same information but with the more precise spatial resolution of the traffic assignment zone. These issues are of particular concern in the next stage of the research process. At this stage, we need an awareness of the strengths and weaknesses of the data sources to be used in order to determine the feasibility of the proposed investigation.

Because some analysts suggest that low-skill, low-paying service jobs are leaving the inner city for the suburbs and thereby abandoning workers with commensurate job skills and earning potential, it is desirable to demonstrate the extent of reverse commuting on the part of that segment of the population. Here, question formulation grows more difficult. Although the PUMS has detailed breakdowns of both personal and household income by type, the TBI does not consider income in much detail. Therefore, a definition of "low-income" applicable to both data sources must be identified. For purposes of clarity, household income is used as an identifier. Persons living in households with total income below $15,000 annually are considered, and within this group working residents are examined in this study. A sixth question is added to give special consideration to the needs of this segment of the population:

6. How do these patterns (addressed in questions 1-5) vary for Minneapolis's low-income working residents?

Now that focused questions have been composed, the next step is to determine exactly how best to approach each of them.

C. DETERMINING METHODS OF ANALYSIS

The TBI and PUMS have differing, if equally valuable, characteristics relevant to transportation research. To address the questions at the center of this inquiry, both sources must be used. Only the TBI can be used for question 3 (What travel behavior patterns are common among Minneapolis's working residents?), as the PUMS does not address non-work travel at all. Likewise, useful maps of work and home location can be derived only from the TBI.

Sorting for answers to questions 2 (How prevalent is reverse commuting among Minneapolis's working residents?), 4 (What occupations draw reverse commuters out of Minneapolis for employment?) and 5 (What means of transportation do reverse commuters use, and how much time do they spend in the work journey?) does not require much geographic precision. Records of Minneapolis residents who work outside the city can easily be isolated within the microdata sample and examined for trip length, for means, and for worker occupation. The TBI's three-file structure--by trip, by person, by household--makes non-locational analysis more cumbersome than when using census data.

Results can be presented in a wide variety of forms of varying effectiveness. Question 1 (Where do workers living in Minneapolis work?), for example, can be addressed in summary form with a simple numerical response: 102,810 Minneapolis residents work in the City of Minneapolis itself; 53,682 travel to suburbs and outlying areas; and 9,936 commute to St. Paul. It is more effective, however, to show the same information proportionally. One method is a pie chart (Figure 1). At a glance, the segment of the population in question is visible as about one-third of all commuters living in Minneapolis. However, this issue is best displayed cartographically, with heavy concentrations of workplace destinations located in and around downtown Minneapolis, a small cluster in downtown St. Paul, and the remainder scattered in the suburbs, with the density diminishing with increasing distance from the city (Figure 2).

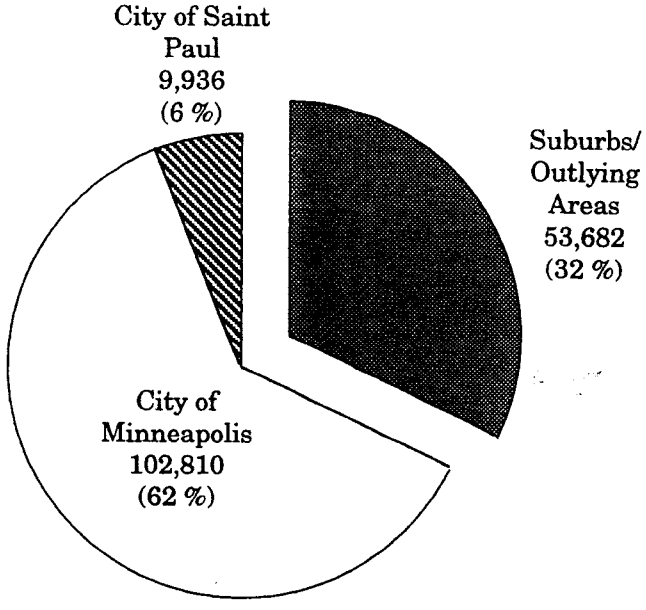


Figure 1. Workplace Location of Minneapolis Residents. Responses of those employed Minneapolis residents who did not specify workplace location or worked out of state are not included in percentage calculations shown here. See Appendix A for a complete breakdown of employed Minneapolis residents by workplace location. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

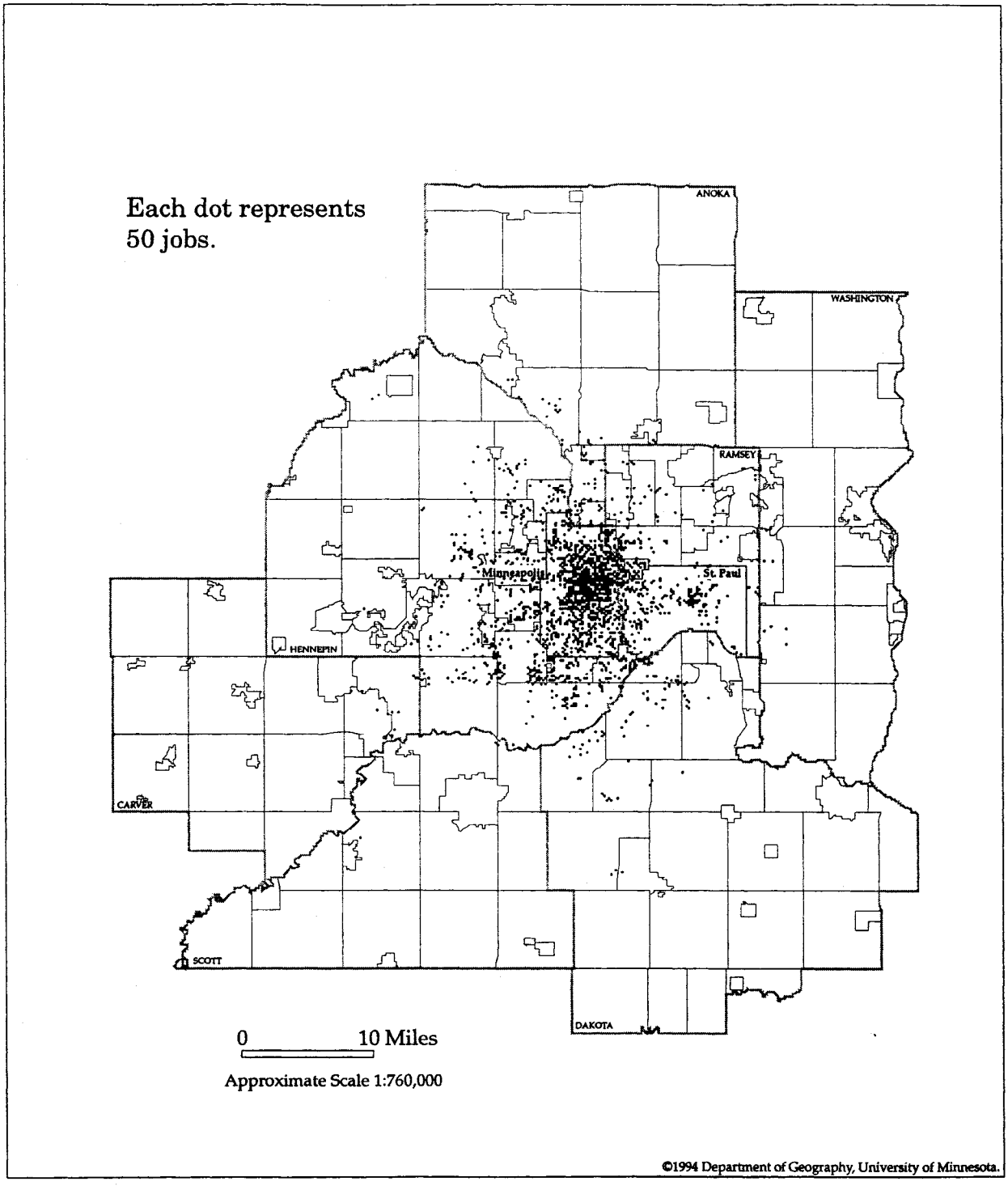


Figure 2. Workplaces of Employed Residents of Minneapolis. Data Source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

Information from both types of visual display applies to Question 2 as well (prevalence of reverse commuting). For Question 3, however (travel patterns common among the city's working residents?), maps alone are effective for quick communication of geographic patterns. For quantitative responses necessary for Questions 4 and 5 (What occupations draw reverse commuters out of Minneapolis for employment? What means of transportation do reverse commuters use, and how much time do they spend in the work journey?), it is useful to employ charts as well as numerical detail. The goal of the project is to provide a better understanding of the reverse commuting issue by conveying results in an efficient, effective, and interesting manner.

III. FINDINGS

This section provides a summary of results obtained in response to the six questions posed at the outset of the case study. First, we consider the case of all working residents of Minneapolis. Second, we examine records of workers from low-income Minneapolis households.

A. ALL WORKING RESIDENTS

The specific nature of the questions upon which this study is based makes the presentation of results effective in outline form. First, the working population of Minneapolis is addressed.

1. Where do workers living in Minneapolis work?

   - Figure 1 indicates the locational breakdown of jobs held by working residents of Minneapolis.
   - The majority work within the city limits of Minneapolis--62 percent.
   - 53,688 (32 percent) hold jobs in the suburbs or outlying areas of the Twin Cities.
   - St. Paul draws only six percent of Minneapolis's working population.
   - Figure 2 shows employment concentrations within and surrounding Minneapolis.

2. How prevalent is reverse commuting among Minneapolis's working residents?

   - Nearly one-third of the total working population living in Minneapolis make "reverse" commutes.
   - The proportion is highest among workers in two-person households (39 percent), those commuting by private automobile (42 percent), and those with longer-than-average work journey durations.

- Reverse commuting is more common than within-city commuting for skilled-labor occupations (the precision production, craft, and repair occupation category).

3. What travel behavior patterns are common among Minneapolis's working residents?

   - Figure 3 indicates the central concentration of Minneapolis's working residents' non-work travel within the cities and the inner-ring suburbs.

   - The map of shopping trip destinations reveals prominent clusters at retail centers like suburban shopping malls, corridor auto-oriented shopping development, and major agglomerations of commercial activity around Rosedale, Brookdale, and Southdale (Figure 4).

   - Business-related travel of working residents seems to dominate towards locations south, southwest, and west of downtown Minneapolis, although isolate destinations to the north and east also draw business-related trips (Figure 5).

4. What occupations draw reverse commuters out of Minneapolis for employment?

   - Table 1 provides examples of jobs included in each occupation category.

   - Figure 6 presents the occupation breakdown by employment location.

   - More Minneapolis residents with Technical Sales, & Administrative Support positions work in the suburbs than any other occupation type.

   - Managerial and Professional occupations are the most common of all other job types held by employees living and working in the city of Minneapolis..

   - The skilled labor group is the only occupation category that employs more Minneapolis residents outside the city than within.

5. What means of transportation do reverse commuters use, and how much time do they spend in the work journey?

   - The automobile dominates among all work location groups (Figure 7).

   - Not surprisingly, significantly more people walk or bike to jobs within the city limits than to jobs in St. Paul or the suburbs (94 percent).

   - Of all transit-users, 83 percent commute to jobs within the city limits.

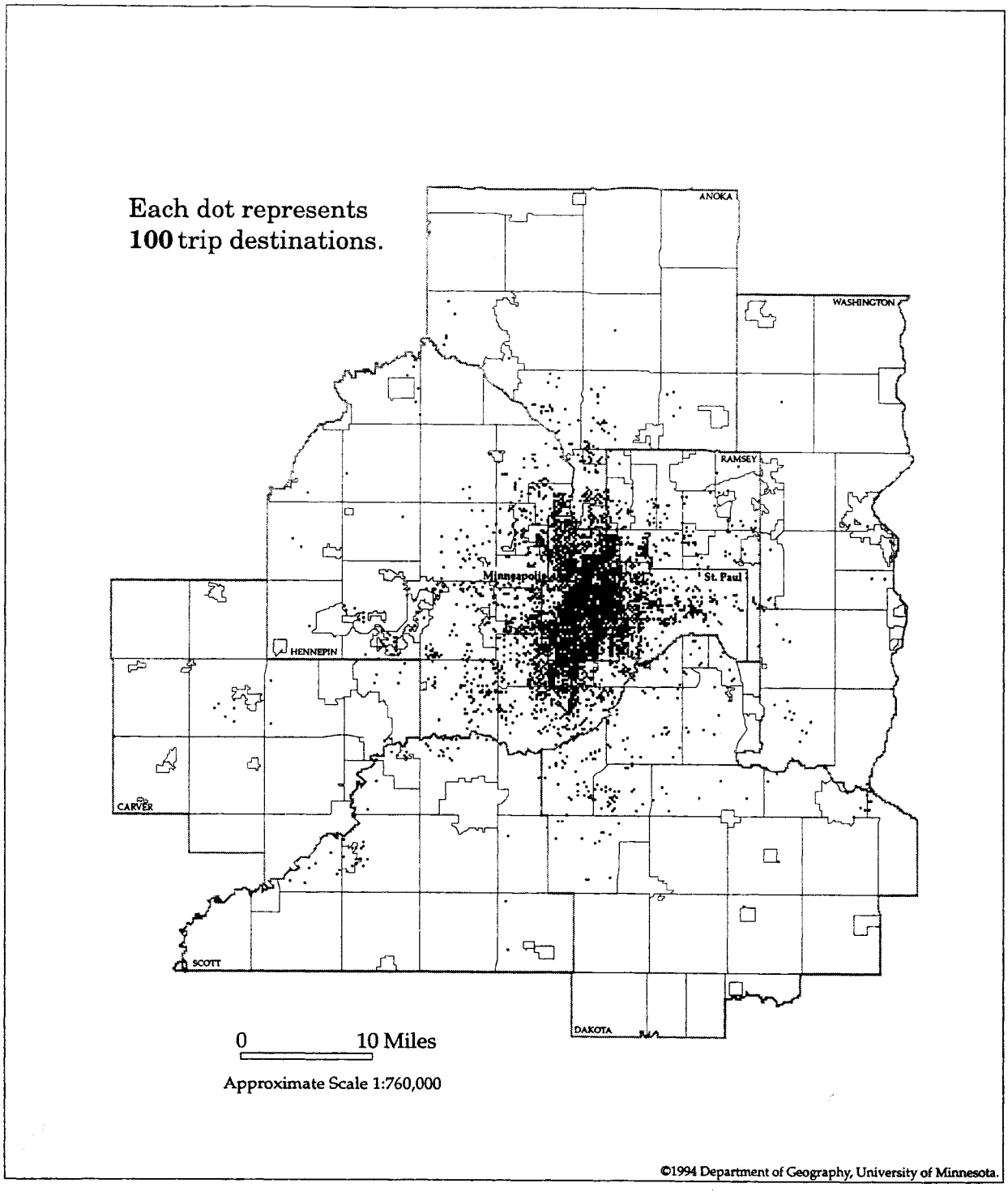


Figure 3. Destinations of All Non-Work Travel of Employed Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

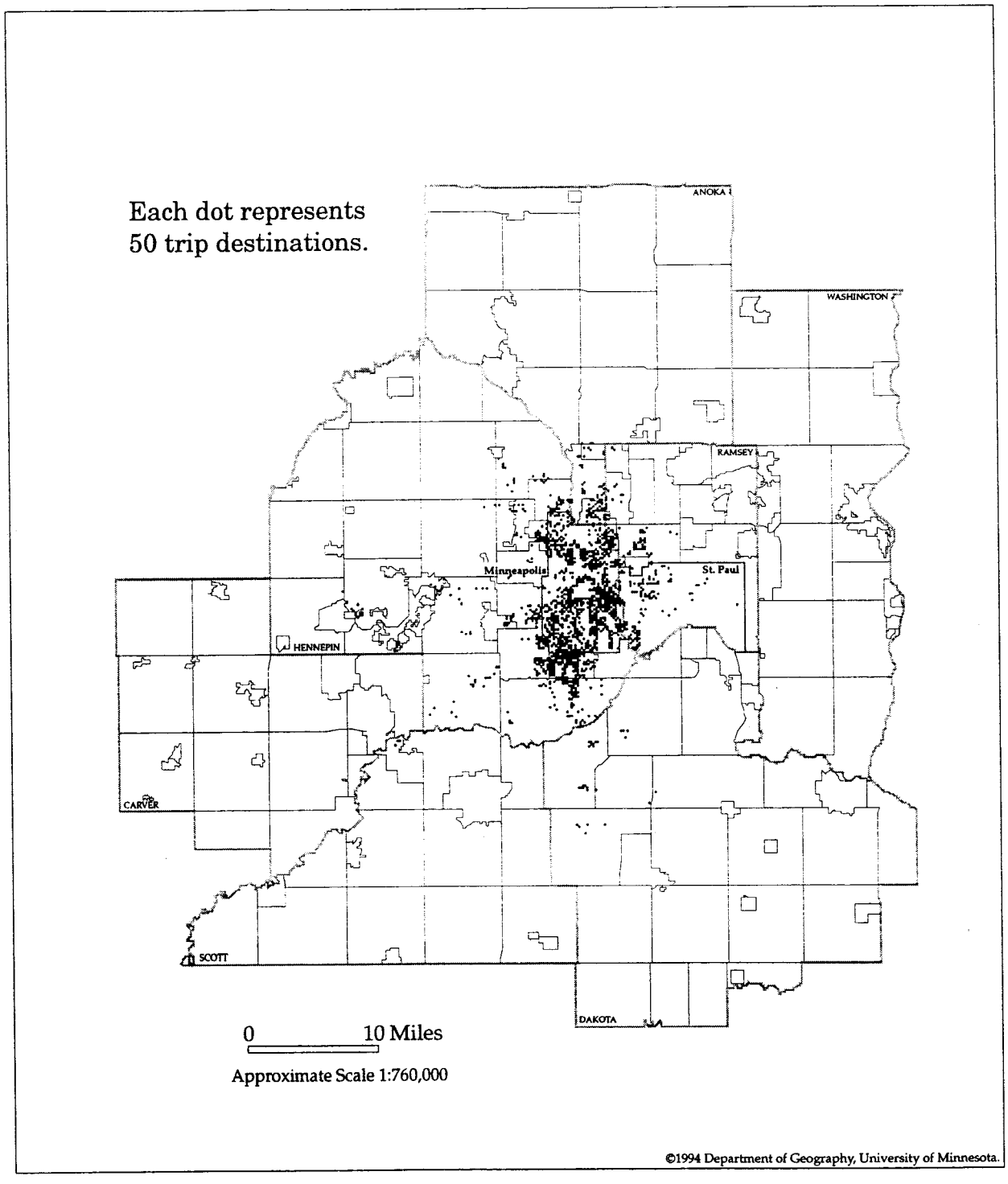


Figure 4. Destinations of Shopping Trips of Employed Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

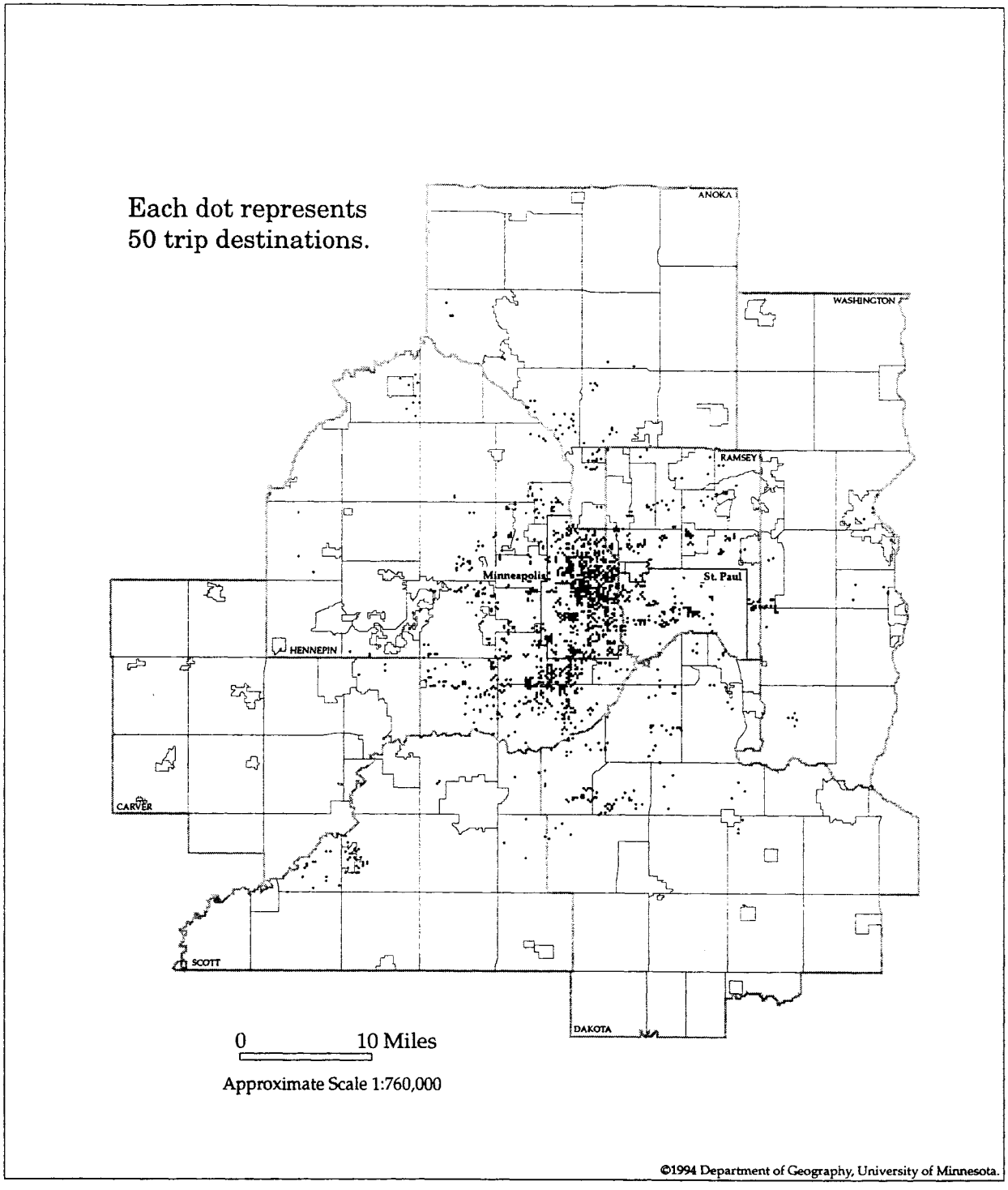


Figure 5. Destinations of Work-Related Business Trips of Employed Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

Table 1. Examples of Job Types from Each Occupation Categories

Operators, Fabricators, and Laborers	*assembly line workers, truck drivers, bus drivers, machine operators, service station attendants*
Precision Production, Craft, & Repair	*auto mechanics, appliance repairers, carpet installers, bricklayers, plumbers, tailors, butchers, power plant operators*
Farming, Forestry, & Fishing	*farmers, nursery workers, groundskeepers, timber cutters*
Service	*housekeepers, cooks, firefighters, police officers, orderlies, janitors, child care workers, waiters / waitresses*
Technical, Sales, and Administrative Support	*technicians, pilots, computer programmers, retail sales employees, secretaries, telephone operators, mail carriers, bank tellers, clerks*
Managerial & Professional Specialty	*engineers, architects, teachers, scientists, lawyers, doctors, registered nurses, professors, legislators*

Source: Census of Population and Housing, 1990: Public Use Microdata Sample U.S. Technical Documentation / prepared by the Bureau of the Census. Washington, DC: U.S. Bureau of the Census, 1992.

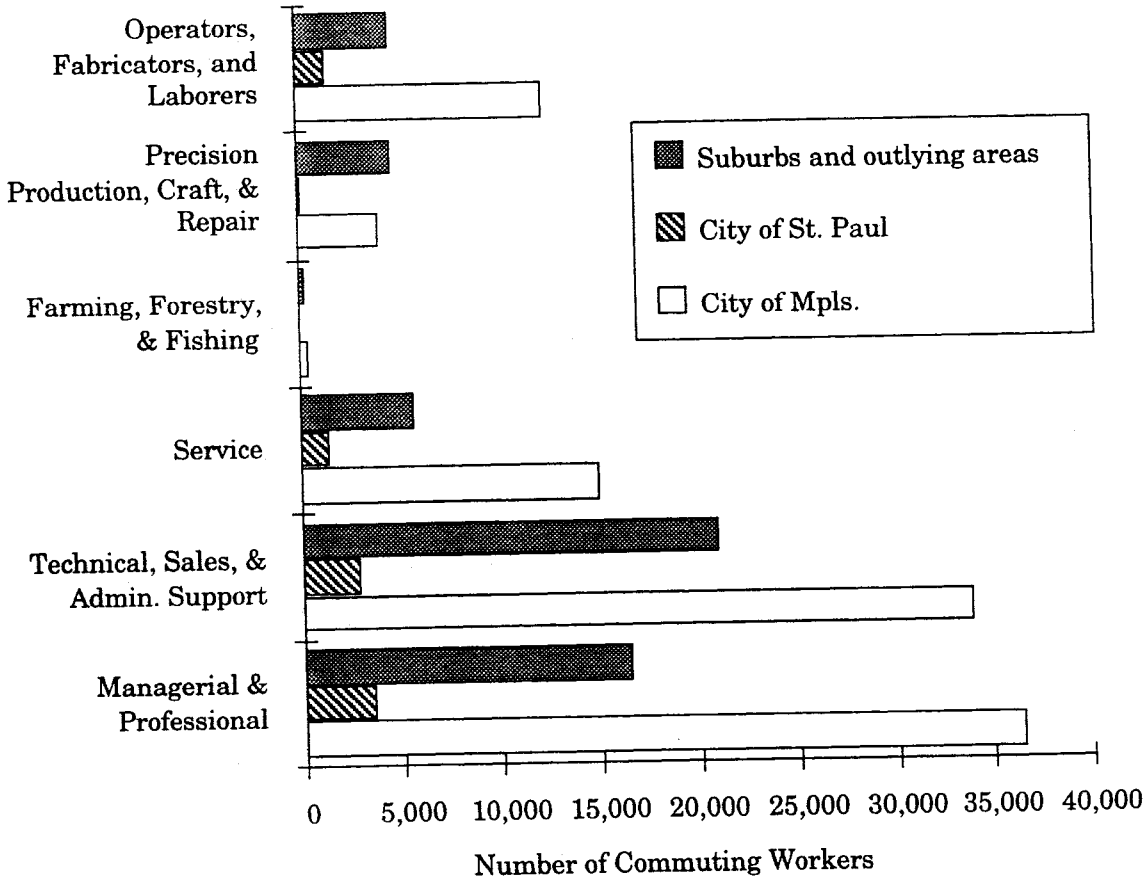


Figure 6. Workplace Locations of Various Occupation Types. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

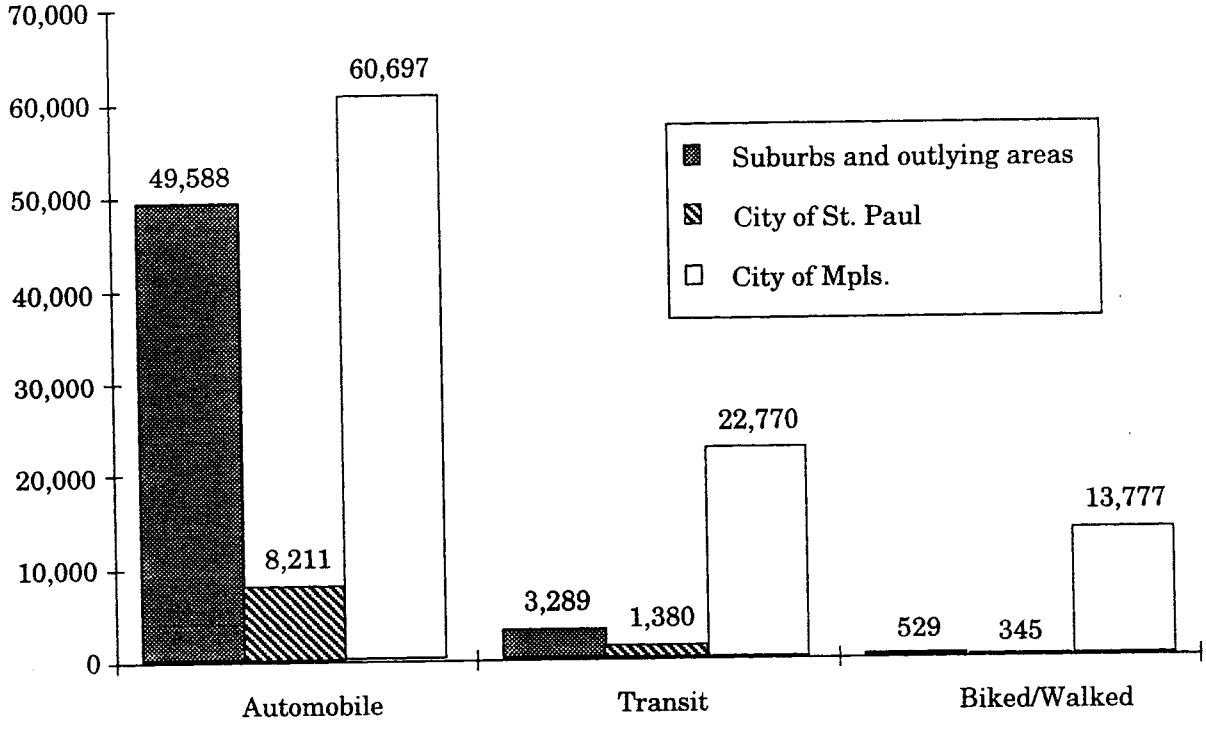


Figure 7. Means of Transportation to Work Used by Minneapolis Residents Commuting Within the Cities and Suburbs. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

- The proportion of city-bound commuters using a private automobile is much smaller--only 51 percent. However, this proportion corresponds to nearly three times the number of people commuting to jobs in the city via public transit.

B. RESIDENTS OF LOW-INCOME HOUSEHOLDS

To evaluate differences in commuting and other travel patterns among low-income residents, the same questions are asked of all working residents of Minneapolis living in households with annual incomes below $15,000. Table 2 summarizes the proportions of all working residents of Minneapolis in low-income households as compared to the same proportion among all working from all households.

1. Where do workers living in Minneapolis's low-income households work?

   - Figure 8 indicates the locational breakdown of jobs held by working residents of Minneapolis who live in households earning $15,000 and less annually.

   - A greater majority of workers from low-income households work within the city limits of Minneapolis--75 percent--than of all working residents--62 percent.

   - Only 3,657 (16 percent) hold jobs in the suburbs or outlying areas of the Twin Cities--a proportion half as large as that of all working residents.

   - St. Paul, however, employs nine percent of Minneapolis's workers from low income households.

   - Figure 9 shows employment concentrations within and surrounding Minneapolis for workers from low-income households. The dominance of the downtowns and the corridor between them is evident.

2. How prevalent is reverse commuting among Minneapolis's low-income working residents?

   - Less than one-fifth of the working population living in Minneapolis's low-income households make "reverse" commutes.

   - The proportion is highest among workers in one-person households (15 percent), those commuting by private automobile (24 percent), and those with longer-than-average work journey durations.

Table 2. Suburban Workplace Proportions: Low-Income and All Working Residents

	Percentage Working in Suburbs and Outlying Areas	
	All Workers	Workers in Low-Income Households
Persons in Household		
1	24.6 %	14.7 %
2	39.2 %	17.7 %
3 or more	30.1 %	15.8 %
Grand total	31.9 %	15.6 %
Means of Transportation to Work		
Automobile	41.5 %	23.7 %
Transit	11.9 %	19.4 %
Biked/Walked	3.5 %	0.0 %
Other	18.2 %	28.6 %
Grand total	31.9 %	15.6 %
Work Journey Duration (Minutes)		
1 to 9	14.4 %	8.3 %
10 to 19	25.0 %	7.2 %
20 to 29	45.9 %	28.5 %
30 to 39	45.7 %	30.6 %
40 to 49	31.5 %	17.2 %
50 to 59	30.5 %	0.0 %
60 or more	47.5 %	29.0 %
Grand total	31.9 %	15.6 %
Occupation Type		
Managerial & Professional Specialty	29.0 %	9.0 %
Technical, Sales, & Admin. Support	36.0 %	14.9 %
Service	25.5 %	19.4 %
Farming, Forestry, & Fishing	41.7 %	0.0 %
Precision Production, Craft, & Repair	52.1 %	0.0 %
Operators, Fabricators, and Laborers	25.7 %	21.7 %
Grand total	31.9 %	15.6 %

Source: U.S. Bureau of the Census, Special tabulations of the Public Use Microdata Sample (1 percent sample), Minnesota, 1990. Calculations by the authors.

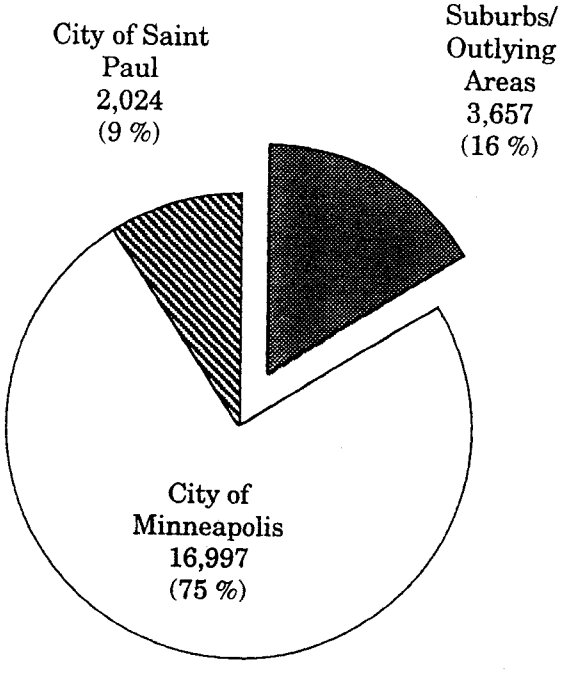


Figure 8. Workplace Location of Minneapolis Residents in Low-Income Households. Responses of those employed Minneapolis residents in low-income households who did not specify workplace location or worked out of state are not included in percentage calculations shown here. See Appendix A for a complete breakdown of employed Minneapolis residents in low-income households by workplace location. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

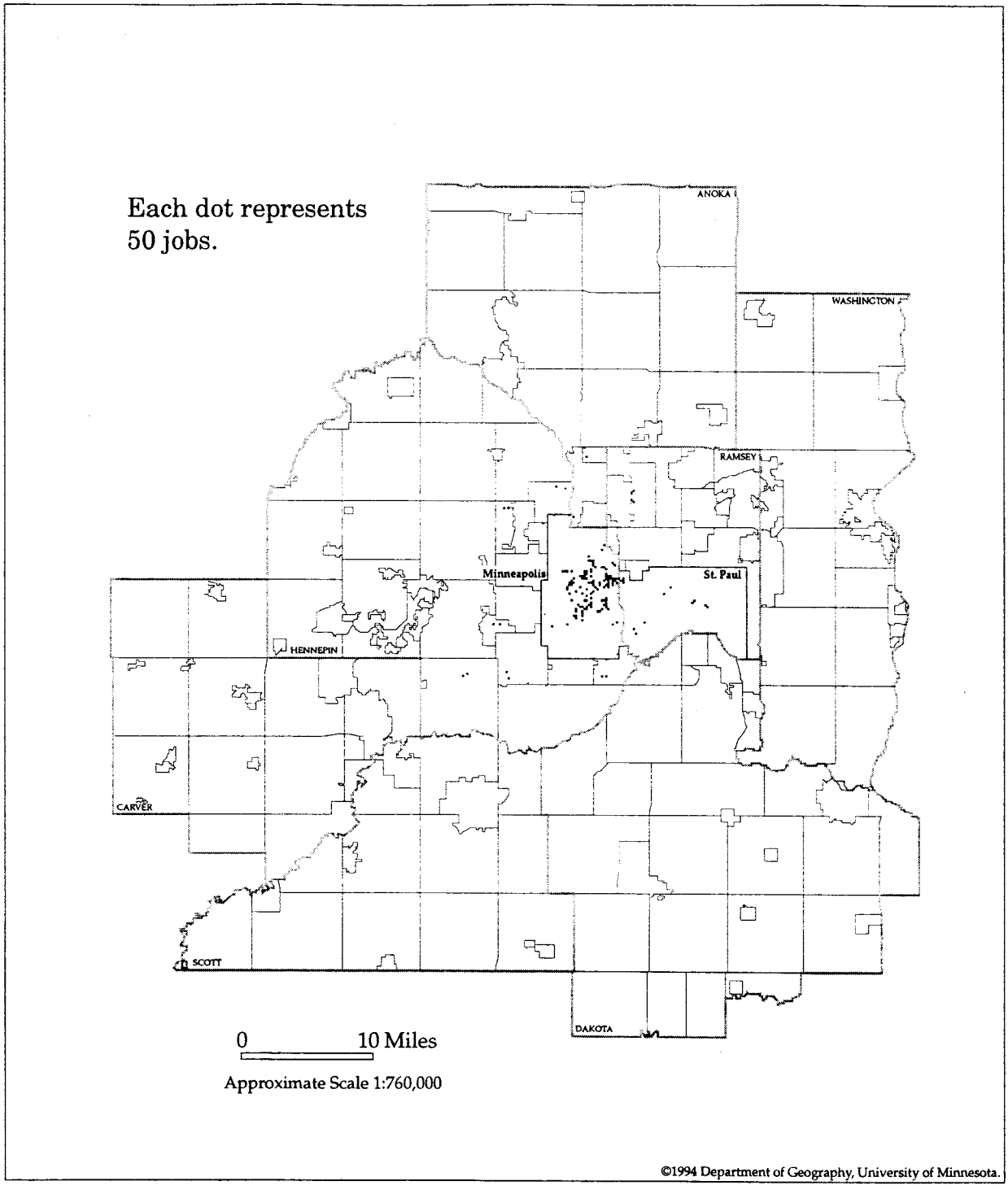


Figure 9. Workplaces of Employed Low-Income Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

- Reverse commuting is more common than within-city commuting for support occupations (unskilled labor, service, and technical, sales, and administrative support positions). However, within-city commuting surpasses reverse commuting for all occupation types held by workers in low-income housing.

3. What travel behavior patterns are common among Minneapolis's working residents from low-income households?

   - Figure 10 indicates the central concentration of Minneapolis's low income working residents' non-work travel within the cities.

   - Figure 11 shows the dominance of close-to-home retail activity among this segment of the working population.

   - Business-related travel of working residents in low-income households shown on Figure 12 reveals a similar concentration of activity within Minneapolis, with limited activity in downtown St. Paul and inner-ring suburbs to the north.

4. What occupations draw reverse commuters from low-income households out of Minneapolis for employment?

   - Figure 13 presents the occupation breakdown by employment location.

   - Service, labor, and technical positions dominate this segment of the population, and draw the most Minneapolis residents to the suburbs for work.

   - The City of St. Paul attracts nearly as many administrative and technical positions as the suburbs.

   - In each occupation group, the large proportion of positions held within Minneapolis dwarfs those of St. Paul and the suburbs.

5. What means of transportation do reverse commuters use, and how much time do they spend in the work journey?

   - The automobile is used as a means of transportation more often than any other among all work location groups: 24 percent of all low-income workers travel by auto work in the suburbs, while 20 percent of all those commuting by transit do Figure 14). However, among those employed within the city, there is a nearly even three-way split among those traveling by automobile, transit, and biking/walking.

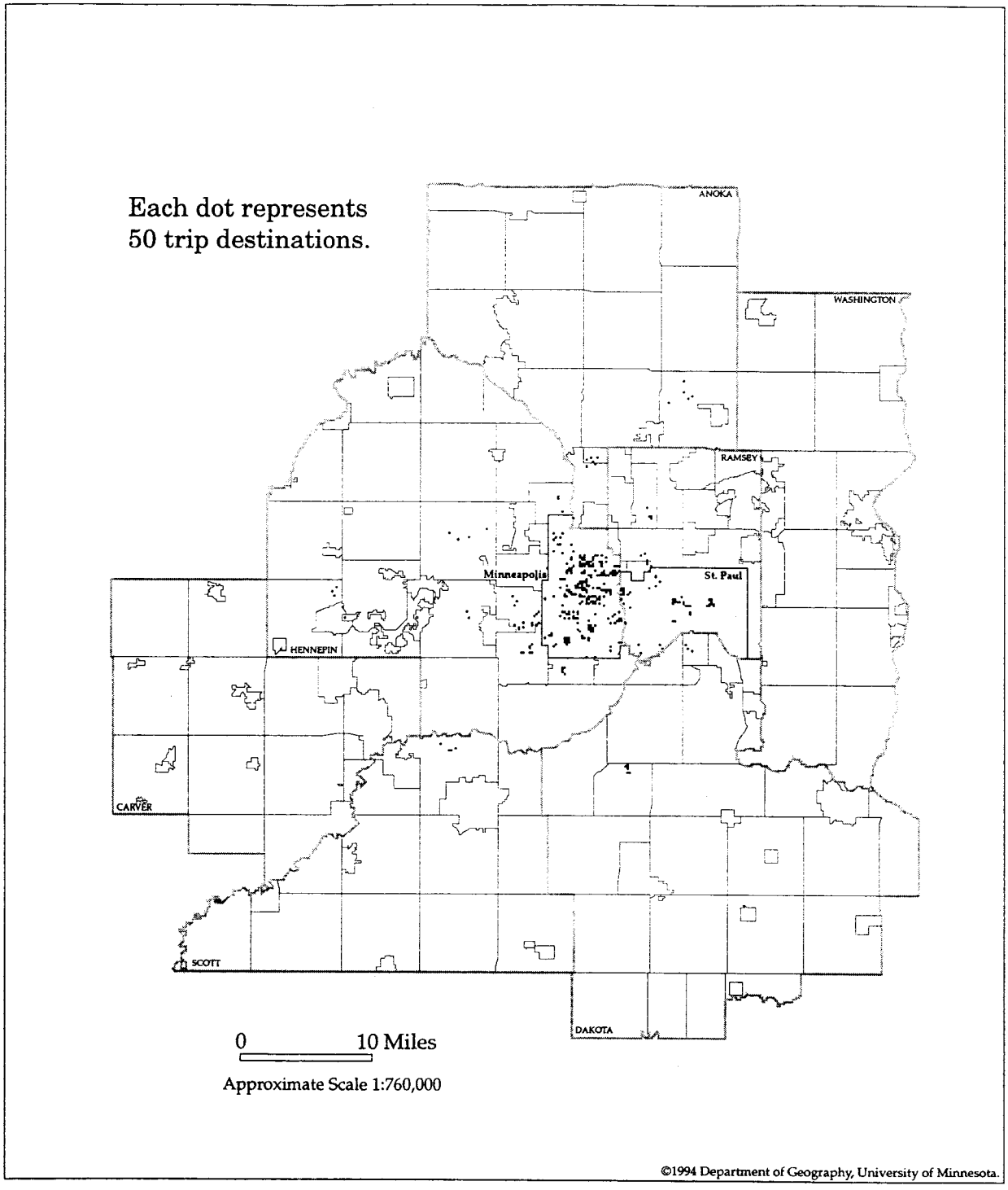


Figure 10. Destinations of All Non-Work Travel of Employed Low-Income Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

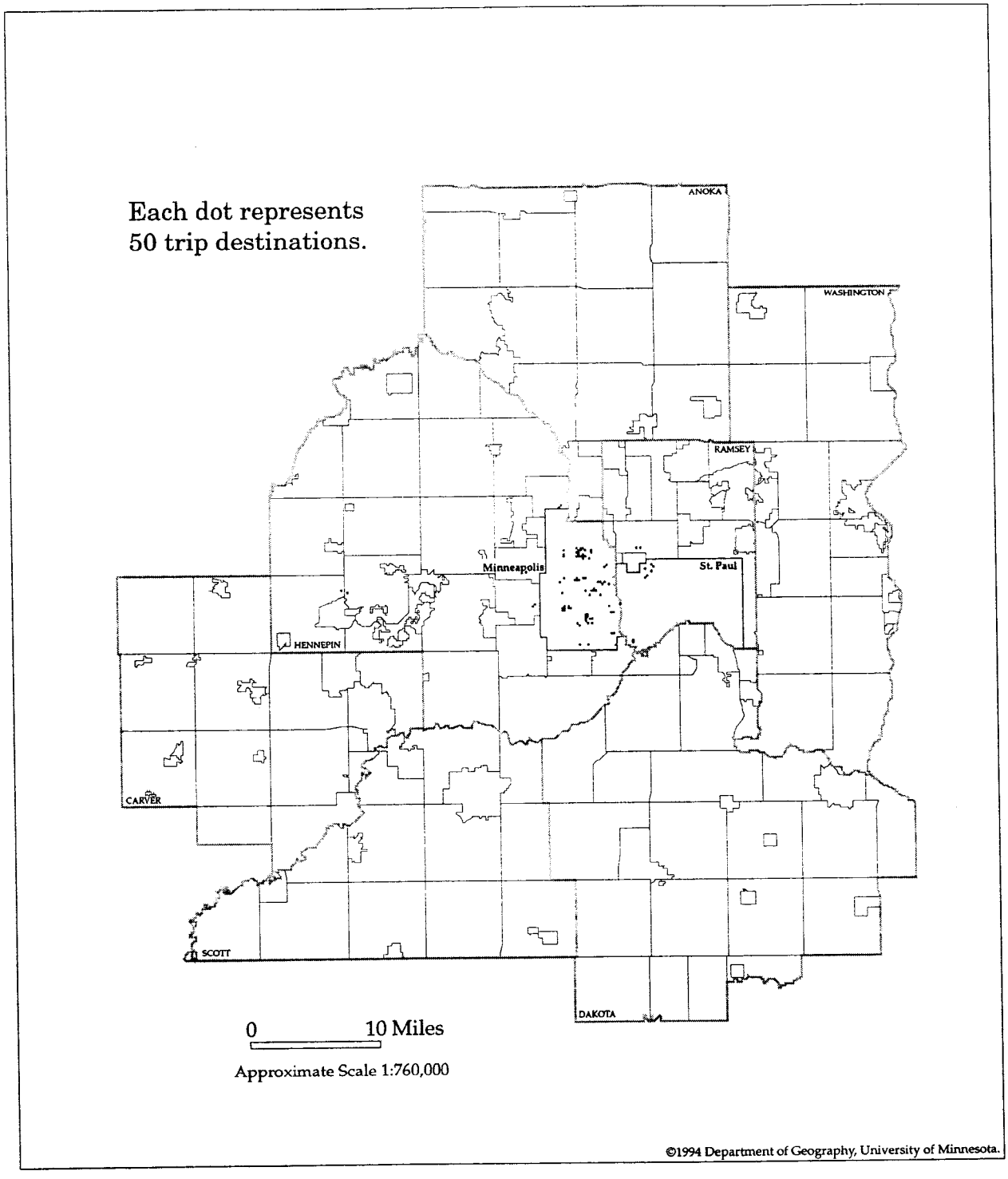


Figure 11. Destinations of Shopping Trips of Employed Low-Income Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

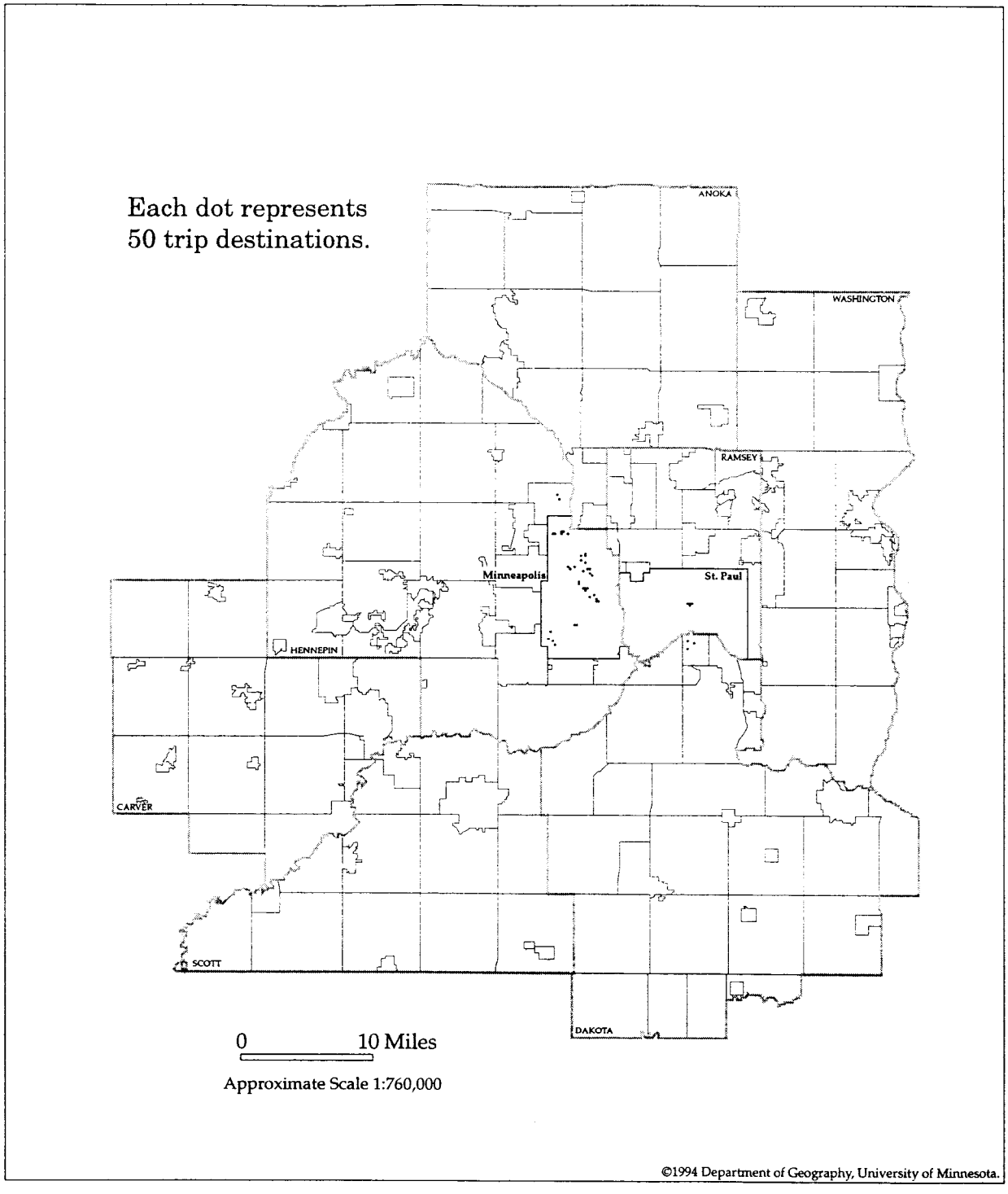


Figure 12. Destinations of Work-Related Business Trips of Employed Low-Income Residents of Minneapolis. Data source: Metropolitan Council, Travel Behavior Inventory. Calculations and design by the authors.

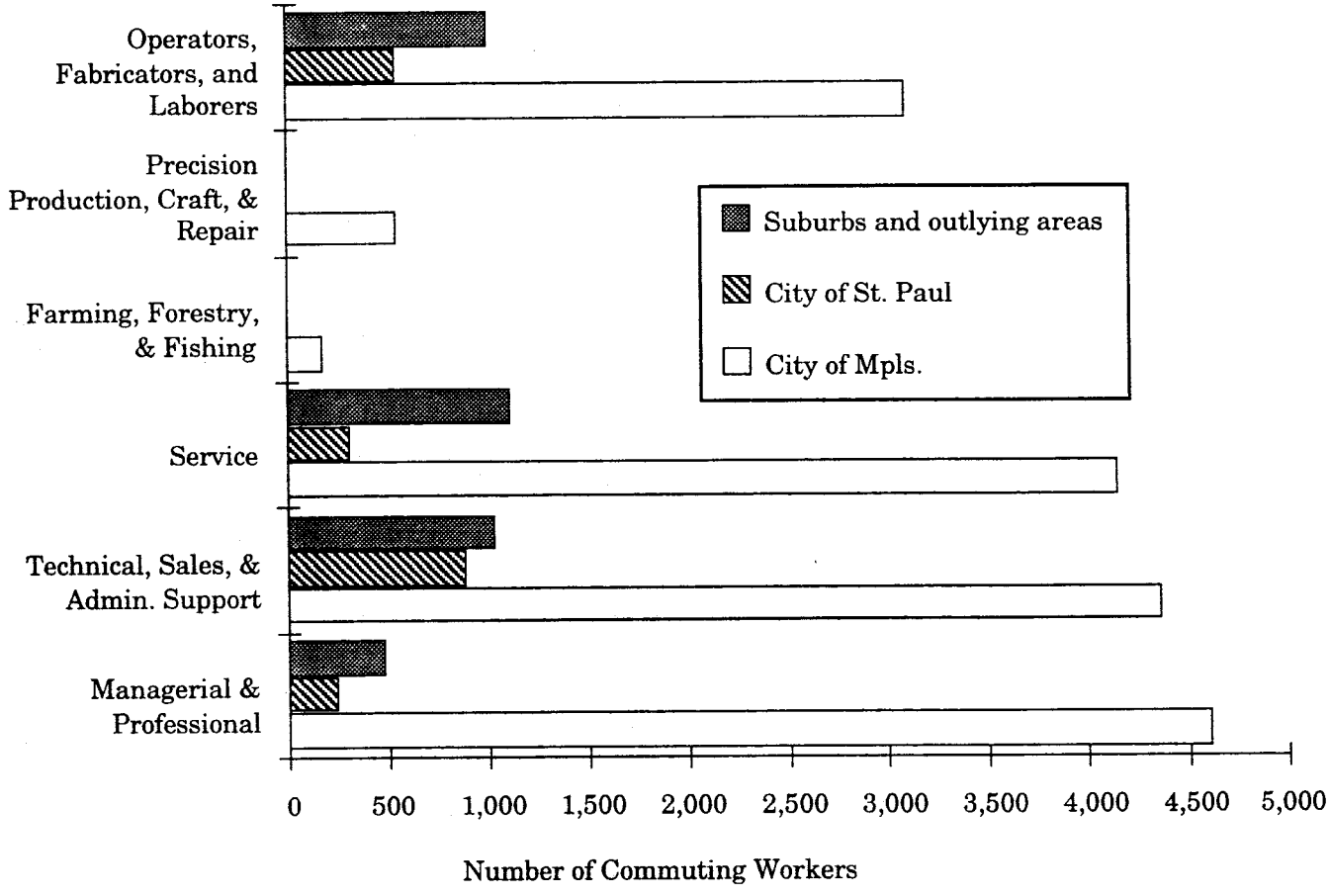


Figure 13. Workplace Locations of Minneapolis Residents in Low-Income Households by Occupation Type. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

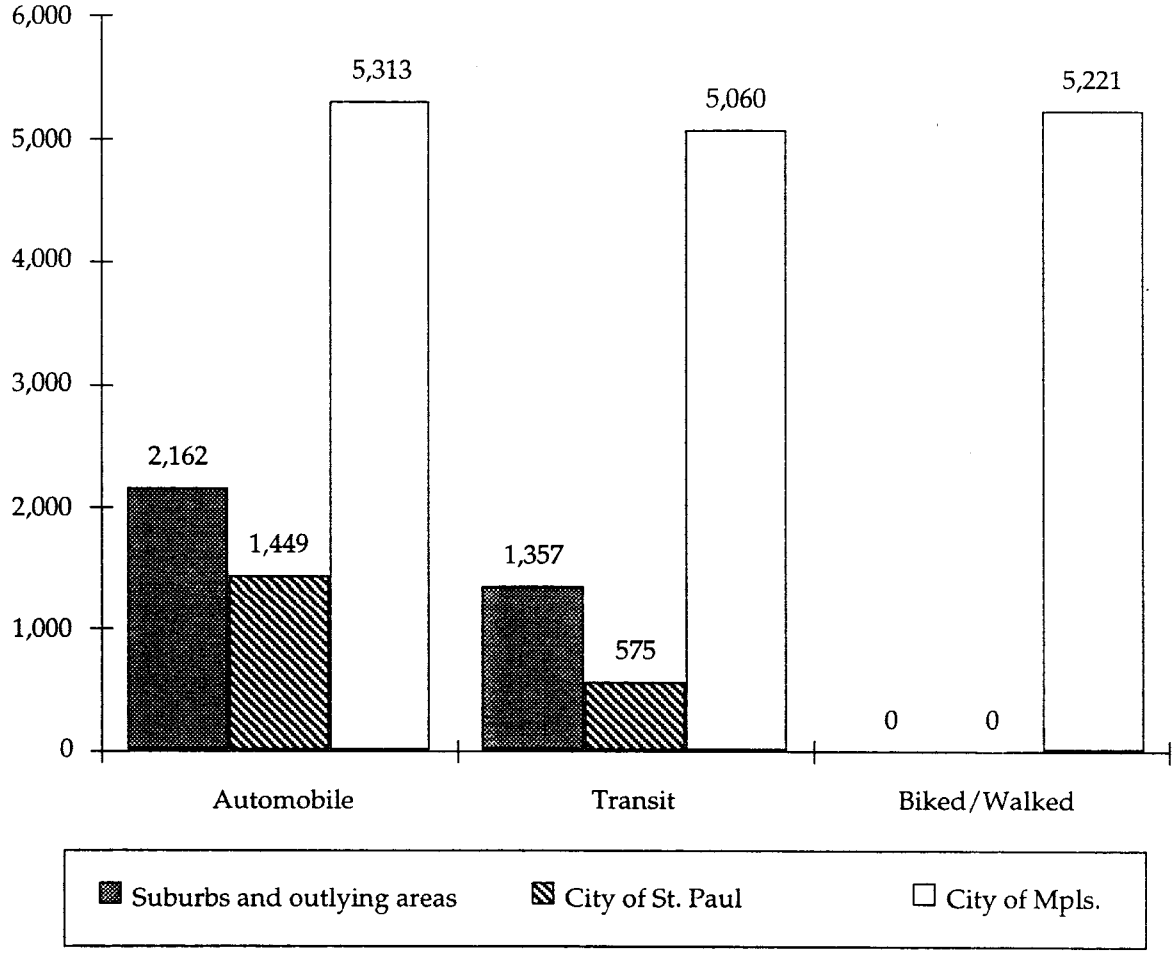


Figure 14. Means of Transportation to Work Used by Minneapolis Residents in Low-Income Households Commuting Within the Cities and Suburbs. Source: U.S. Bureau of the Census, Special Tabulations of the Public Use Microdata Sample (1 percent sample), 1990. Calculations by the authors.

- None of the workers from low-income households bike or walk to positions outside Minneapolis. However, nearly one-fifth of all working residents living in Minneapolis use these means for commuting.

Tabular results are provided in the Appendix for all Minneapolis workers and low-income householders.

IV. CONCLUSIONS

The TBI and PUMS data are used here to evaluate the prevalence and nature of reverse commuting among Minneapolis' working residents. The PUMS files provide superior socioeconomic data, while the TBI allows for more specific locational analysis than would otherwise be available. Taken individually, neither would provide such thorough results. Considering both sources allows a more complete understanding of where reverse commuters go and how and why they undertake work journeys that go against the traditional flow of central-city oriented travel.

The strengths and weaknesses of both the TBI and PUMS sources are mitigated by their complementary characteristics. The timing of the 1990 Census and the Metropolitan Council's TBI makes combined use of these invaluable data sources extremely attractive and immeasurably useful to transportation researchers concentrating on metropolitan area issues.

REFERENCES

[1] See also Census of Population and Housing, 1990: Public Use Microdata Sample. Technical Documentation. Prepared by the Bureau of the Census. (Washington, DC: U.S. Bureau of the Census, 1992).

[2] 9,746 completed household surveys were drawn from 10,746 recruited households. This figure reflects 1.1 percent of the 875,504 households reported in the Twin Cities Metropolitan Area in 1990. However, survey responses were not uniformly 1.1 percent across the metropolitan area. Table 1 (p.11) of Home Interview Survey Methodology and Results reveals the skewed distribution among inner-city and suburban areas. See Metropolitan Council (1992). Twin Cities Metro Area Home Interview Survey Methodology and Results. (St. Paul: Metropolitan Council), and Stephen Alderson, Mark Fillipi, and Bill Barrett (1994). 1990 Travel Behavior Inventory: Summary Report, Twin Cities Metropolitan Area. (St. Paul: Metropolitan Council)

[3] Adams, J.S., and E.K. Wyly (1994). Commuter Linkages Among Counties in the Twin Cities and Greater Minnesota. Report No. MN/RC-94/02. (St. Paul: Minnesota Department of Transportation).

Appendix A

Summary Cross-Tabulations of Commute-Related Attributes

Summary Cross-Tabulations of Commute-Related Attributes for All Workers Living in Minneapolis

	Place of Work				
	City of Mpls.	City of St. Paul	Suburbs and outlying areas	Not Specified/Out of state	**Total Workers**
Persons in Household					
1	27,531	2,346	10,005	828	**40,710**
2	31,786	3,105	22,701	276	**57,868**
3 or more	43,493	4,485	20,976	690	**69,644**
Grand total	*102,810*	*9,936*	*53,682*	*1,794*	***168,222***
Means of Transportation to Work					
Automobile	60,697	8,211	49,588	897	**119,393**
Transit	22,770	1,380	3,289	115	**27,554**
Biked/Walked	13,777	345	529	644	**15,295**
At-Home Work	4,462	0	0	0	**4,462**
Other	1,104	0	276	138	**1,518**
Grand total	*102,810*	*9,936*	*53,682*	*1,794*	***168,222***
Work Journey Duration (Minutes)					
0	4,462	0	0	0	**4,462**
1 to 9	14,421	920	2,737	920	**18,998**
10 to 19	46,437	3,151	16,767	759	**67,114**
20 to 29	20,493	2,737	19,734	0	**42,964**
30 to 39	10,787	1,311	10,189	0	**22,287**
40 to 49	4,853	1,035	2,760	115	**8,763**
50 to 59	529	414	414	0	**1,357**
60 or more	828	368	1,081	0	**2,277**
Grand total	*102,810*	*9,936*	*53,682*	*1,794*	***168,222***
Occupation Type					
Managerial & Professional Specialty	36,547	3,703	16,583	368	**57,201**
Technical, Sales, & Admin. Support	33,925	2,921	21,183	874	**58,903**
Service	15,111	1,426	5,842	552	**22,931**
Farming, Forestry, & Fishing	483	0	345	0	**828**
Precision Production, Craft, & Repair	4,209	207	4,807	0	**9,223**
Operators, Fabricators, and Laborers	12,535	1,679	4,922	0	**19,136**
Grand total	*102,810*	*9,936*	*53,682*	*1,794*	***168,222***

Source: U.S. Bureau of the Census, Special tabulations of the Public Use Microdata Sample (1 percent sample), Minnesota, 1990. Calculations by the authors.

Summary Cross-Tabulations of Commute-Related Attributes for Workers from Minneapolis's Low Income Households

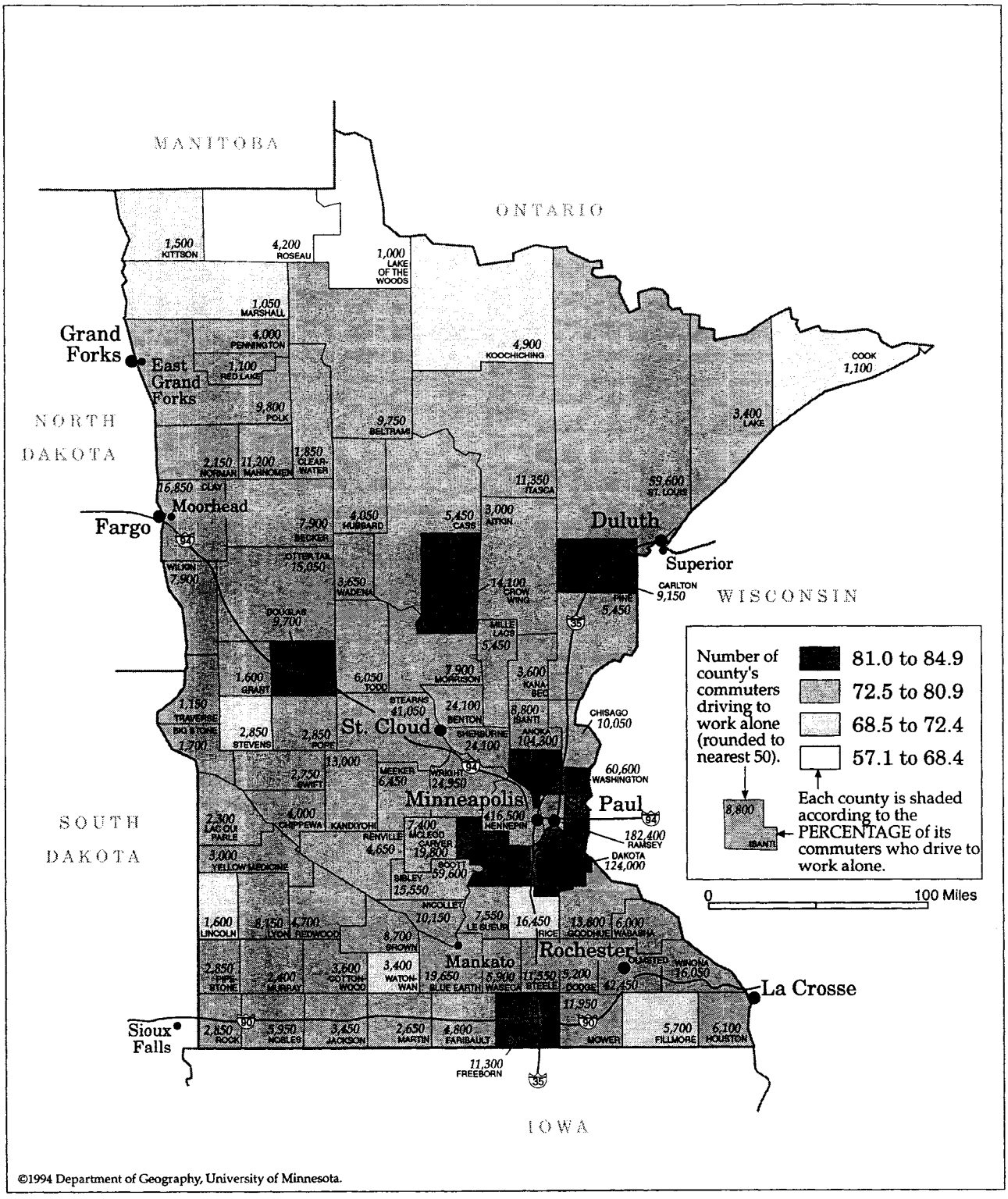
	Place of Work				
	City of Mpls.	City of St. Paul	Suburbs and outlying areas	Not Specified/Out of state	**Total Workers**
Persons in Household					
1	10,258	1,219	2,116	828	**14,421**
2	4,071	644	1,012	0	**5,727**
3 or more	2,668	161	529	0	**3,358**
Grand total	*16,997*	*2,024*	*3,657*	*828*	***23,506***
Means of Transportation to Work					
Automobile	5,313	1,449	2,162	184	**9,108**
Transit	5,060	575	1,357	0	**6,992**
Biked/Walked	5,221	0	0	644	**5,865**
At-Home Work	1,058	0	0	0	**1,058**
Other	345	0	138	0	**483**
Grand total	*16,997*	*2,024*	*3,657*	*828*	***23,506***
Work Journey Duration (Minutes)					
0	1,058	0	0	0	**1,058**
1 to 9	3,542	368	414	690	**5,014**
10 to 19	6,141	506	529	138	**7,314**
20 to 29	3,220	299	1,403	0	**4,922**
30 to 39	1,495	437	851	0	**2,783**
40 to 49	1,219	0	253	0	**1,472**
50 to 59	0	230	0	0	**230**
60 or more	322	184	207	0	**713**
Grand total	*16,997*	*2,024*	*3,657*	*828*	***23,506***
Occupation Type					
Managerial & Professional Specialty	4,623	253	483	0	**5,359**
Technical, Sales, & Admin. Support	4,370	897	1,035	644	**6,946**
Service	4,163	322	1,127	184	**5,796**
Farming, Forestry, & Fishing	184	0	0	0	**184**
Precision Production, Craft, & Repair	552	0	0	0	**552**
Operators, Fabricators, and Laborers	3,105	552	1,012	0	**4,669**
Grand total	*16,997*	*2,024*	*3,657*	*828*	***23,506***

Source: U.S. Bureau of the Census, Special tabulations of the Public Use Microdata Sample (1 percent sample), Minnesota, 1990. Calculations by the authors.

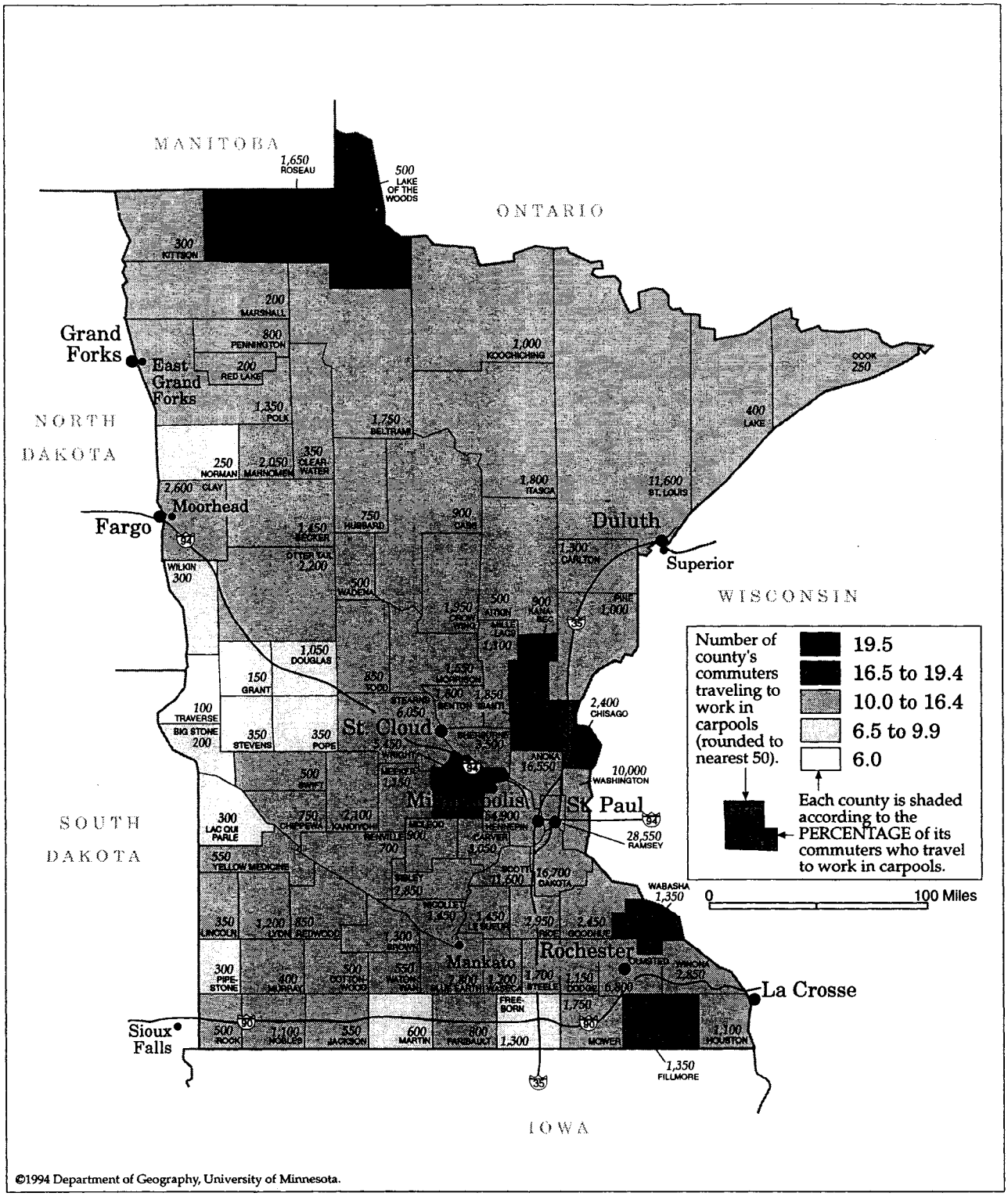
Appendix B

Transportation-Related Measures for Minnesota Counties, 1990: Six Reference Maps

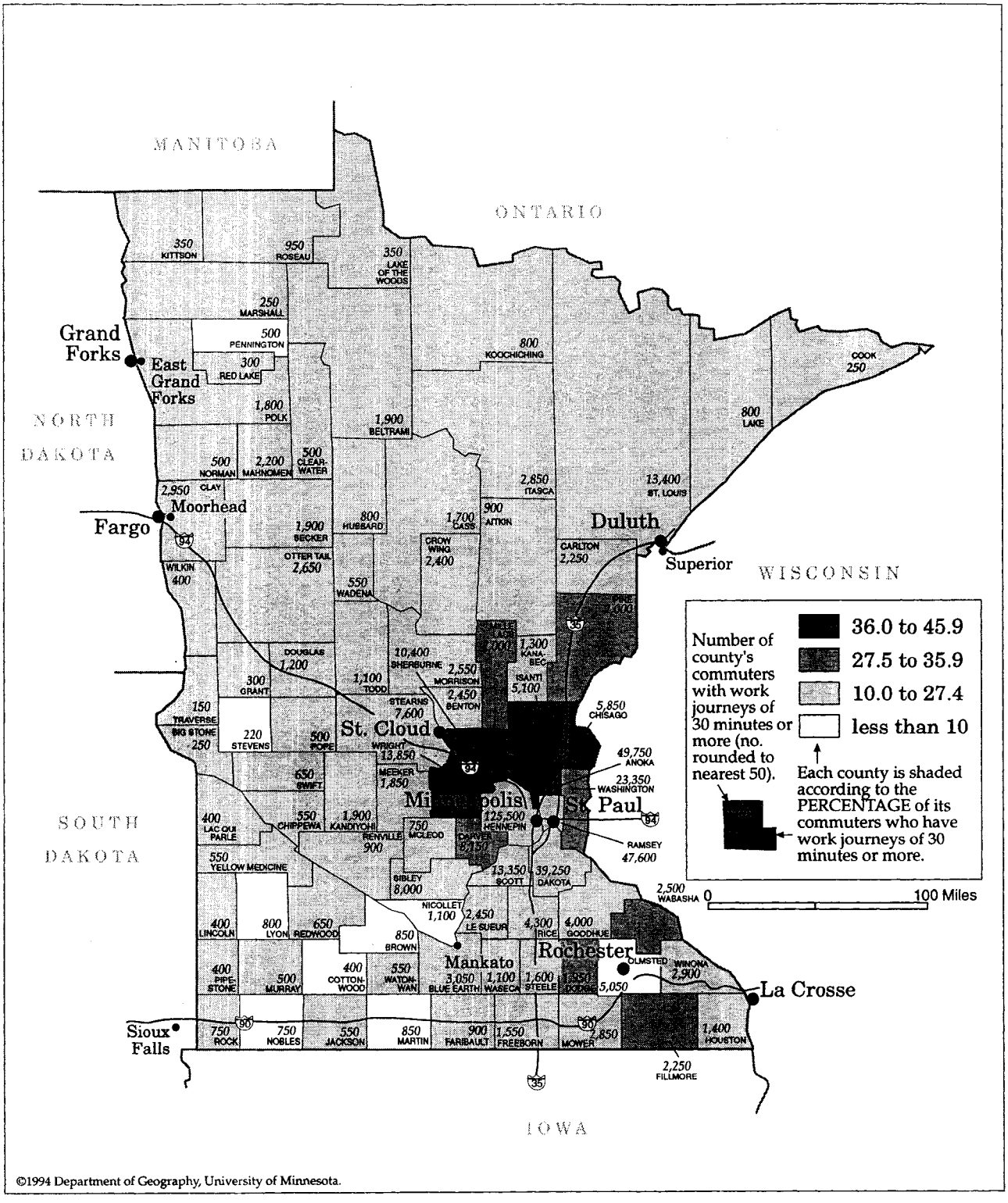
The following maps are provided for consideration with all reports in this series.



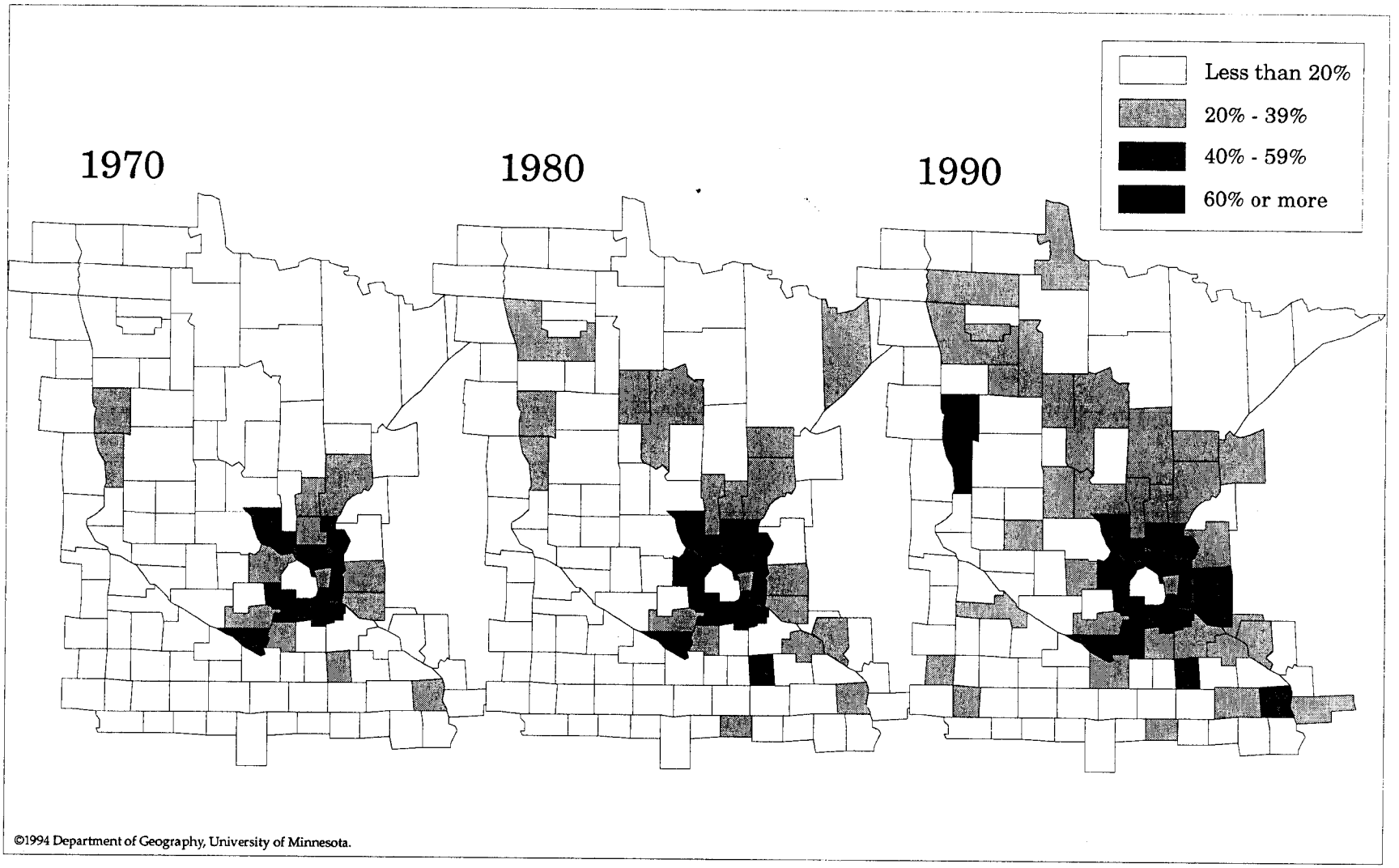
Reference Map 1. Commuters Driving to Work Alone, Minnesota Counties, 1990. *(Data Source: U.S. Bureau of the Census, Summary Tape File 3.)*



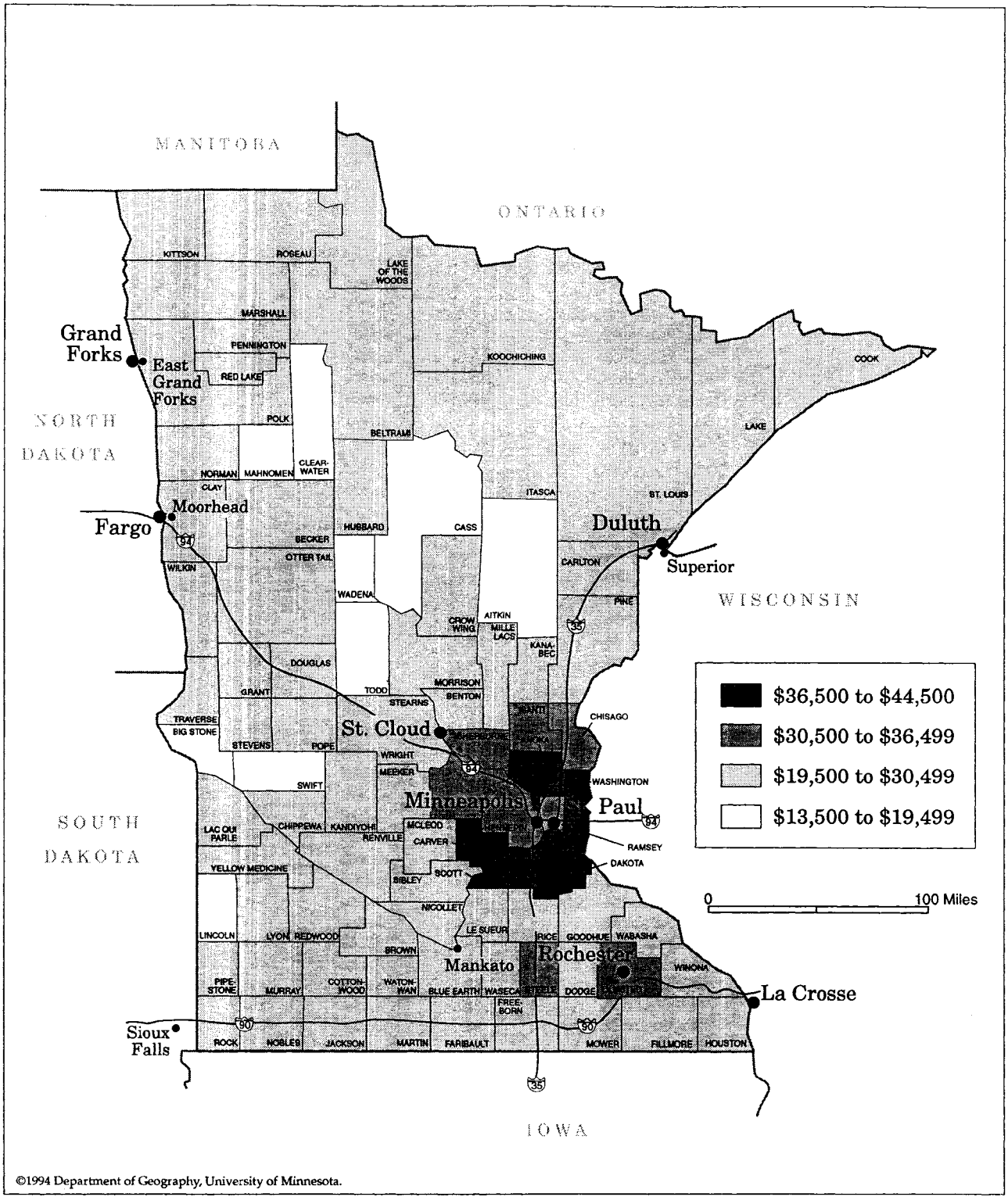
Reference Map 2. Commuters Traveling to Work in Carpools, Minnesota Counties, 1990. *(Data Source: U.S. Bureau of the Census, Summary Tape File 3.)*



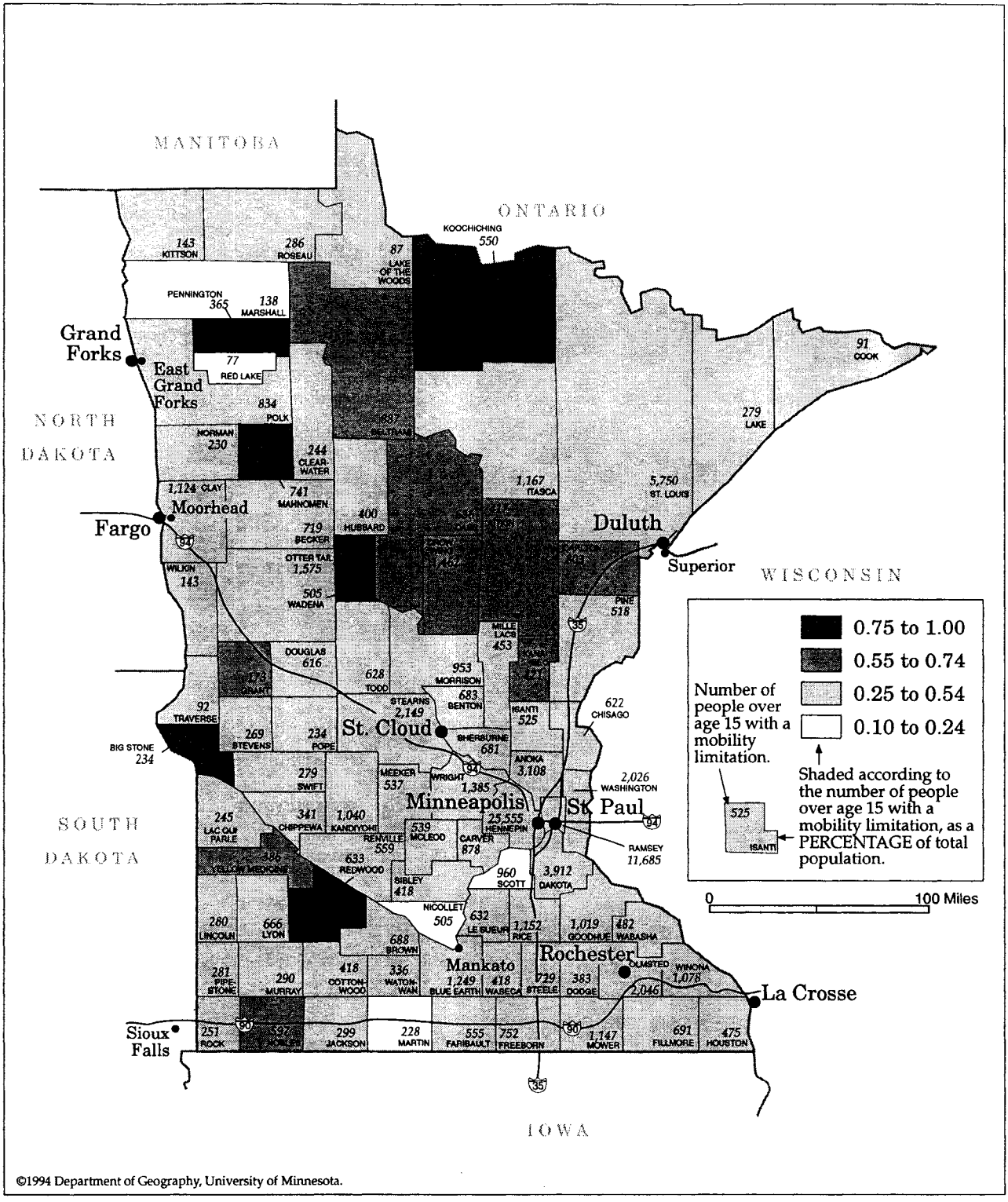
Reference Map 3. Commuters with Work Journeys of 30 Minutes or More, Minnesota Counties, 1990. *(Data Source: U.S. Bureau of the Census, Summary Tape File 3.)*



Reference Map 4. Percentage of Commuters Working Outside County of Residence, 1970 to 1990. *(Data Source: Special tabulations of U.S. Bureau of the Census Journey-to-Work Frequency Tables, and Bureau of Economic Analysis data.*



Reference Map 5. Median Household Income, Minnesota Counties, 1990.
(Data Source: U.S. Bureau of the Census, Summary Tape File 3.)



Reference Map 6. Limited Mobility Population, Minnesota Counties, 1990.
(Data Source: U.S. Bureau of the Census, Summary Tape File 3.)

Other Research Reports in This Series:

LONG-DISTANCE COMMUTING IN MINNESOTA

Workers making long daily commutes in the 1950s were understood as those best able to afford amenities normally available outside the "urban core"--that is, the downtown central business district (CBD) plus adjacent transportation-industrial zones and high density residential neighborhoods within "central cities" such as Minneapolis and St. Paul. This report examines characteristics of Minnesota workers residing in Minnesota's metropolitan and non-metropolitan areas who made long duration (more than 30 minutes one way) commutes in 1990, concluding that early metropolitan-based models today lack much if not all of their former applicability.

Minnesota's average commute of 19.1 minutes fell below the national average of 19.7, but more than 450,000 Minnesota workers spent more than 30 minutes commuting each way. Long duration work journeys were not restricted to the stereotypical upper income suburban family. In all geographic categories, the largest group of long duration commuters came from two person households, whose commuting may reflect compromises between two job locations.

In a five county "exurban" (i.e., beyond continuously built-up suburban areas) study area between Minneapolis and St. Cloud, average auto commuting time was the state's highest, at nearly 26 minutes. Blue collar workers reported commuting times longer than professionals. Findings have implications for policy proposals such as highway improvements, toll roads, or new energy taxes.

TRANSPORTATION-BASED CLASSIFICATIONS OF MINNESOTA'S COUNTIES AND METROPOLITAN STATISTICAL AREA TRACTS USING MEASURES FROM THE 1990 CENSUS OF POPULATION AND HOUSING

Census measures are used to classify Minnesota counties and metropolitan area census tracts according to demographic, journey-to-work, and mobility characteristics in 1990. Counties differ regarding scores calculated with respect to Population Mass--reflecting measures such as numbers of persons, of commuters, and of vehicles available for personal use; and a general Commuting tendency--reflecting proportions of commuters traveling more than 30 minutes, average commute time, and average number of vehicles per household. Three other basic characteristics of counties--average Socioeconomic Status of residents, degree of Mobility Impairment of residents; and Solo Commuting tendency--provide scores further differentiating counties. County scores are used to group Minnesota's 87 counties into six diverse clusters: 1) Hennepin (Minneapolis); 2) Ramsey (St. Paul); 3) Anoka and Dakota (Twin Cities suburbs); 4) St. Louis (Duluth); Olmsted (Rochester), Stearns (St. Cloud), Washington (Twin Cities); and 6) all others.

The second analysis examines 833 census tracts in the Minnesota's five MSAs, classifying them with the procedures used for counties. Resulting classifications illustrate that relationships between travel activity and socioeconomic characteristics vary considerably for different metropolitan contexts. As a demonstration of potentially useful methods applied to census data for Minnesota, the study provided results. On other grounds, its value is more limited.

MODELING COMMUTER FLOWS AMONG LOCAL LABOR MARKETS IN MINNESOTA, 1970-1990

Between 1970 and 1990 the share of Minnesota Commuters working outside their county of residence increased from 18 to 29 percent. This study analyzes this trend by examining commuter flows among labor markets in a 120-county study area encompassing Minnesota and counties in adjacent states.

A series of maps and statistical models relate commuter flows to changes in demographic and employment conditions over the past two decades. Commuter flows have strengthened since 1970, becoming more important in declining rural counties as well as growing suburban and exurban labor markets. Longer work journeys in declining rural areas appear to reflect individual coping strategies, as workers search farther afield for opportunities in a regional labor market undergoing a geographic transformation. For most types of jobs, employment growth is dispersing outward from metropolitan cores, while in nonmetro areas jobs are consolidated into widely-spaced regional centers. These trends have created a network of diffuse labor markets in which commuter flows link widely scattered communities of labor deficits to areas with labor surplus, in patterns too complex to be modeled solely in terms of aggregate population and housing variables.