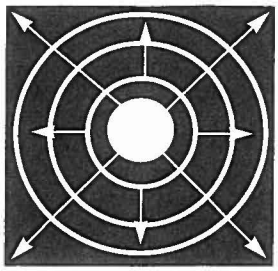

TRANSPORTATION & REGIONAL GROWTH

a study of the relationship between transportation and regional growth

A collaboration among:

University of Minnesota
Center for
Transportation Studies

Center for Urban
and Regional Affairs

Minnesota Department
of Transportation

Metropolitan Council
of the Twin Cities

Minnesota Local Road
Research Board

Synthesizing Highway Transportation, Land Development, Municipal and School Finance in the Greater Twin Cities Area, 1970-1997

Report #4 in the Series:

Transportation and Regional Growth Study

Prepared by

John S. Adams, Julie L. Cidell,
Laura J. Hansen, and Barbara J. Van Drasek

Department of Geography, University of Minnesota

Published by

Center for Transportation Studies, University of Minnesota

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This report presents results of analyses of land development, school finance and local government finance, and statistical analyses of the relationship between land development and transportation infrastructure investment in the Twin Cities region from 1970-1997. The report is second in a series on Twin Cities Regional Dynamics, which is one of six parts of the Transportation and Regional Growth Study sponsored by the Center for Transportation Studies, University of Minnesota, the Metropolitan Council of the Twin Cities, and the Minnesota Department of Transportation.

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TRANSPORTATION AND REGIONAL GROWTH

The Transportation and Regional Growth Study is a research and educational effort designed to aid the Twin Cities metropolitan region in understanding the relationship between transportation and land use. Many metropolitan regions of the country are experiencing rapid outward expansion of commercial and residential development, often accompanied by growth in population and in the region's total area of developed land. This trend has raised a range of concerns, including the costs of infrastructure needed to support development and the social and environmental side effects of expanding development patterns.

This study is an effort to better understand the linkages among land use, community development, and transportation in the Twin Cities metropolitan region. It is designed to investigate how different transportation and land use alternatives might be used in the Twin Cities region to accommodate growth and the demand for travel, while holding down the costs of transportation and maximizing its benefits. The costs of transportation are construed broadly, to include the costs of publicly financed infrastructure, environmental costs, and those costs paid directly by individuals and firms. Benefits are construed broadly as well, and include the gains that consumers accrue from travel, the contributions of transportation and development to the economic vitality of the state, and the advantages associated with stable neighborhoods and communities.

The University of Minnesota's Center for Transportation Studies is coordinating the Transportation and Regional Growth Study at the request of the Minnesota Department of Transportation and the Metropolitan Council. The project has two components. The first is a research element designed to identify transportation management and investment alternatives consistent with the region's growth plans. It has six parts:

1. Twin Cities Regional Dynamics
2. Passenger and Freight Travel Demand Patterns
3. Full Transportation Costs and Cost Incidence
4. Transportation Financing Alternatives
5. Transportation and Urban Design
6. Institutional and Leadership Alternatives

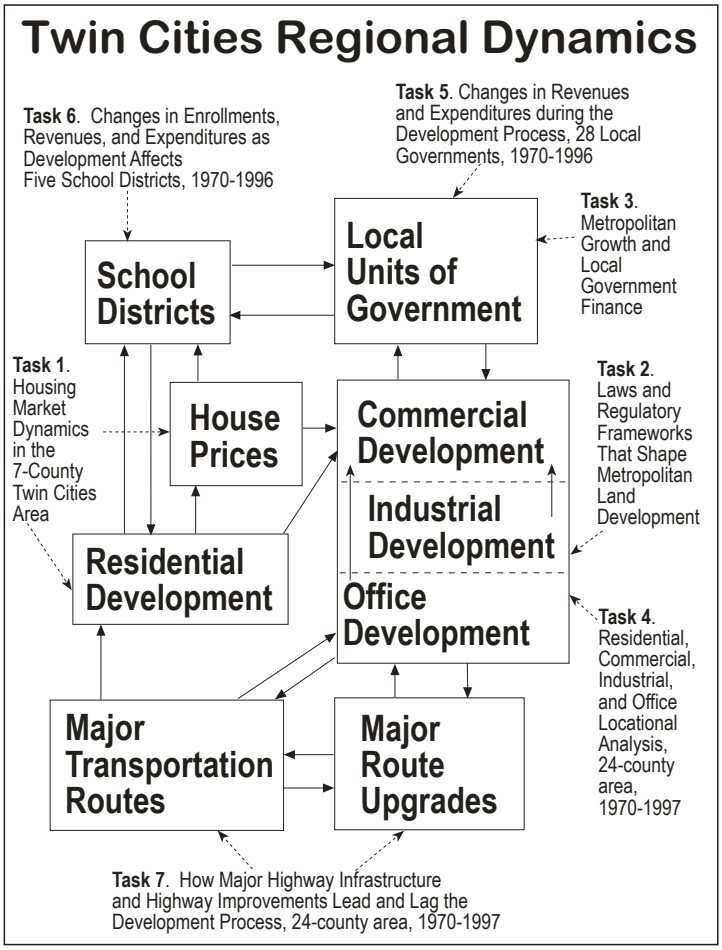
The first three research areas are designed to gather facts about the transportation system and its relationship to land use in the Twin Cities metropolitan region. The other three research areas

will build upon these facts to investigate alternatives in financing, design, and decision making that could support or alter this relationship. Results of this research are and will be available in a series of reports published for the Transportation and Regional Growth Study.

The study's second component is a coordinated education and public involvement effort, designed to promote opportunities to discuss the relationship between transportation and growth as depicted by the study's research results. This dialogue will increase knowledge and raise the level of awareness about these issues among the study's many audiences, including policy-makers, agency professionals who implement policy, and the general public who experience the consequences of those policies.

TWIN CITIES REGIONAL DYNAMICS

Twin Cities Regional Dynamics, Part I of the Transportation and Regional Growth Study, synthesizes the complexity of interactions among transportation infrastructure and flows, housing market dynamics, economic development processes, local government finances, and regulation, and how these singly and jointly influence the shape and substance of metropolitan growth.



The findings of these reports raise additional questions and highlight the need not only for more detailed analyses, but for new ways of looking at metropolitan growth dynamics. The overriding questions in our examinations of Twin Cities regional dynamics and parallel dynamics in other major metropolitan areas are: What are the true costs and benefits of various metropolitan land use and transportation development options? Who pays and who benefits from different options? And what difference does it make?

ACKNOWLEDGMENTS

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We also would like to thank Jonathan (J.J.) Du Chateau, Wisconsin Department of Transportation Geographic Data Coordinator, Geographic Information Services Unit, for sharing digital files and technical assistance; Jim Guidry, Chief, General Purpose Governments Section, Bureau of Local Financial Assistance, Wisconsin Department of Revenue, for providing local government finance data for Wisconsin; Rick Olin, Wisconsin Legislative Fiscal Bureau, for advice on interpreting property tax law in Wisconsin; Bob Wolback, Minnesota Department of Transportation, for the BaseMap CD-ROM and associated information; John Jernberg, Office of the State Auditor, for Minnesota local government finance data and guidance on its use; Norman Anderson, Land Management Information Center, Minnesota State Planning Agency, for technical assistance; and Brian Vollum, Interagency Liaison, Minnesota Department of Transportation, for guidance on our highway change data. Finally, we are grateful for the assistance of staff members at the Minnesota Historical Society Research Center, the Metropolitan Council Data Center, and the Wisconsin State Historical Society. Special thanks to Pat Tupper, Head Librarian at the Minnesota Department of Children, Families and Learning, for her help with fugitive literature on Minnesota's schools.

The authors remain fully responsible for any errors in fact.

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Report #2. Twin Cities Regional Dynamics:
Development and Transportation

EXECUTIVE SUMMARY

***A** new transportation planning initiative for Minnesota…*

*to ensure transportation's contribution to the **economic vitality** of the state and region…*

*and to support **economically vital communities** and **livable neighborhoods** in Minnesota.*

The Transportation and Regional Growth Project grew out of the Minnesota Department of Transportation's (MnDOT) desire to better understand the linkages among land use, community development, and transportation.

MnDOT wishes to ensure that transportation continues to contribute to the economic vitality of the state and the Twin Cities region, and helps to stabilize and enhance the livability of neighborhoods within them.

What can MnDOT and regional government do in the next few years to support livability and sustainability? The Transportation and Regional Growth study (TRG) is a research project and education initiative undertaken to help answer this question. It will portray and discuss selected elements of land use and transportation development within the greater Twin Cities region, and analyze how those elements have helped to shape the geographical structure and dynamics of the region since World War II.

Our approach is organized around:
• economic and social *incentives* that guide behaviors of individuals, households, businesses, institutions, public agencies and local governments;
• *land use patterns and transportation activity* that come about as a consequence of those behaviors; and
• how land use arrangements and transportation systems influence subsequent behavior in a continuing process of *circular and cumulative causation*.

This report describes and analyzes:

- *the geographical patterns of residential, commercial, industrial, and office development and transportation improvements since 1970;*
- *revenue and expenditure patterns of local units of government and how they have changed with development;*
- *revenue and expenditure patterns of local public school districts and how they change with development;*
- *leads and lags in the relationship between transportation improvements and development over time.*

As the Twin Cities emerged as capital of the Upper Midwest region, the pre-World War II highway system serving the Twin Cities linked the area with its region, and provided direction to suburban expansion.

Residential development in greenfield areas initially enjoys low local property taxes, but soon the newly arriving households expect and demand a full range of municipal services that must be supplied and paid for, either by the newcomers themselves, or by shifting some portion of incremental capital and operating costs to current residents, which can lead to political tension.

The resources available to school districts from local tax sources depend on the tax capacity supplied by local development, a process that is regulated by local units of government.

Major highway infrastructure and improvements have both led and lagged the development process. The location of major routes influences developer decisions on where to place new housing. Major office developments cluster at major transportation nodes, but many important nodes support little or no office development. Industrial development appears to be tied closely to transportation routes in the earlier periods, but in later years the close connection appears to fade.

The benefits of land development and transportation improvements accumulate disproportionately within one set of geographical areas, while many of the costs are imposed through time and space on others.

Chapter 1

TWIN CITIES REGIONAL DYNAMICS: DEVELOPMENT AND TRANSPORTATION

INTRODUCTION

The Transportation and Regional Growth study has six research elements, accompanied by a series of parallel education and public outreach initiatives that are intended to elevate public discourse and debate on matters relating to land use, transportation, and long-range planning and governance for the Twin Cities region, with some attention to the other expanding metropolitan regions of Minnesota.

The six research inquiries center on:

- Twin Cities regional dynamics
- present and future passenger and freight travel demands
- estimating full transportation costs and cost incidence
- forecasting future transportation financing options
- urban design options for the Twin Cities
- metropolitan planning and governance options

Research goals of the first research project are (1) to portray and discuss selected elements of *land use* and *transportation development* within the greater Twin Cities region, and (2) to demonstrate how those elements appear to have interacted with one another in shaping the geographical *structure* and *dynamics* of the region during the post-World War II period, with special emphasis on the years since 1970.

Our approach has been to illustrate aspects of a general argument that links:

- Economic and social *incentives* that guide behaviors of individuals, households, businesses, institutions, public agencies, and local governments;
- *Land use patterns and transportation activity* that come about as a consequence of those behaviors; and
- How land use arrangements and transportation systems influence subsequent behavior in a continuing process of *circular and cumulative causation.*

Linkages and Feedbacks that Drive the Development Process

We continue with this work to highlight the linkages among the elements that structure the metropolitan system, and the feedbacks that make the system dynamic:

- First, metropolitan economic growth, higher levels of living, and population expansion combine to stimulate new housing construction, most of it on the edges of the built-up area.
- Economic growth brings with it additional jobs.
- Commercial development in the form of retail trade and consumer services pursues household purchasing power into the developing suburbs.
- Industrial expansion adds job opportunities on large open sites that can be provided with urban services at and beyond the built-up edges of the metropolitan area.
- Office construction continues at the downtown cores, and at high-amenity and easily accessible locations around the region.
- The area's extensive highway network facilitates dispersal of households and jobs, and until recently permitted fast, trouble-free movement among all parts of the built-up metropolitan area.
- Overall population and economic growth, changes in population composition, and changes in life styles and labor force participation, coupled with dispersed low-density development, has meant *more* trips, by *more* people, in *more* vehicles over *longer* distances.
- Recently, according to the Minnesota Department of Transportation (Mn/DOT) measurements and forecasts, travel demand has begun to exceed what highway infrastructure can accommodate, and congestion is becoming an increasing public concern–one of the several prices that the state and region pay for developing and dispersing in the current manner.
- Outcomes appear to be neither benign nor fully intended. Scholars have observed that the economic benefits of this familiar development process occur disproportionately within one set of geographical subareas of the state and metropolitan region, while many of the associated costs accumulate through *time* and over *space* in a different set of subareas, raising challenging questions of social and environmental justice [1].

- Benefits of low-density development flow disproportionately to suburban individual households and businesses, but aggregate costs to the community of dispersed, low-density development–both immediately and over time–are already high and going higher, with many of them concentrating geographically in the central cities of Minneapolis and St. Paul and increasingly in parts of the first- and second-ring suburbs [2].
- The 192 local governments in the 7-county area, as well as many of the remaining 400-plus within our 24-county study area, obligated as they are to match their revenues with costs, frequently are motivated to strategize using land use plans within their jurisdictions to maximize property tax revenues. They may do this by promoting and subsidizing land development of specific types, or by zoning land with an eye toward the revenue and cost consequences of one development pattern over another.
- Meanwhile, on the one hand, school districts are required to respond to land use decisions that are made by local governments and over which they have no control. On the other hand, the state equalization program helps to reduce the costs of low-density development to districts by subsidizing the additional transportation and debt service costs that it incurs. The state has a constitutional mandate to do this in order to provide equal educational opportunity for all, but the consequence is that the effects of low-density development on demands for school services are passed on to the state, providing no local financial incentives for greater efficiency in the provision of those services.

Twin Cities Regional Dynamics

What we describe in our research is a system that on average has performed well up to now—a system that has created many livable communities within the metropolitan area and for a majority of households and businesses within our wider study area. But it is unlikely that the livability that we currently enjoy can be maintained if present development trajectories are not redirected. Efficiency of the present system seems to be declining, and trends are worrisome if we are to have an efficient, equitable, and environmentally sustainable metropolitan system in the decades ahead.

Much of the increase in business and real estate wealth in some parts of the metropolitan area are being offset by declines in other parts. Many of the incentives influencing business and household behavior inadvertently create instability within neighborhoods, undermining

their livability.

If we had more efficient patterns of land development and land use arrangements, it is argued, it could mean:

- more efficient use of highways and other elements of the built environment;
- reduced impacts on fragile environments;
- more manageable travel demand;
- reduced need for new infrastructure investment–roads, utilities, schools, etc.;
- cheaper costs of maintaining existing facilities;
- less dispersal of population; and
- stronger, more stable communities [3].

Our analysis of this argument can be illustrated with a diagram that relates land use, property values, transportation, the fiscal condition of local government, and other features of the evolving metropolitan system (Figure 1.1). Our research to date has examined, in turn, the elements presented on the diagram, and selected linkages among them.

Task 1: Housing Market Activity

Our first task was to examine housing market dynamics within the 7-county Twin Cities area. We described where new housing has been built since 1970, and how real estate wealth has been slowly redistributed across the metro area. Residential development takes place at locations accessible by major highways. It leads to demands on school districts, provides new markets for commercial development, and triggers residential mobility which, in turn, influences housing prices.

Task 2: Regulatory Frameworks Influencing Development and Redevelopment

Our second task summarized the various laws and regulatory frameworks that shape the geographical patterns of development in new areas, and the redevelopment of older settled areas. As a result of the legal and regulatory frameworks, developers usually find it easier in time and money, and ultimately less risky and more profitable, to develop on greenfield sites on the built-up metro edges than to redevelop older areas of the central cities and inner suburbs.

Task 3: Development, Local Units of Government, and Transportation

The third task portrayed in a preliminary way how growth of population and expansion of economic activity within local municipal jurisdictions are accompanied by increases in per-capita revenues and expenditures, and how increased traffic pressure on major highways accompanies

development. In addition, it outlined ways in which local units of government can zone land for different uses in order to affect their own tax capacity, as well as the tax capacity available to the school districts that serve the cities.

These first three tasks were published as Report #1 on Twin Cities Regional Dynamics [4]. Our current research is built around four tasks, which comprise the chapters that follow.

Task 4 (Chapter 2): Geographical Patterning of Residential, Commercial, Industrial and Office Development, and Transportation Development

This chapter portrays residential, commercial, industrial and office development within the 24-county study area for the period 1970 to the present. We describe the emergence of the greater Twin Cities area as the capital of the Upper Midwest region and the economic and population center of the State of Minnesota. We portray the timing and density of residential development around the cores of Minneapolis and St. Paul, with emphasis on the period after 1950. We show how the pre-World War II highway system serving the Twin Cities area linked the metro area with its region, and provided direction to suburban expansion.

The analysis of residential development is accompanied by a profile of industrial, commercial and office development in the 24-county study area after 1970. Extensive office and industrial development brings employees and businesses into a local area, which in turn provides customers for retail trade and services. Much of the retail trade in downtown Minneapolis, for example, comes from dollars spent by employees and businesses located inside the CBD. Local government pays attention to the needs of commercial-industrial interests, who in turn pay a significant share of local property taxes, even though they do not vote in local elections. As house prices advance beyond rates of general inflation, household “wealth effects” stimulate and support vigorous nearby retail trade and service activity.

Task 5 (Chapter 3): Revenue and Expenditure Patterns of Local Units of Government and How They Change With Development

The fifth task portrays changes in revenues and expenditures during the development process for a sample of 28 local units of government chosen from throughout the study area from 1970 to 1996. The sample governments represent six different development eras, identified by the median year of construction of their housing stock (pre-1940, 1940s, 1950s, 1960s, 1970s, 1980s), and the diversity of their housing stock (from high variability in housing ages to highly homogeneous stocks).

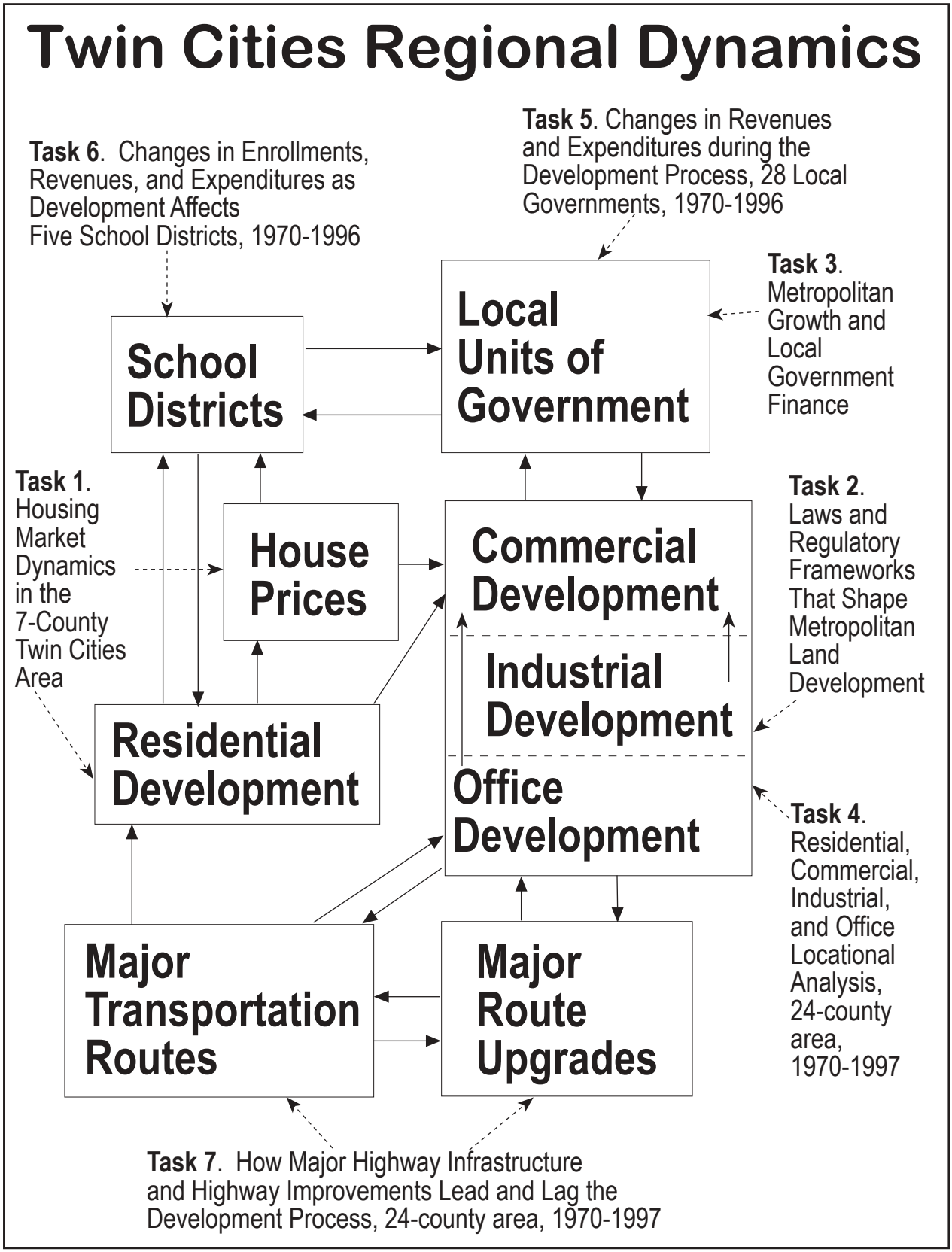


Figure 1.1. Part I of the Transportation and Regional Growth Study.

Residential development in greenfield areas initially enjoys low local property taxes, but soon the newly arriving households expect and demand a full range of municipal services that must be supplied and paid for, either by the newcomers themselves, or by shifting some portion of incremental capital and operating costs to existing residents, which can lead to political tension.

Task 6 (Chapter 4): Revenue and Expenditure Patterns of Local Public School Districts and How They Change With Development

The sixth task examines changes in school enrollments, revenues, and expenditures as development affects five sample school districts at different points in the development process over the period 1970-96. When school enrollments are rising rapidly, new schools must be built and staffed. When school enrollments decline, operating costs and per-pupil capital levies often fail to drop as fast as might be expected because school buildings are older and sometimes less efficient, and older teachers are paid at higher rates than newcomers to the classroom.

The resources available to school districts from local tax sources depend on the tax capacity supplied by local development, a process that is regulated by local units of government. The difference between local needs and available tax revenues is shifted largely onto state general revenues. The degree of efficiency or inefficiency in these financial arrangements and linkages is hard to assess, but regional development dynamics play a role.

Task 7 (Chapter 5): Leads and Lags in the Relationship Between Transportation Improvements and Development

The seventh task shows how major highway infrastructure and highway improvements have both *led* and *lagged* the development process within the 24-county study area in the period since 1970. Statistical relationships differ by decade, as well as by type of development. The location of major routes influences developer decisions on where to place new housing. Major office developments seem to cluster at major transportation nodes, but many important nodes support little or no office development. Industrial development appears to be tied closely to transportation routes in the earlier periods, but in later years the close correlations appear to fade.

Our analysis was carried out with the 632 local units of government or minor civil divisions (MCDs) as the observations. It is possible that if analysis were repeated with still smaller areal units as the observations, the statistical results would differ from what we present in Chapter 5.

The four current tasks (4 through 8) form the four substantive chapters in this report. It is to these chapters that we now turn.

Chapter 1

REFERENCES

1. J. S. Adams, B.J. VanDrasek, and L. Lambert, *The Path of Urban Decline: The Twin Cities and Ten Other Metropolitan Areas,* the second in the series, "What the 1990 Census Says About Minnesota" (Minneapolis: Center for Urban and Regional Affairs, University of Minnesota, 1993).

2. Ibid. See also R. Voith,"Does the Federal Tax Treatment of Housing Affect the Pattern of Metropolitan Development?" *Business Review*, Federal Reserve Bank of Philadelphia, March/April 1999: 3-16.

3. Metropolitan Council, *Regional Blueprint: Twin Cities Metropolitan Area* (St. Paul: Metropolitan Council, 1994).

4. J. S. Adams, M.D. Bjelland, L. J. Hansen, L. L. Laaken, and B. J. VanDrasek, *The Role of Housing Markets, Regulatory Frameworks, and Local Government Finance*, Report No. 1 in the series, "Transportation and Regional Growth Study," Report No. 98-01 (Minnesota Department of Transportation, Center for Transportation Studies, University of Minnesota, and the Metropolitan Council, May 1998).

Chapter 2

TIMING AND LOCATION OF DEVELOPMENT IN THE GREATER TWIN CITIES METROPOLITAN AREA, 1970-1997

INTRODUCTION

This chapter describes the timing and location of residential, commercial, industrial, and office development in the Twin Cities metropolitan area between 1970 and the 1990s. Development is also related to highway improvements in the same time period. Overall, the data indicate a continuing trend towards lower density in all four categories, though to different degrees, a trend that is likely to multiply the number of trips over longer distances and thereby exacerbate current and forecasted highway congestion.

We begin by setting the Twin Cities within its national and regional geographic contexts. Next, we describe some of the consequences of the low-density patterns of land use that are typical of the area. Then, we describe and analyze the timing and location of residential development and patterns of residential densities in suburban expansion since 1950; describe and analyze the timing and location of commercial, industrial, and office development since 1970; and, finally, compare these results to the timing and location of highway development over four time periods since 1970.

THE TWIN CITIES IN ITS REGION

The Twin Cities and Its Nationwide Competitors

The Twin Cities metropolitan center is set within a competitive nationwide system of major metropolitan centers. At mid-20th century, nearby competitors of the Twin Cities for business, corporate leadership, specialized higher education, professional activity, recreation, and for attracting migrants included Seattle and Portland to the west, Denver and Kansas City to the southwest, and St. Louis, Chicago and Milwaukee to the south and southeast. Recently, the North American Free Trade Agreement (NAFTA) appears to be slowly eroding the trade-barrier effects of the U.S.-Canada border, making it easier for Winnipeg to the northwest to make its competitive presence felt on the business front, while simultaneously making it easier for businesses and residents of southern Manitoba to interact with the Twin Cities-based economy (Figure 2.1) [1].

Figure 2.1. First-, second-, and third-order trade centers and trade areas in the United States (suggested by John R. Borchert).
Used with permission, from: R. F. Abler, J. S. Adams, and P. R. Gould. 1971. *Spatial Organization: The Geographer's View of the World*. Englewood Cliffs, N.J.: Prentice-Hall, p. 375.

The Minneapolis-St. Paul Metropolitan Statistical Area (MSA) has grown at above-average rates for most of the past three decades. In 1990 it ranked 15th in the U.S., with just over 2.5 million population. Such fast growth has been unusual among major Midwestern metropolitan areas in recent years, with only the Denver-Boulder-Greeley, CO area expanding at a significantly faster rate in the years following the 1990 census.

Meanwhile, outside the Midwest, coastal cities that serve as convenient "hinges" linking the U.S. to other major world regions enjoy locational advantages for foreign trade and for attracting foreign immigrants, because they lie closer to places of origin. They also attract domestic migrants, because they offer the warmer climates that many people prefer. Moreover, young migrants settling in expanding coastal and Sunbelt areas carry their reproductive potential with them, so their children are born at the destinations, thereby fueling population growth there instead of replenishing populations at their places of origin.

Differential growth of major MSAs in the United States has steadily reordered the nation's metropolitan hierarchy. The New York, Los Angeles, and Chicago areas remained on top in 1990, followed in order by Washington-Baltimore, San Francisco-Oakland, Philadelphia, Boston, and Detroit. MSAs like Miami, Atlanta, Houston, and San Diego were rising rapidly in size and prominence, but many older centers in the Northeast and Midwest such as Cleveland, Detroit and Pittsburgh were slipping in rank, even in cases where their populations and economic activity levels had been maintained or even slightly improved. In the face of fierce competition from other Midwestern metropolitan centers, and from increasingly powerful coastal centers that enjoy important locational advantages, the Minneapolis-St. Paul region has been doing well by most conventional measures of economic health [2].

The Twin Cities Within the Upper Midwest

Within the Upper Midwest (also variously termed the Northern Great Plains, or the 9th Federal Reserve District), the Twin Cities MSA stands at the top of the urban hierarchy, the regional capital dominating "America's Northern Heartland." The Twin Cities metropolitan economy draws human, natural, and financial resources from across the region, while at the same time linking much of that economy with the rest of the world through its business headquarters, research and educational institutions, professional associations, financial services, and arts and entertainment industries [3].

Smaller and less dominant regional sub-centers are scattered across the Upper Midwest. Some are in Minnesota, like St. Cloud, Mankato, and Rochester. Some straddle the boundaries with neighboring states, like Duluth-Superior, Fargo-Moorhead, Grand Forks-East Grand Forks, and La Crosse-La Crescent. The Dakotas and Montana contain still others, such as Bismarck, Pierre, Great Falls, Billings, and Butte (Figure 2.2). At a *regional* scale of investigation, these cities and metropolitan areas appear as points on a map, some growing, some stable, and some declining as they compete with one another for population and resources. At the *local* scale each forms an urbanized region faced with the problems of managing growth, or stability, or decline. In the greater Twin Cities area, continued growth has been accompanied by continued low-density development that today extends over at least the 24 counties in Minnesota and Wisconsin that in 1990 sent at least 5 percent of their daily commuters into the 7-county metropolitan area [4].

Regional Ground Transportation Links With the Twin Cities

An extensive series of pre-European settlement trails first linked the 19th-century St. Paul and Minneapolis centers with Minnesota, the Upper Midwest region, and parts of what is today

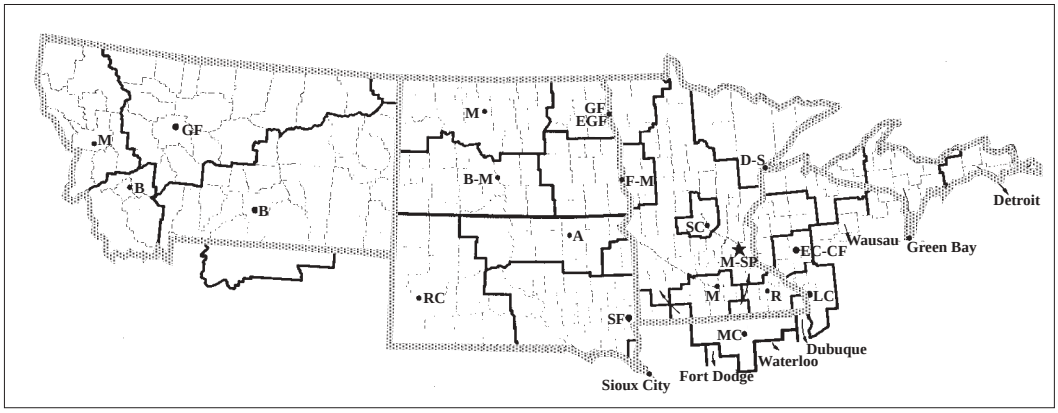


Figure 2.2. Trade Areas at the Secondary Wholesale-Retail Level.
Used with permission, from J. R. Borchert and R. B. Adams. 1963. *Trade Centers and Trade Areas of the Upper Midwest.* Minneapolis: Upper Midwest Economic Study, University of Minnesota, p. 20.

Manitoba. Many of these early trails followed major water courses, and when the railroads first entered the region they followed the routes of many of the trails, reinforcing the linkages connecting the region with Minneapolis and St. Paul [5].

In a process of circular and cumulative causation, trails then promoted settlement and development of the region's natural resources. The settlements were linked with one another and with the Twin Cities by the railroads. In the 20th century, as the highways were built, they reinforced ties among places that already had been linked by the railroads [6].

At the onset of World War II, 14 major highway corridors radiated outward from Minneapolis and St. Paul into the Upper Midwest region (Figure 2.3):

- US8 extended northeast of St. Paul, through St. Croix Falls, Rhinelander, WI, and eventually to Iron Mountain, MI.
- US61 ran north from St. Paul to Duluth, the North Shore of Lake Superior, and Grand Portage.
- S65 went north from Northeast Minneapolis (NE Central Avenue) to Cambridge, then east of Mille Lacs, to McGregor and the Mesabi Iron Range.
- US169 went north from Minneapolis (N. Lyndale Avenue) along the west side of Mille Lacs to Grand Rapids, then through the Mesabi and Vermillion Iron Ranges.
- US10 ran northwest of St. Paul parallel to the Mississippi River on the east side, through St. Cloud, across the river at Little Falls, then to Detroit Lakes, and on to Fargo, ND.

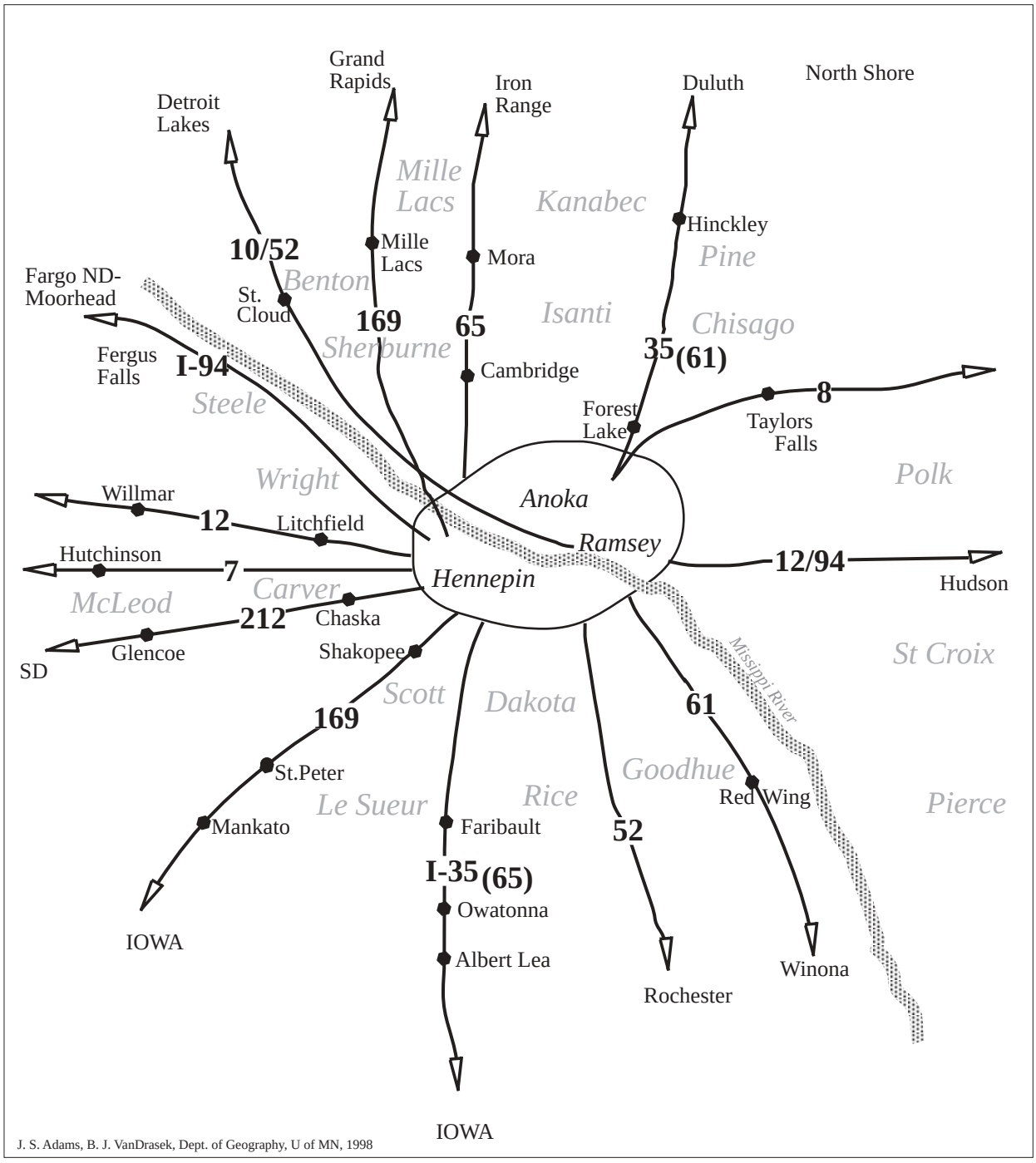


Figure 2.3. 14 Main Highway Corridors Serving the Twin Cities.

- US52 ran west of north Minneapolis (W. Broadway Avenue) parallel to the Mississippi River on its west side, through Sauk Centre, Alexandria, and Fergus Falls.
- US12 ran west from downtown Minneapolis (Wayzata Boulevard) through Wayzata, Litchfield, Willmar, and Ortonville, then into South Dakota.
- S7 ran west from W. Lake Street through St. Louis Park and Excelsior, then through Hutchinson and Montevideo to Ortonville.
- US212 ran west from W. 50th Street in the southwest corner of Minneapolis through Glencoe, Granite Falls, and on to Watertown, SD.
- US169 ran southwest from Minneapolis to Shakopee, following the Minnesota River to St. Peter, crossing the river at Mankato, then on to Blue Earth and Iowa.
- US65 ran south on Lyndale Avenue across the Minnesota River to Faribault, Owatonna, Albert Lea, and eventually to Des Moines, IA.
- US52 ran on S. Robert Street from downtown St. Paul to Rochester, then to Decorah, IA and beyond.
- US61 ran from St. Paul's East Side southward on Point Douglas Road, crossing the Mississippi River at Hastings, then following the west side of the river through the river towns of Red Wing, Winona, La Crosse, and points east into Wisconsin.
- US12 ran east of St. Paul across the St. Croix River to Hudson, and eventually to Madison and Chicago [7].

After the war, the major highways steadily supplanted railroads for freight and passenger movement. These fourteen highways were the main routes, supplemented by others of lesser importance, that linked the expanding Twin Cities center with its region. These were the routes that carried shoppers, visitors, and migrants to the Twin Cities, and that were used in distributing goods and services to the region.

Inside the Twin Cities to the 1960s

Until World War II, except for the years of the Great Depression, areas south, southwest, west and northwest of the Twin Cities were prosperous and relatively heavily populated, especially the fertile farming areas directly south of the Twin Cities. As annual precipitation diminished in abundance and reliability with increasing distance west of the Twin Cities, farm population density and income per acre of farmland also declined [8].

West, northwest, southwest, and south of the Twin Cities were the regions of the Upper Midwest that supplied Minneapolis with its major market area and principal migration field, giving the city a substantial economic and demographic advantage over St. Paul. Areas north of the Twin Cities to the Iron Range and beyond, northeast to Duluth, the counties of northwestern Wisconsin, and districts east and southeast of the Twin Cities fell into St. Paul's orbit. St. Paul's tributary area was relatively unpopulated compared with Minneapolis's, with areas to the north and northeast containing farm populations that on average were substantially less prosperous than farming areas served by Minneapolis. In addition, areas east and southeast of St. Paul were courted aggressively by business interests from Chicago and other Wisconsin cities, and drew off migrants that otherwise might have come to St. Paul. Minneapolis, on the other hand, encountered little competition either on its west or south sides all the way to Iowa, which remained securely within Chicago's hinterland. Traditional freight flows eastward from Iowa and rigged freight rates made it more economical for shippers and customers in Iowa and Nebraska to do business with Chicago than with the Twin Cities, which was often closer in miles [9].

Downtown Minneapolis, lying on the west side of the Mississippi River by Nicollet Island and the Falls of St. Anthony, enjoyed superior access to its prosperous tributary market area, which lay in Greater Minnesota and the Dakotas to the northwest, west, southwest, and south. From the 1920s to the 1960s, the main highways serving Minneapolis markets focused on downtown Minneapolis. They provided familiar pathways in and out, and paralleled passenger and freight rail lines that had linked Minneapolis with different parts of the Upper Midwest region for most of a century [10].

For the past century, most of the Minneapolis population has lived in south Minneapolis, with a smaller share in north Minneapolis. These two parts of Minneapolis enjoyed an advantageous location between downtown and the city's main state and regional markets (Figure 2.4). As the city's population grew, the large southside and smaller northside populations spread outward, especially after World War II. East Side Minneapolis populations–that is, east of the Mississippi River–spread outward slowly because populations were smaller, purchasing power was less, and the inclination on the part of working-class families to abandon their close-knit neighborhoods for suburban destinations was muted [11].

Downtown St. Paul lay on the east side of the Mississippi River, and enjoyed superior rail and highway access to resources, markets and the smaller populations to the north, northeast and

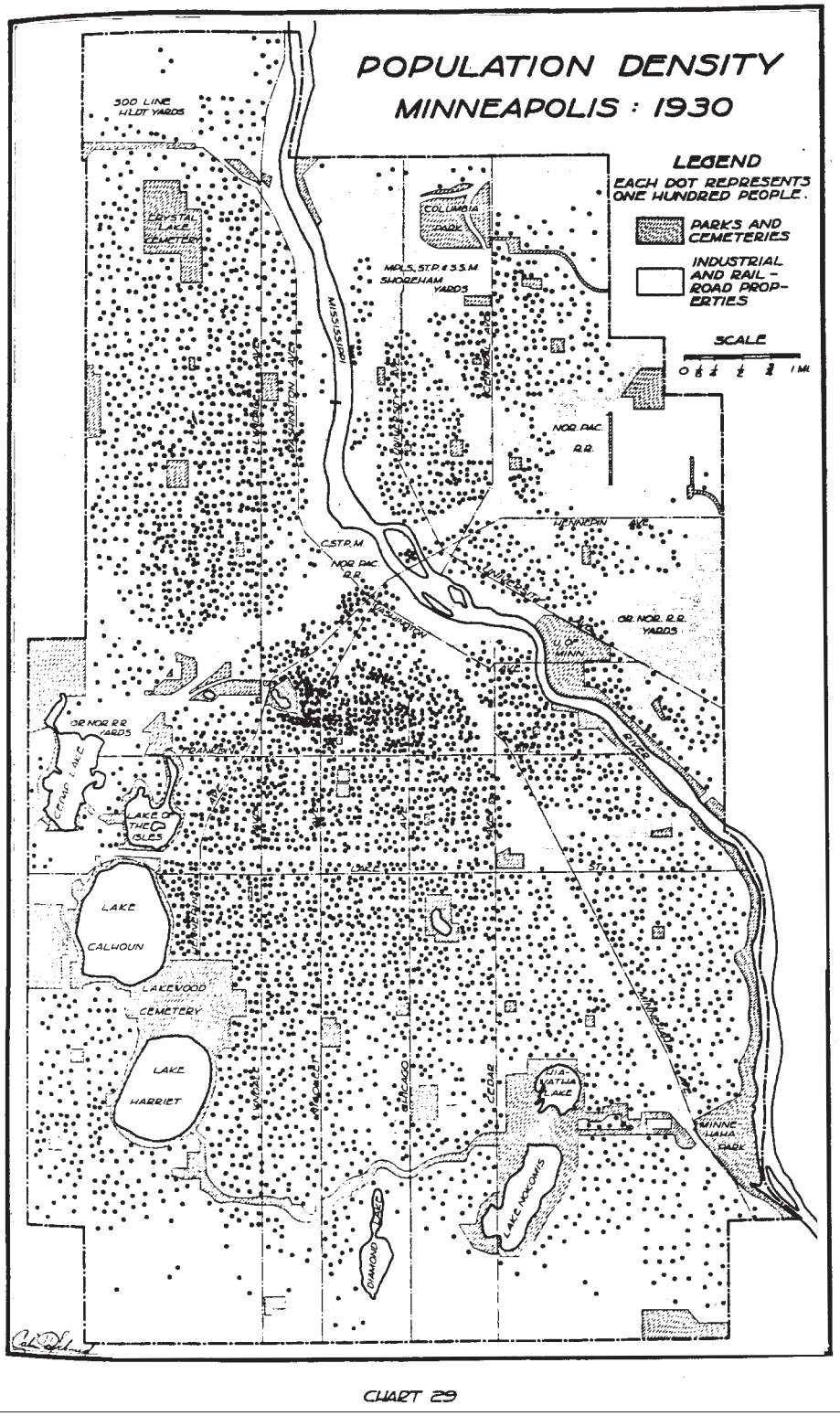


Figure 2.4. Minneapolis Population Density, 1930.
From: Calvin F. Schmid. 1937. *Social Saga of Two Cities: An Ecological and Statistical Study of Social Trends in the Minneapolis and St. Paul*. Minneapolis, MN: Minneapolis Council of Social Agencies, p. 59.

east. But those areas contained the poorly-drained and relatively unproductive farms on the Anoka Sand Plain, the recently cut-over northern pine forests, the Iron Range, the Lake Superior region, and nearby Wisconsin counties beyond Chicago's reach.

As St. Paul grew, the large middle-class population west of downtown spread westward toward Minneapolis (Figure 2.5). But the city, expanding on a smaller population base, and growing more slowly because of its smaller and less prosperous tributary area and inferior competitive position vis-à-vis Minneapolis, took longer to fill up and to spill outward into its first-ring suburbs [12].

Storm Clouds Gathering

Growing Population, Dispersing Jobs, and Housing

Until 1950, almost all of the population of the Twin Cities area lived inside the central cities of Minneapolis and St. Paul, with modest spillover into (1) first-ring streetcar suburbs such as Richfield, Edina, St. Louis Park, Roseville, and West St. Paul, (2) a handful of commuter suburbs like Wayzata, Excelsior, and White Bear Lake, and (3) some industrial suburbs like Hopkins and South St. Paul. Steady post-war population expansion, accompanied by the suburban residential building boom, filled up the first-ring suburbs. Expansion stimulated a second ring of growth as the Metropolitan Planning Commission, and its successor the Metropolitan Council after 1967, undertook to coordinate the orderly expansion of development on the edges of the built-up area [13].

Easy movement in all directions on the area's post-war streets and highways meant good access to ample supplies of developable land. Large supplies of buildable lots meant low land prices, so new houses could be built on inexpensive large lots, yielding suburban residential densities that were much lower than those in the core cities or even some of the first-ring suburbs [13]. Low residential densities, coupled with suburban zoning practices that separated residential, commercial and industrial areas from one another meant that linking home to work, home to shop, home to school, and other trips usually required the use of private cars and other motor vehicles. On the demand side, consumer households experienced a clear preference for new housing, large lots, and private automobiles.

In recent years, these patterns of land development and motor vehicle use appear to be yielding some unwanted and unanticipated outcomes.

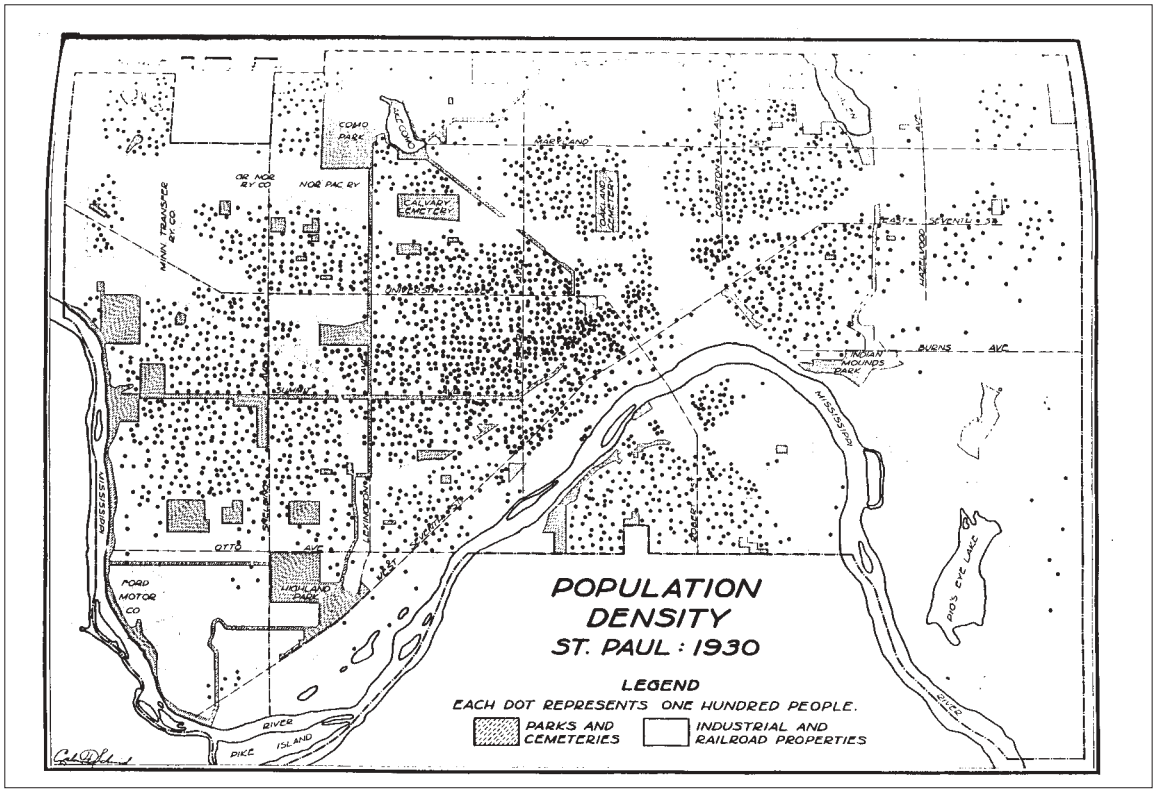


Figure 2.5. St. Paul Population Density, 1930.
From: Calvin F. Schmid. 1937. *Social Saga of Two Cities: An Ecological and Statistical Study of Social Trends in Minneapolis and St. Paul*. Minneapolis, MN: Minneapolis Council of Social Agencies, p. 60.

- Low-density development means that origins and destinations are located farther apart, so greater distances must be covered in carrying out daily household routines linking home, jobs, shopping, day care, school, friends and relatives, and so forth.
- Zoning practice that prohibits activities of different types from locating next to one another forces more travel than would be necessary if more types of mixed-use developments were permitted.
- Low-density settlements with segregated land uses in most cases require the use of a car to get from place to place, so that people without a car–such as those who cannot or should not drive, cannot afford to drive, or prefer not to drive–find it difficult to live there.
- As origins and destinations become increasingly scattered at low densities across the metropolitan area, the provision of frequent, low-cost public transit becomes financially prohibitive because it cannot generate sufficient patronage and revenue per mile. Thus reliance on the ownership and use of private cars is reinforced.

- As traffic volumes approach and begin to exceed the planned carrying capacity of some freeway and thoroughfare routes, the question arises whether there might be some combination of (1) land use modifications coupled with (2) public transit improvements of several kinds that would relieve roadway congestion or at least prevent it from worsening [14].

Growing Highway Congestion

Since the 1960s, the population of the greater Twin Cities area has continued to grow. That growth, accompanied by dispersal along historic channels of freight and passenger movement, is causing vehicle miles traveled to increase at a faster rate than infrastructure is made available to accommodate them. The serious highway congestion that results at several points within the metropolitan area is only one example of how demand originating on the edge of the metropolitan area can yield negative effects closer to the center.

During peak traffic periods, 35 percent of freeway miles in the 7-county Twin Cities region and 55 percent of principal arterial lane miles are congested, which means that traffic volumes exceed designed capacity during some parts of the day. Miles of congested freeway increased from 72 in 1984 to 104 in 1994. The Metropolitan Council and Mn/DOT expect the number to increase to 220 miles by 2020 and anticipate that increased freeway congestion will gradually place an increasingly intolerable load on the region's arterial system [15].

There are several reasons for the increased congestion:

- more households, and more vehicles per household;
- more and longer trips per vehicle within an increasingly dispersed built-up area and the commute-shed surrounding it; and
- more two-earner households and therefore more journeys to work per household.

At the same time that highway travel demand is rising and congestion is getting worse, the state legislature, Mn/DOT, and the Metropolitan Council have concluded that the gap between travel demand and highway capacity cannot be closed by new construction. Few new roads are scheduled to be built between now and 2020. Instead, most available resources will be devoted to maintaining existing capacity, such as lane additions on some routes, and bridge and pavement repair and replacement, which are investments made necessary by structural fatigue resulting in part from increased reliance on trucks rather than rail to move heavy freight [16].

Transit Improvements Slow in Coming

As travel demands begin to overwhelm the capacity that infrastructure can supply, we begin to reflect on the underlying land use and transportation relationships. The term "transit" in its broadest definition means the conveyance of persons or goods from one place to another, by private means as well as by public transportation. The geographical arrangement of homes, jobs, shopping, recreation, and other facilities on the Twin Cities landscape forms the stage upon which transit in this broad sense occurs. People and goods, in the process of daily production and consumption activity, move across this stage from one place to another. Their principal means of movement are cars and trucks on the region's streets and highways.

Land use modifications that would reduce the demand for movement could include building at somewhat higher densities in new areas, rebuilding at higher densities in obsolescent built-up areas, and greater emphasis on mixed-use development. Transit improvements require a broader public understanding of the many ways in which transit services can be provided and supported financially. Transit services may be provided by:

- city buses–publicly or privately owned–and operating on scheduled routes;
- streetcars and light rail systems;
- above- and below-ground heavy rail systems;
- privately-owned and operated cars and trucks;
- school buses;
- van pools;
- taxis;
- jitneys (small passenger vehicles following regular routes, often privately owned);
- airport limousines;
- vans for the handicapped, such as Metro Mobility;
- charter buses; and
- bicycle loan programs.

One approach to reducing congestion is to raise the price that users must pay to gain access to the highway system. Mn/DOT's 1997 attempt to test the idea of user fees to generate revenues and to manage traffic met with stiff public resistance. Proposals included toll roads and paid subscriptions to use traffic lanes currently reserved for high-occupancy vehicles. On the other hand, metering vehicle access to metropolitan-area freeways (charging a price in terms of time) in order to minimize congestion and maximize traffic flow, although eliciting complaints, has proved to be an effective and valuable technology.

Congestion in some highway corridors got worse with the accelerated outward push of development to the edge of the 7-county Twin Cities area and beyond. As land costs in developing areas inside the seven counties have risen, developers in far-flung areas are responding to a market wanting more land and house for their dollar, even when it means longer commutes and more time and miles spent on other types of trips. Many people prefer what they think of as "rural amenities" in the form of lower-density living, a greater sense of personal safety, and little traffic congestion. But ironically, in moving farther out to avoid congestion they increase vehicle miles traveled and ultimately aggravate the very congestion they sought to escape. In other words, congestion contributes to low-density residential and commercial development, which quickly contributes more traffic, which–on a roadway system of fixed capacity–eventually produces more congestion [17].

An integrated land use and transportation system that is attuned to the needs and wants of a growing metropolitan region must simultaneously coordinate:

- building and maintaining the regional transportation infrastructure;
- building and maintaining the local streets and thoroughfares;
- local land use planning and zoning practices; and
- a mix of public and private transit services, appropriately financed and effectively priced to users.

Considered this way, it becomes clear that a discussion of road improvements without regard either to (1) the land use arrangements that generate demand for more roads, or (2) the ways that road improvements may influence land use zoning and land use patterns will probably contribute to the very problems that it is intended to resolve. It also becomes clear that discussing one kind of transit improvement without attention to the full range of other transit forms means missing other possible options. In the same vein, trying to plan for high-capacity, fixed-route transit options without regard to local land use arrangements and their relationship to transit patronage will undermine publicly-sponsored transit options that should be taken seriously, but that require local units of government along with private development interests to cooperate over the long term with regional planning authorities, state planning agencies, and local citizen interest groups [18].

These are complicated matters and they present no simple, short-term fixes. For effective highway transportation planning, transit planning, and land use planning to work efficiently and

effectively, a consistent long-term vision of many decades is needed, along with continuing commitments and persistent cooperation among several layers of state and local government.

Development Beyond the Seven Counties, Spreading Over 24 Counties

The metropolitan expansion process in and around the 7-county area proceeds in approximately the following fashion:

- Population expansion from natural increase and net in-migration stimulates new housing construction.
- Most of the new construction occurs on open land in suburban and exurban locales.
- Population growth both responds to and promotes economic expansion.
- Population and jobs increase together, because economic expansion requires additional workers, and this new population adds to the demand for locally-provided goods and services, which in turn means more jobs and more spending in the local economy.
- As population growth, suburban construction, and general economic expansion proceed, commercial development pursues household purchasing power into the developing suburbs.
- Meanwhile, industrial expansion adds new as well as relocated job opportunities around the suburban edges of the metropolitan area.

The next section describes and discusses the geographical patterning of various forms of land development in and around the Twin Cities in recent decades, and how these development patterns have been associated with the timing and location of major highway improvements.

Suburban and Exurban Land Development in the Greater Twin Cities Area

The foregoing sections described the relations between the Twin Cities and the Upper Midwest region, and how low-density development of the Twin Cities region has resulted from the combination of continued growth, transport development, local terrain, and consumer preference. This section has three goals:

- to describe and analyze the timing and location of *residential development* and the geographical patterns of *residential densities* in areas of suburban residential expansion around the Twin Cities core since 1950;

- to describe and analyze the geographical patterning of *commercial* and *industrial* development in the greater Twin Cities area since 1950; and
- to describe and comment on the geographical and historical relationships between the amount and locations of *development* and the timing and locations of *major highway improvements* during the four time periods 1970-79, 1980-84, 1985-89, and 1990-94.

Timing of Residential Development

Major American cities that grew rapidly up through the 1880s had only one significant means of dispersing housing and people, and then only for the privileged few. Those means were the railroad suburbs of the sort found around places like New York, Philadelphia or Chicago. Other fast-growing places accommodated their pre-1890 growth by squeezing the poor and working classes into tight quarters, producing high residential densities.

The electrification of horsecar lines and steam-propelled street railroads, which produced the electric streetcar, permitted the outward dispersal of the built-up urban area, and enabled the working classes to live outside the congestion in and near the core but still move quickly and cheaply to work and shopping.

The new housing put up during the streetcar era, which began in 1889-90 in the Twin Cities, was built in neighborhoods reached by streetcar lines. Most streetcar lines in Minneapolis were built to serve the Southside, reinforcing growth in that sector of town, as well as toward the southwest Lake District. In St. Paul, the first streetcar lines ran west and northwest of downtown, setting the city's future course of residential growth [19].

The outstanding growth of the Twin Cities during the 1880s and 1890s nurtured such extravagant expectations on the part of the streetcar owners that they eventually overbuilt the network. The extension of the streetcar lines opened up vast stretches of suburban land and was largely responsible for the low-density development of Twin Cities residential areas. When urban growth fell short of expectations, the surplus land eventually was absorbed by platting large lots, producing some of the lowest residential densities found among midwestern cities. Among the major metropolitan areas nationwide, today only Kansas City and Atlanta contain lower densities.

St. Paul streetcar lines reached South St. Paul and the stockyards, Stillwater on the St. Croix River, North St. Paul and White Bear Lake. Minneapolis lines reached Columbia Heights,

Robbinsdale, St. Louis Park, Hopkins, Edina, and resort areas on the north (Wayzata) and south (Excelsior) sides of Lake Minnetonka. Lines also connected with interurban lines to Hastings and Anoka.

During each economic boom period and building era, the volume of residential construction and the densities promoted and permitted by the prevailing urban transportation systems controlled the amounts of land devoted to each housing unit. Around downtown Minneapolis and St. Paul, mere traces remain of the pre-1890 walking and horse-car era. Downtown expansion and urban renewal programs destroyed the rest.

The electric streetcar era produced finger-shaped extensions of residential areas because it was easy and inviting to build outward on new land available on either side of the lines, but it remained difficult to expand between them (Figure 2.6). In the 1920s and 1930s, after automobiles made it possible to move easily in all directions, a filling-in process at still lower densities yielded a roughly circular-shaped city once again. Then during the post-World War II era, highways fanning out from the cities in all directions encouraged suburban low-density development, at the margins of or in leap-frog development beyond the continuously built-up area.

The setting of the Twin Cities area contains few physical obstacles to expansion and development in any direction, except for major rivers such as the St. Croix and the Mississippi, which presented formidable barriers to east-west movement in the early days of settlement. At the present time, a network of major highways serves the 7-county Twin Cities area from all directions, although the network is somewhat more dense on the south and west sides of the central cities (Figure 2.7).

The present system of major highways is an extension and improvement of the system of radial routes that served the Twin Cities at mid-century. At the end of the 1930s, state and county highway departments recognized the need to link the principal radial routes with a circumferential route, and Highway 100 (“The Belt Line”) was completed shortly after the war. Highway planners underestimated post-war growth, outward expansion of the built-up area, and automobile and motor truck ownership and usage. Consequently, the Belt Line was overcrowded and functionally obsolete along some of its western and southern stretches even before it was completed.

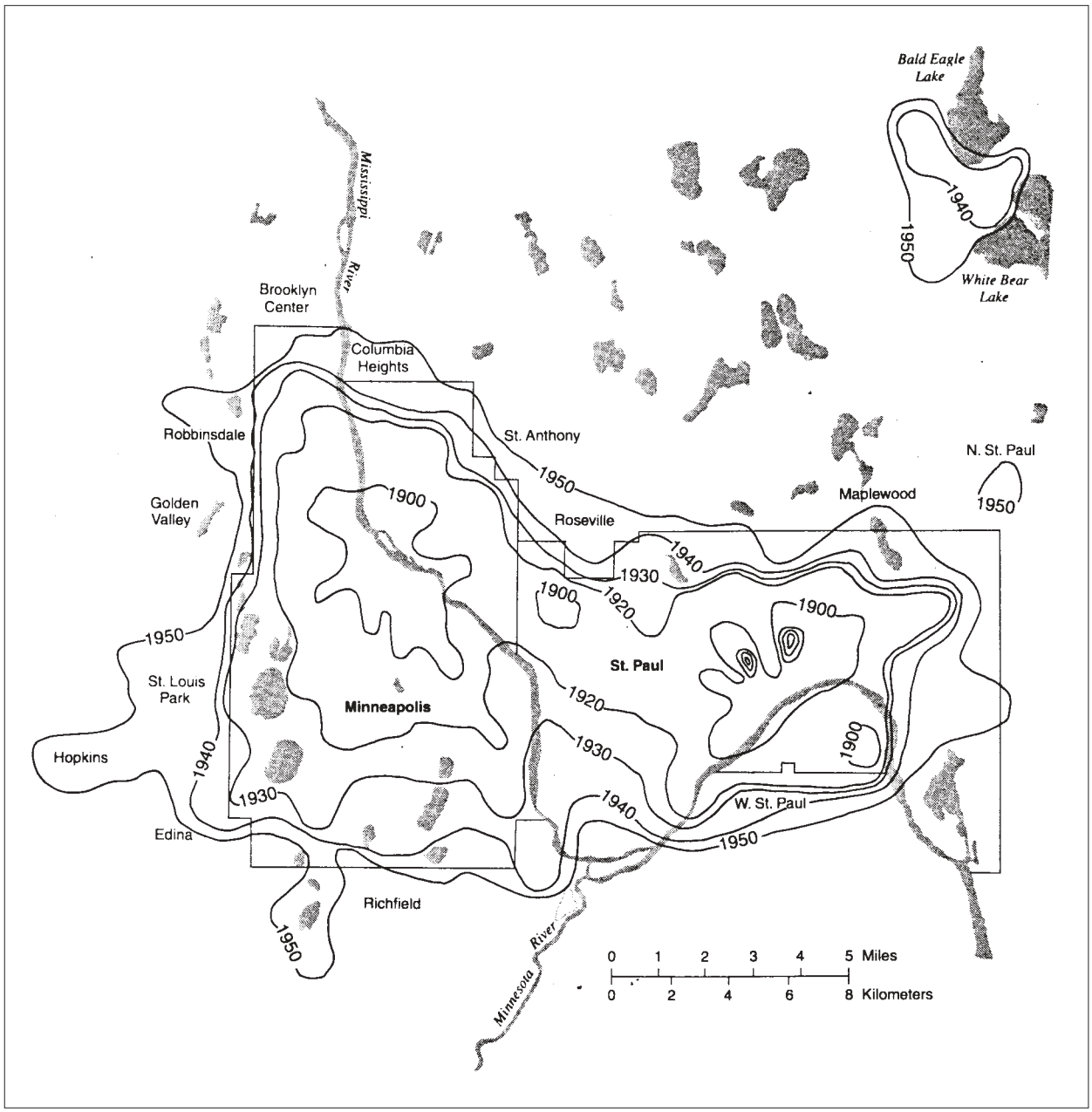


Figure 2.6. Average Year of Housing Construction in Different Areas of the Twin Cities in 1960.

Patterns reflect steady outward growth at ever-lower densities. By 1970, first- and second-tier suburbs were filling in and a third tier was developing. Patches of urban renewal near downtown St. Paul mean substantial numbers of newer houses in those zones.

Data source: U.S. Bureau of the Census, 1960 *Census of Population and Housing.*

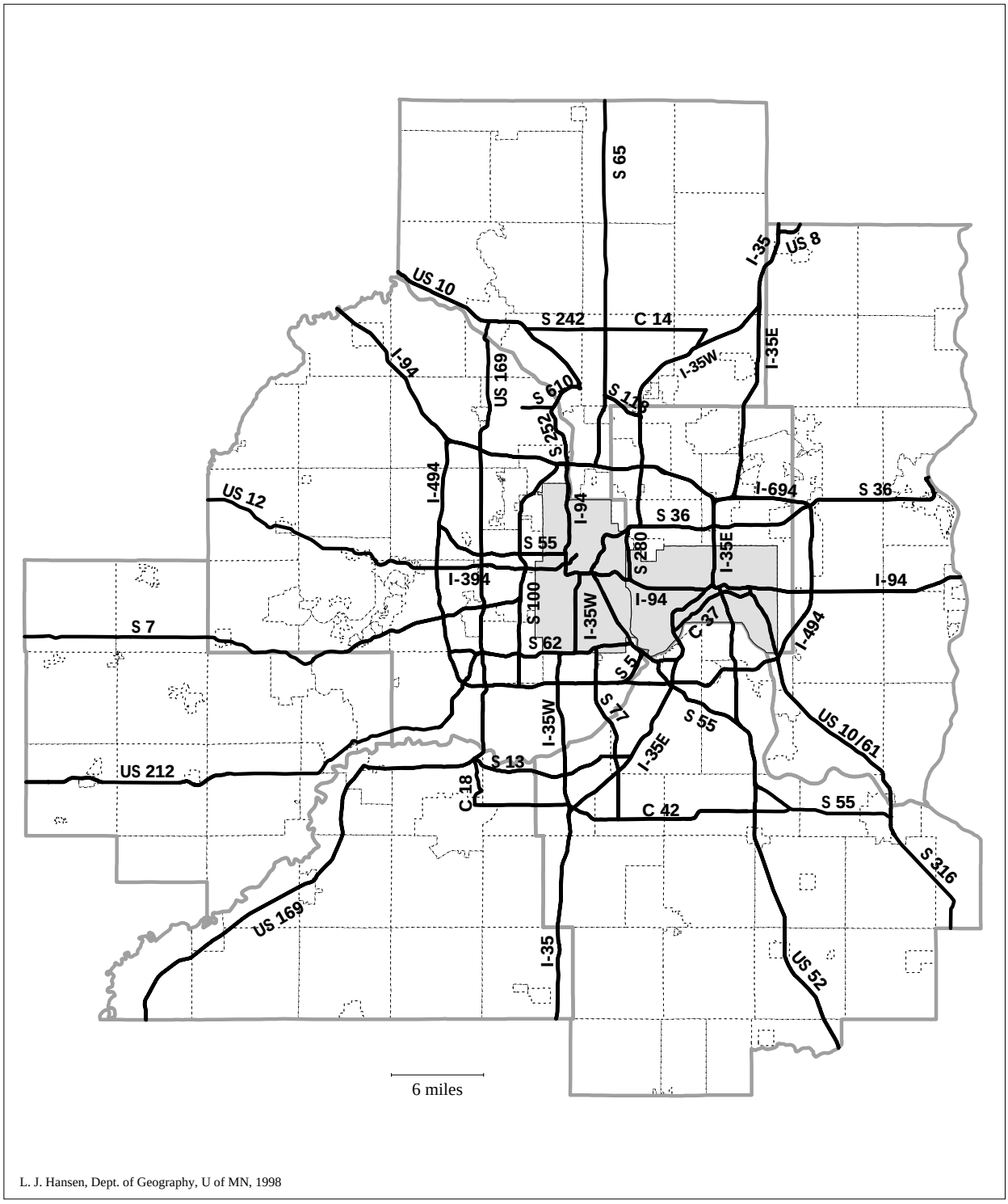


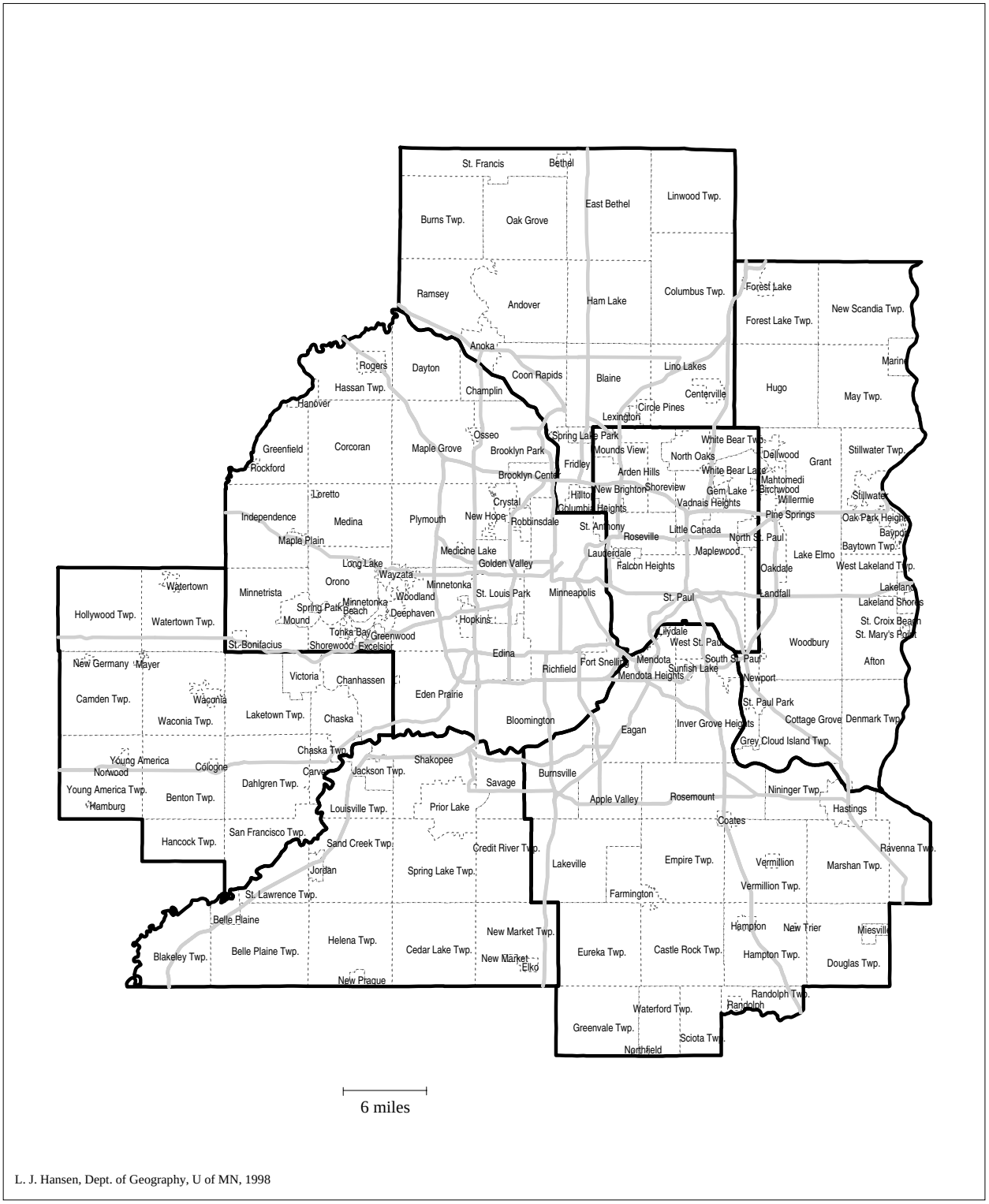
Figure 2.7. Major Highways Serving the Twin Cities, 7-County Area, 1998.
Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97.

The planning and building of Minnesota's interstate highways provided the Twin Cities area with an extra ration of high-speed, limited-access freeways, which simultaneously opened up vast new territory for residential development, while permitting easy movement throughout the region for many years. As in the streetcar era (1890s-1920s), when over-building of the lines led to low land prices and low-density development, the extensive interstate freeway system in the Twin Cities perpetuated the local tradition of low-density development into almost all areas served by the new highways. Included in the freeway network was a second circumferential highway, I-494/694. In recent years, as vigorous development continues on the south and west sides of the area, heavy loads on certain stretches of the circumferentials have been relieved somewhat by improvements in design and capacities of US169 on the west side, C42 on the south side, and S242 and C14 in Blaine and Coon Rapids on the north side.

Some local cities and townships are better served by major highways than others (Figure 2.8). Maple Grove in the northwest part of Hennepin County, for example, is served by I-94 and I-494/694 running through its center. In contrast, parts of Hanover, Rockford, Greenfield, and Corcoran west of Maple Grove lie 6 to 10 miles from a major highway. In Anoka County, Ham Lake and Bethel are well served by S65, while areas farther from the highway west and east are remote from this major route. In general, the closer that a local unit of government lies to one or more of the major highways, the greater has been the development. Chapter 5 examines the relationship between transportation and development more closely.

Minneapolis was almost fully built-up at the end of World War II, so most of the city's housing is now relatively old, despite substantial recent additions in the downtown and selected older parts of the city. The 1990 housing census reported the median year of housing built in Minneapolis as "pre-1940" without providing further details on age. Places like Minneapolis with a median year of construction of 1939 or earlier are labeled "39" (Figure 2.9). St. Paul, which contained extensive tracts of undeveloped land at the onset of World War II, reported a median year of housing built as 1944, and is labeled on the map as "44."

First-ring suburbs that filled up quickly after 1945 include, for example, Richfield (median year of housing built, 1956), St. Louis Park (1957), Robbinsdale (1953), Columbia Heights (1958), Roseville (1964–later because St. Paul was still filling in), Maplewood (1969—for the same reason), and West St. Paul (1964). Edina (1965) was slower to fill in because housing there was more expensive, and the market was therefore smaller. Beyond the continuously built-up area, some places such as Hollywood Twp in the northwestern corner of Carver County and Hancock



L. J. Hansen, Dept. of Geography, U of MN, 1998

Figure 2.8. MCDs Served by Major Highways, 7-County Area, 1998.
Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97.

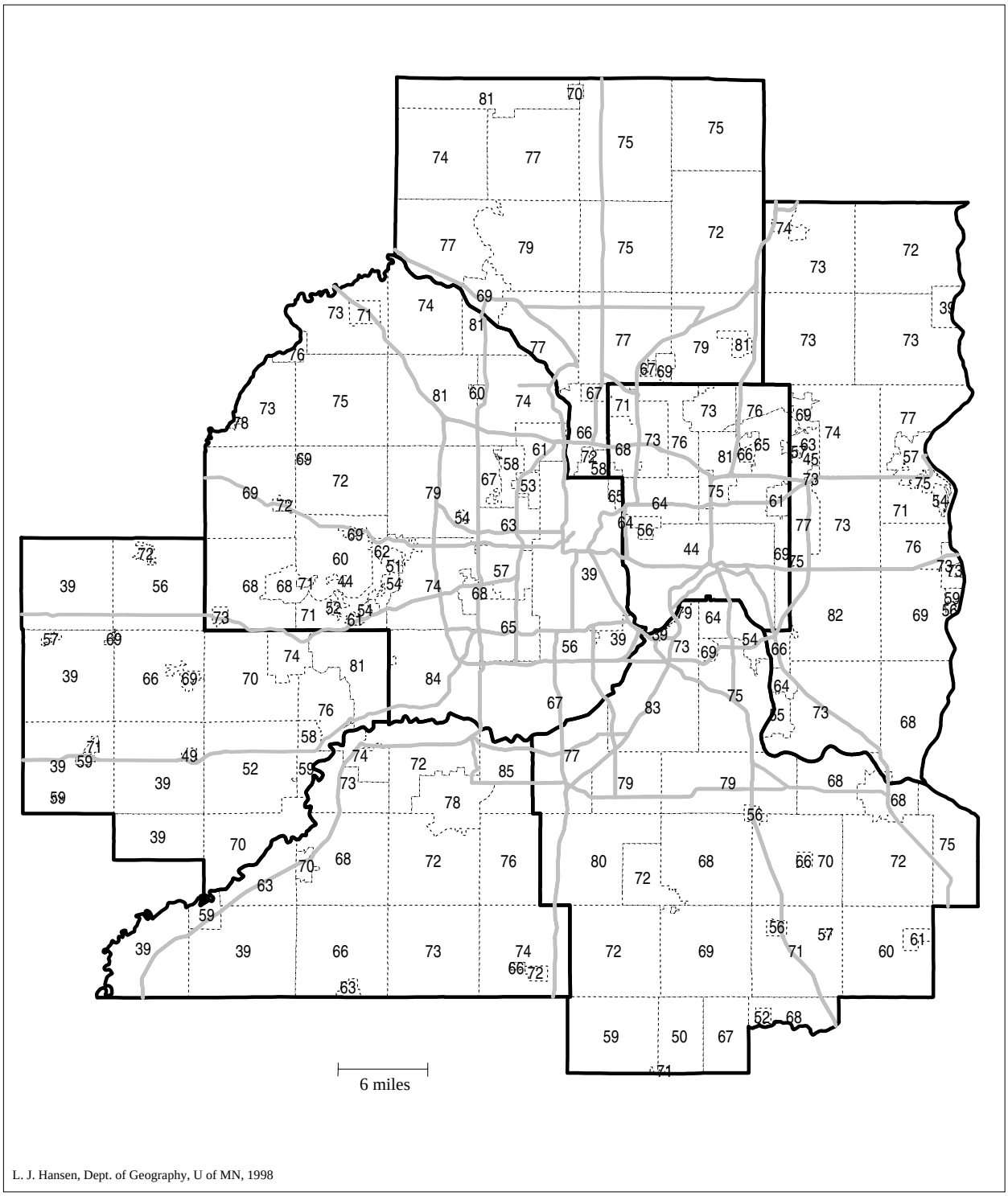


Figure 2.9. Median Year of Housing Construction, MCDs, 7-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Minnesota Department of Transportation, State of Minnesota BaseMap 97.

Twp on Carver's south-central boundary both have medians "pre-1940." These kinds of places, although they received some new housing in recent decades, got increments insufficient to move the median into the recent decades.

Outlying cities and townships often contain a housing stock some of which is quite old (19th and early 20th century), and the rest from the last few decades. When housing ages are arrayed by decade of construction, a bi-modal distribution emerges. The proportion in each end of the age distribution determines the median age. For example, Eureka Township's 1,201 housing units had a median year of construction of 1966, with housing counts by decade of construction as follows: 1980s: 94; 1970s: 144; 1960s: 63; 1950s: 8; 1940s:12; pre-1940: 202. (See Appendix 2-A for a map of places discussed in the text.)

Two types of areas enumerated in the 1990 census contained housing stocks with median ages earlier than 1950 (Figure 2.10). The first type includes the central cities of Minneapolis and St. Paul at the heart of the 24-county area, and the second is an arc of cities, townships (Minnesota) and towns (Wisconsin) on the west, south and east edges of the area, plus a few clusters in the north and northeast that have received too few new units since 1950 to move the median year of construction to more recent decades. At the other extreme, places with housing stocks dating mainly from the 1980s include suburbs south of the Twin Cities (Eagan, Lakeville, Savage, Eden Prairie), northwest of Minneapolis (Maple Grove, Champlin, St. Francis), north of St. Paul (Vadnais Heights), east of St. Paul (Woodbury), and across the St. Croix River around Hudson.

The locations in the 24-county area with the oldest housing stocks are of two main types: core central city, and peripheral agricultural settlements, townships (MN) and towns (WI) where aging farmsteads often comprise a majority of the housing stock (Figure 2.11). The central cities were built up early, and although there has been steady replacement of some of their oldest units especially in and around the two downtowns, the large majority of their stock dates from before 1950. The fact that the city limits of St. Paul and Minneapolis were fixed before World War II by the incorporation of a ring of suburbs around each of them meant that the cities were prevented from expanding in area by annexing adjacent territory during the post-war suburban building boom. Had the central cities been able to capture a larger share of the post-war construction that ended up in suburban communities, their median ages of housing would be younger than they are today.

The peripheral townships, towns and cities that lie well beyond current development pressures

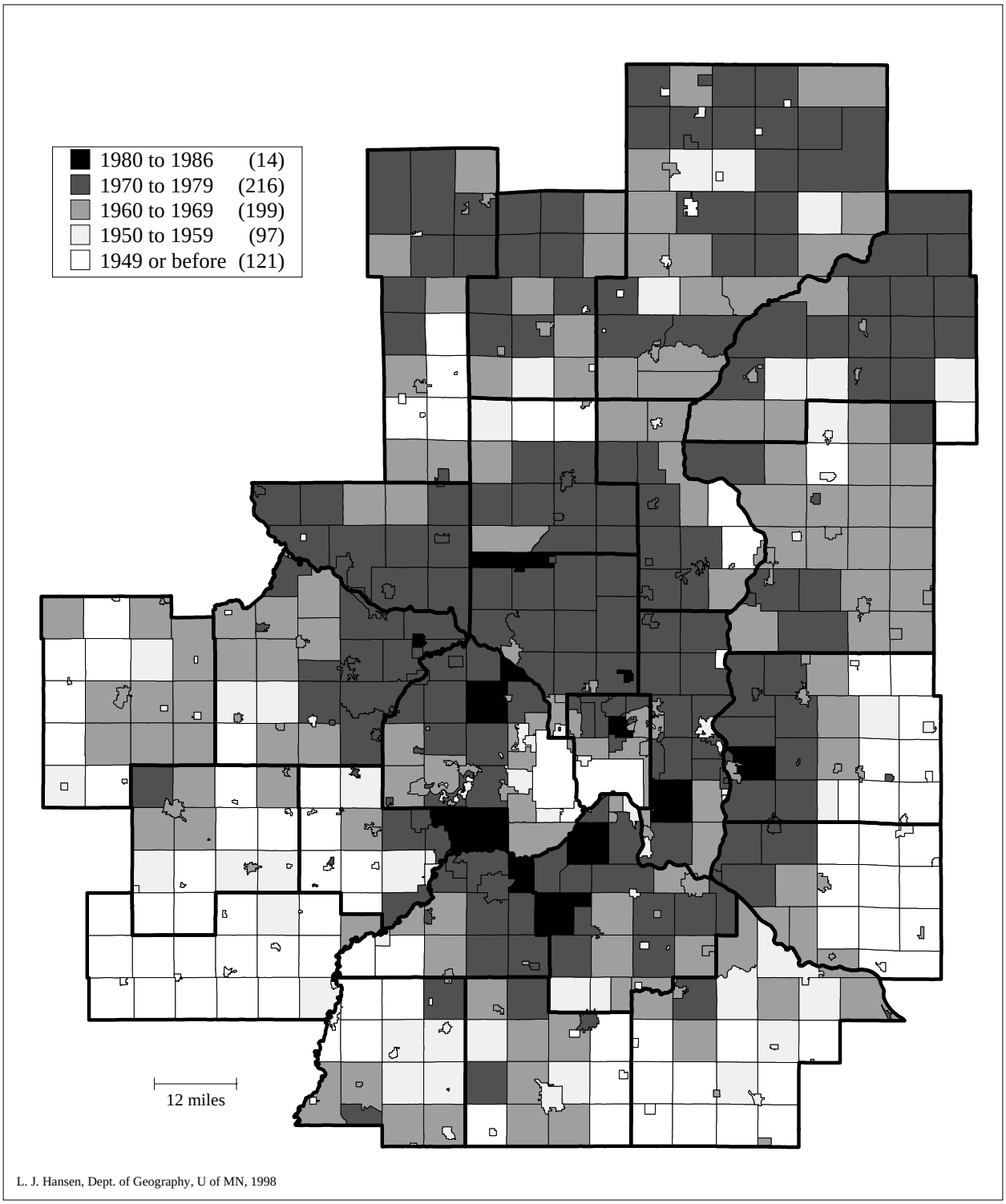


Figure 2.10. Median Year of Residential Construction by MCD, 24-County Area, 1990.

Data Source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

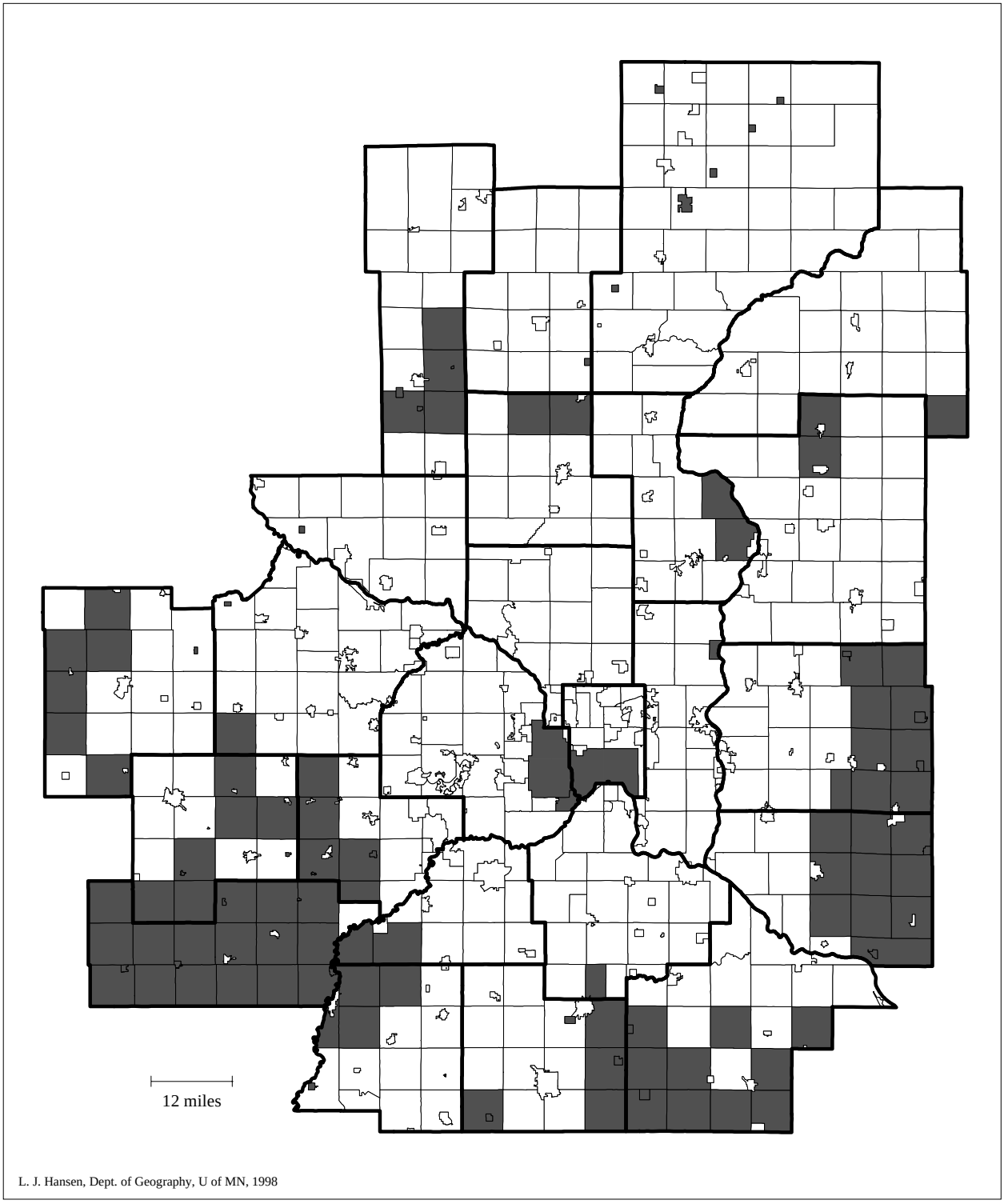


Figure 2.11. MCDs with Median Year of Housing Construction 1950 or Earlier, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

have received too few new units to tip their median year of construction to more recent decades. The census data used to construct the maps in this series reported that almost all places received some new construction each decade, but the peripheral places shaded on the map have remained for the most part beyond the reach of the intense development pressure of the 1980s and 1990s.

Over the history of the Minneapolis-St. Paul metropolitan area, urban land development generally has proceeded from the downtown cores outward. As population and economic activity expanded in the region, new residential, commercial and industrial land development occurred in places that were served efficiently by national and interregional transportation (water, rail, highway, air) and by a succession of local transportation modes and improvements (pedestrian, electric streetcar, automobiles on city streets and local thoroughfares, automobiles on post-war freeway networks) [20].

The history of Twin Cities metropolitan growth and land development is reflected in the map of residential densities inside the 7-county area (Figure 2.12). In early decades of Twin Cities growth, when transportation systems were less well developed than they are today, parcels of urban land that were well served by transportation and communication services were relatively few in number and carried high prices. Users of those expensive land parcels built at high densities.

With steady improvements in regional and local transportation services during the twentieth century, new tracts of buildable land were continually opened up for development on the suburban edges. Some industrial and commercial activities relocated from old, high-density locations to new suburban locations, while newly formed businesses and new housing construction occupied newly developed land at the edges of the formerly built-up area. Today, densities remain highest within the central cities and close-in suburbs and gradually diminish with increasing distance from the core. Cities along the main radial routes outward from the central cities display higher residential densities than areas more remote from those routes.

Population Density and Median Year of Residential Construction in the 24-County Area. The relationship between residential population density and median year of housing construction within local areas (city, township, town, village) can be illustrated by sorting local areas by average age of housing, and examining how residential density varies from place to place [21]. We classified all places in the 24-county area according to their median year of housing construction. Then we grouped the median years into six time periods (pre-1940, 1940s, 1950s,

Figure 2.12. Residential Population Density, 7-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by authors.

1960s, 1970s, 1980s) and mapped the corresponding places, shading places on each map according to their population densities in the 1990s. The aim was to discern two kinds of geographical patterning: first, the locational arrangements of places for each time period, and secondly, the variations in residential population density among places with essentially the same ages of housing.

Within the 24-county area, places with the oldest housing, as noted earlier, include the city of Minneapolis and a series of outlying places at or near the edges of the area (Figure 2.13). Minneapolis stands alone as the highest-density location. Fifteen other small towns and cities appear on the map as small, dark nodes. All other places with median year of construction of 1939 or earlier are in the low-density category of 8 to 53 persons per square mile, which are essentially farm-population densities, probably supplemented here and there by scattered-site non-farm housing on very large lots.

There were 80 places with median year of residential construction 1939 or earlier, but only half that many with median year 1940-49 (Figure 2.14). Few housing units were built in the area during the war years between 1940 and 1945. Beginning at the end of 1945 and through 1949, the post-war building boom was underway. St. Paul, which came out of the war with substantial tracts of vacant land on its southwest, north and east sides, received sufficient new units in the late 1940s and after 1949 and removed sufficient pre-war housing so that its median year of residential construction as of 1990 was between 1940 and 1949.

Most of the places with the lightest shade on the map, indicating 5 to 31 persons per square mile, lie adjacent to a small city, near a river or lake, or have a combination of these features, suggesting spillover growth from the town or housing built to take advantage of the water amenity.

Almost a hundred places have housing with median ages dating from the 1950s. Three types of places with high density stand out on the map (Figure 2.15). First is a series of suburbs of Minneapolis and St. Paul, north, west and south of Minneapolis, on the east shores of Lake Minnetonka, and along the St. Croix River. Second are numerous small towns and cities south and west of the Twin Cities that undoubtedly were participating in the post-war prosperity and Baby Boom in ways that stimulated residential construction in those places. The remainder are scattered townships (MN) and towns (WI), often surrounding the small cities that were adding housing during this period.

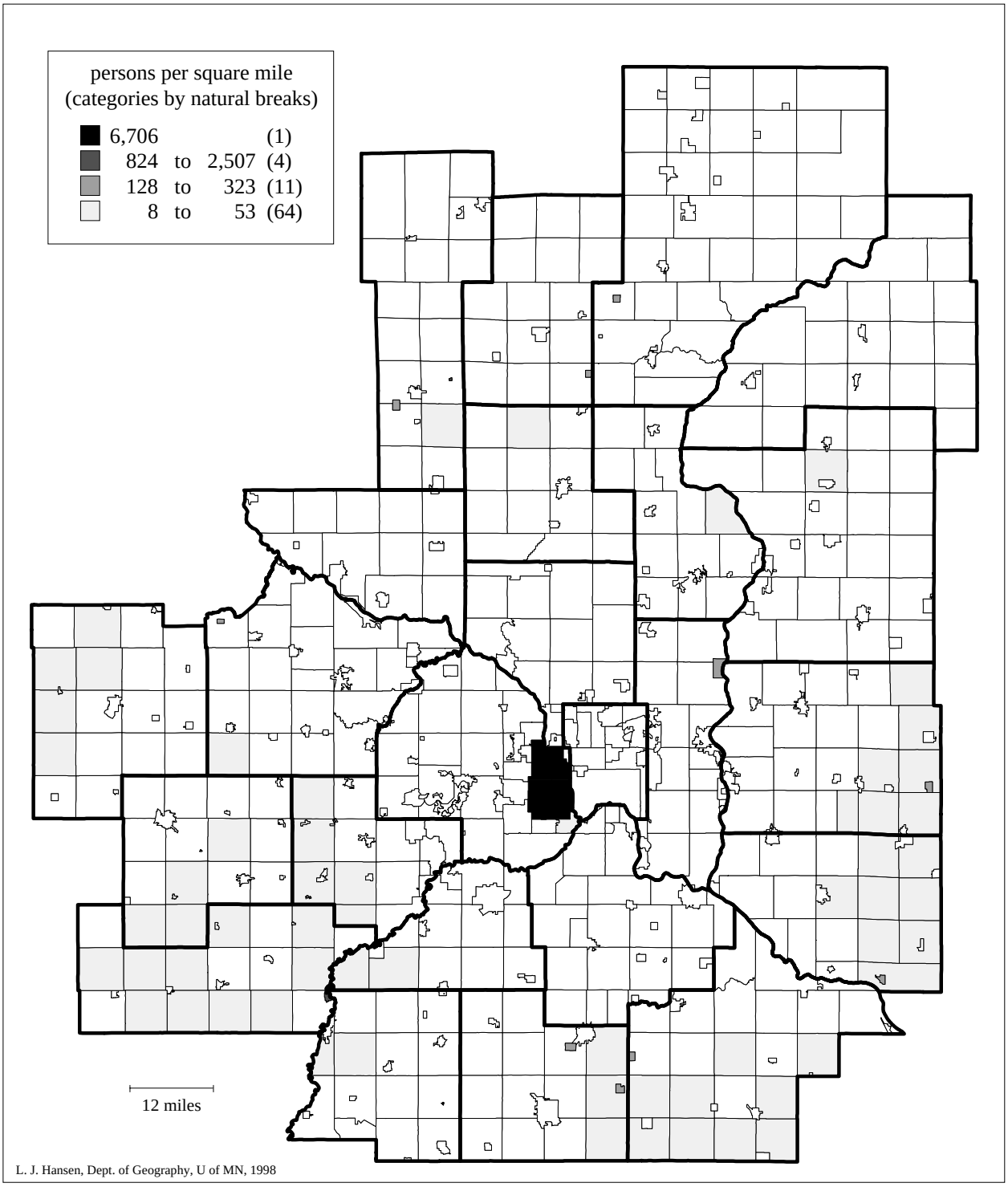


Figure 2.13. Population Density in MCDs with Median Year of Residential Construction 1939 or Earlier, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

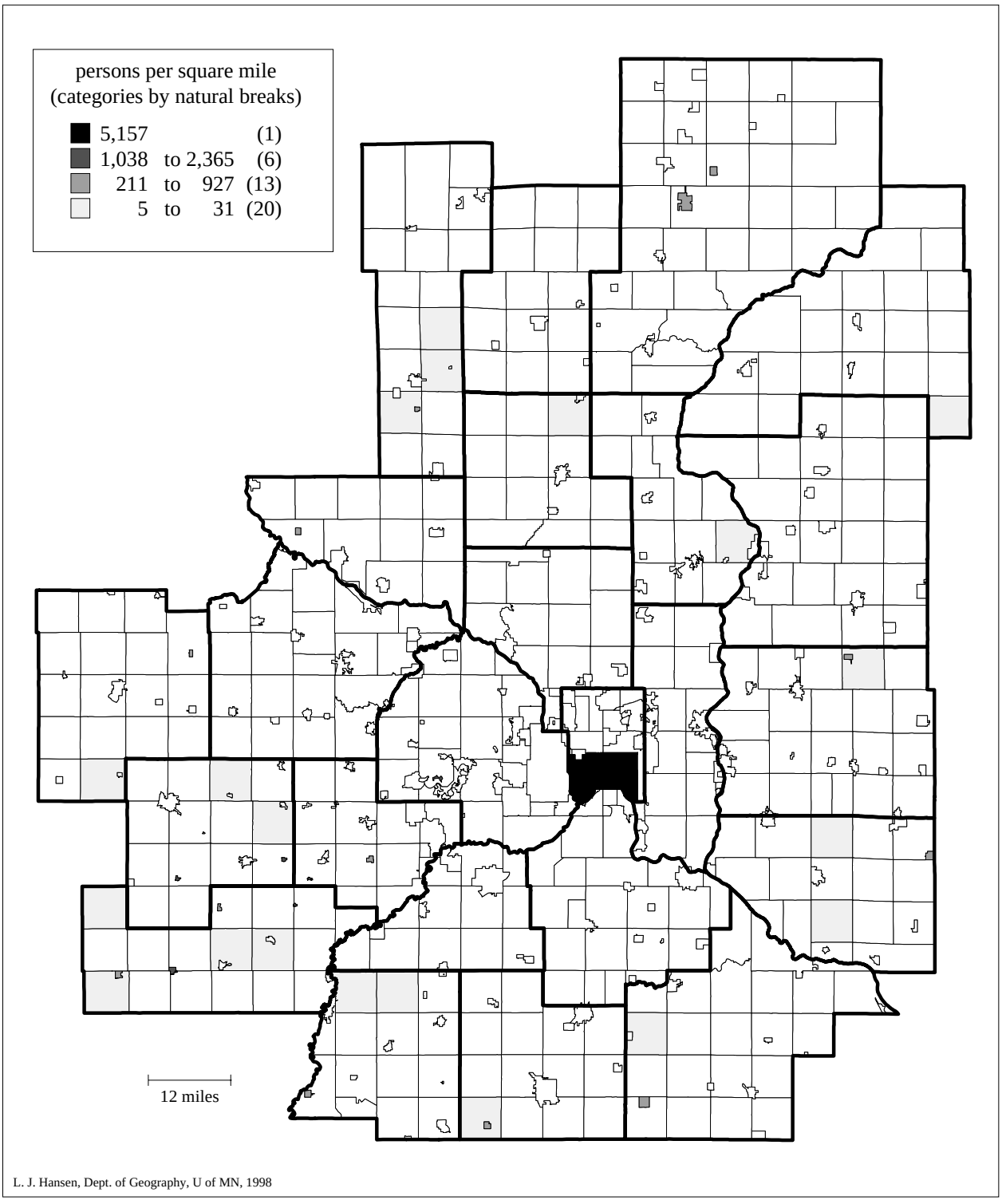


Figure 2.14. Population Density in MCDs with Median Year of Residential Construction 1940-49, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

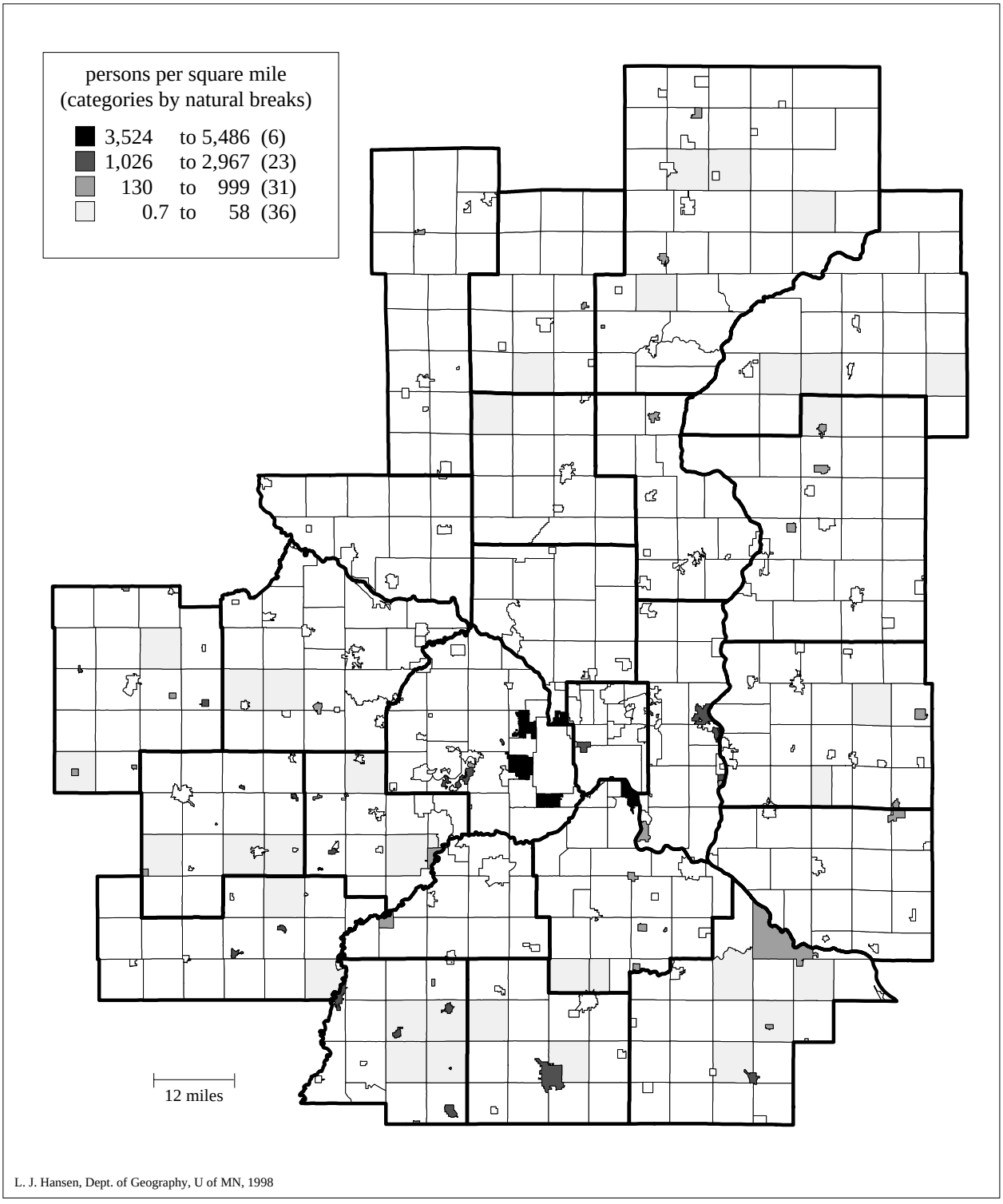


Figure 2.15. Population Density in MCDs with Median Year of Residential Construction 1950-59, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, 1990.

The patterns on the map of the 1950s became more pronounced on the map of places with a median year of residential construction in the 1960s, probably as a result of continued development and construction in the same places (Figure 2.16). There are almost 200 places in this category, or almost a third of all places in the 24-county area. The 22 high-density places include a ring of second- and third-tier suburbs of Minneapolis and St. Paul; and several of the larger cities such as Hudson, Hastings, Hutchinson, Litchfield, and Anoka. The 59 medium-density places are mostly smaller cities scattered across the area. The remaining 112 places–more than half the total–with housing dating from the 1960s have on average .9 to 92 persons per square mile, and form a broad ring around the 7-county metropolitan core.

The map of more than 200 places with median year of construction from the 1970s includes a zone both inside and just outside the 7-county area, plus a set of places in the northern tier of counties–Mille Lacs, Kanabec, Pine and Burnett (WI) (Figure 2.17). Intense second- and third-tier suburban development inside the 7-county area is supplemented by enough growth beyond the seven counties to bring the median age of their housing stock into the 1970s.

Residential densities generally decline from the 7-county core outward, but numerous small cities with 1970s medians, lying within this "penumbra" of exurban growth, display high densities of population (along with medians in the 1970s). This pattern suggests that development and building during the decade concentrated in and adjacent to small-city settings where urban utilities were available.

Only 13 places enumerated in the 1990 census reported median ages of housing in the 1980s, and all were within or adjacent to the 7-county area (Figure 2.18). Although places shaded on the map contain housing from each construction era, including the pre-1940 period, they had sufficient growth in the decade prior to the census that the median year of construction was in the 1980s. Places receiving the largest volumes of new construction in the 1980s were Woodbury, Lakeville, Maple Grove, Eden Prairie, and Eagan. Savage, Chanhassen and Champlin also experienced vigorous growth, but at lower volumes.

The cartographic analysis disclosed obvious differences among the six maps, reflecting the ways that the 24-county area, and the 7-county metropolitan region within it, have grown and developed over the last six decades. The analysis is clouded, however, by significant amounts of internal variation within each of the places examined. No place appears to have a housing stock constructed exclusively within a single year or a single decade. Rather, most places today have

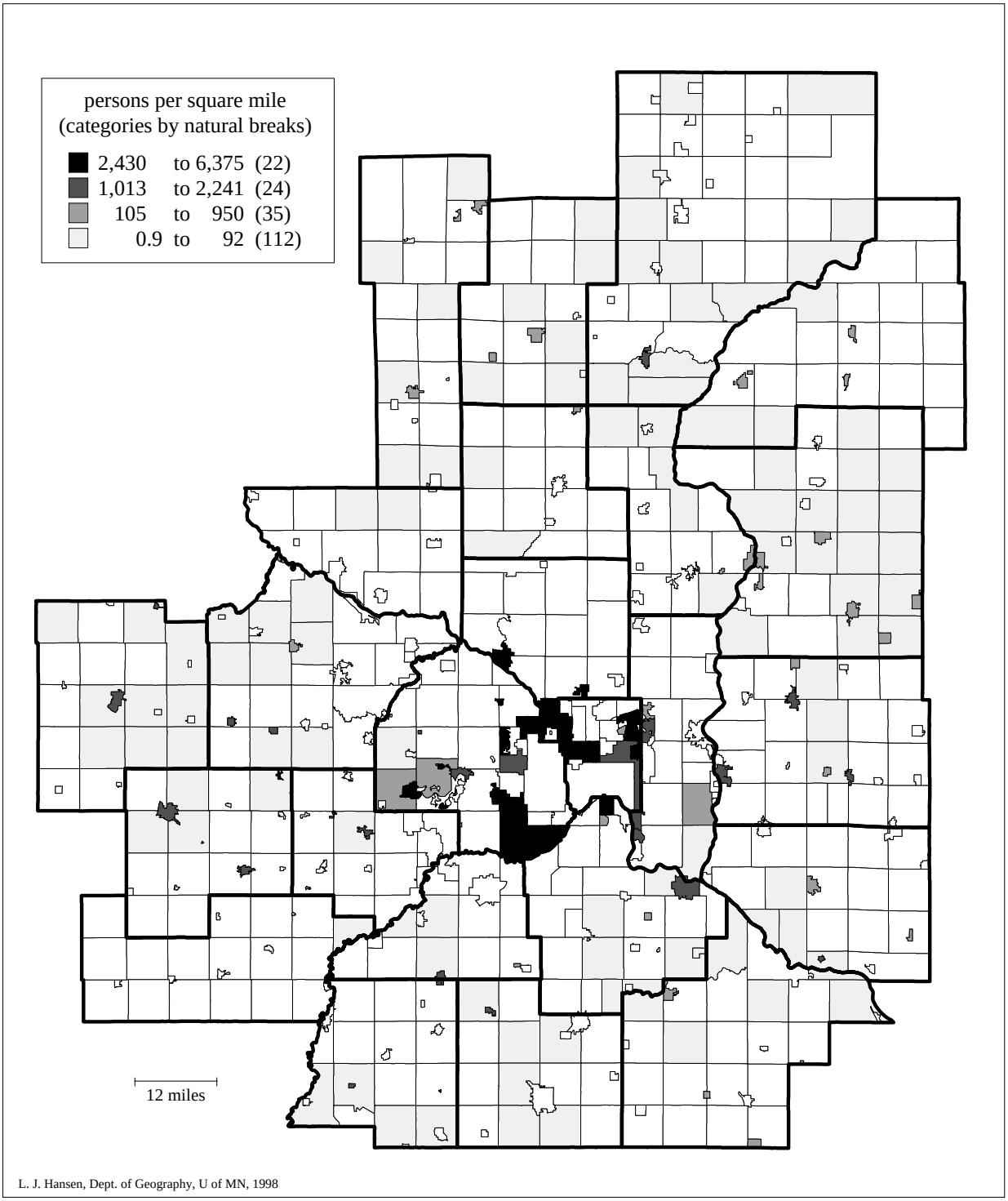


Figure 2.16. Population Density in MCDs with Median Year of Residential Construction 1960-69, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

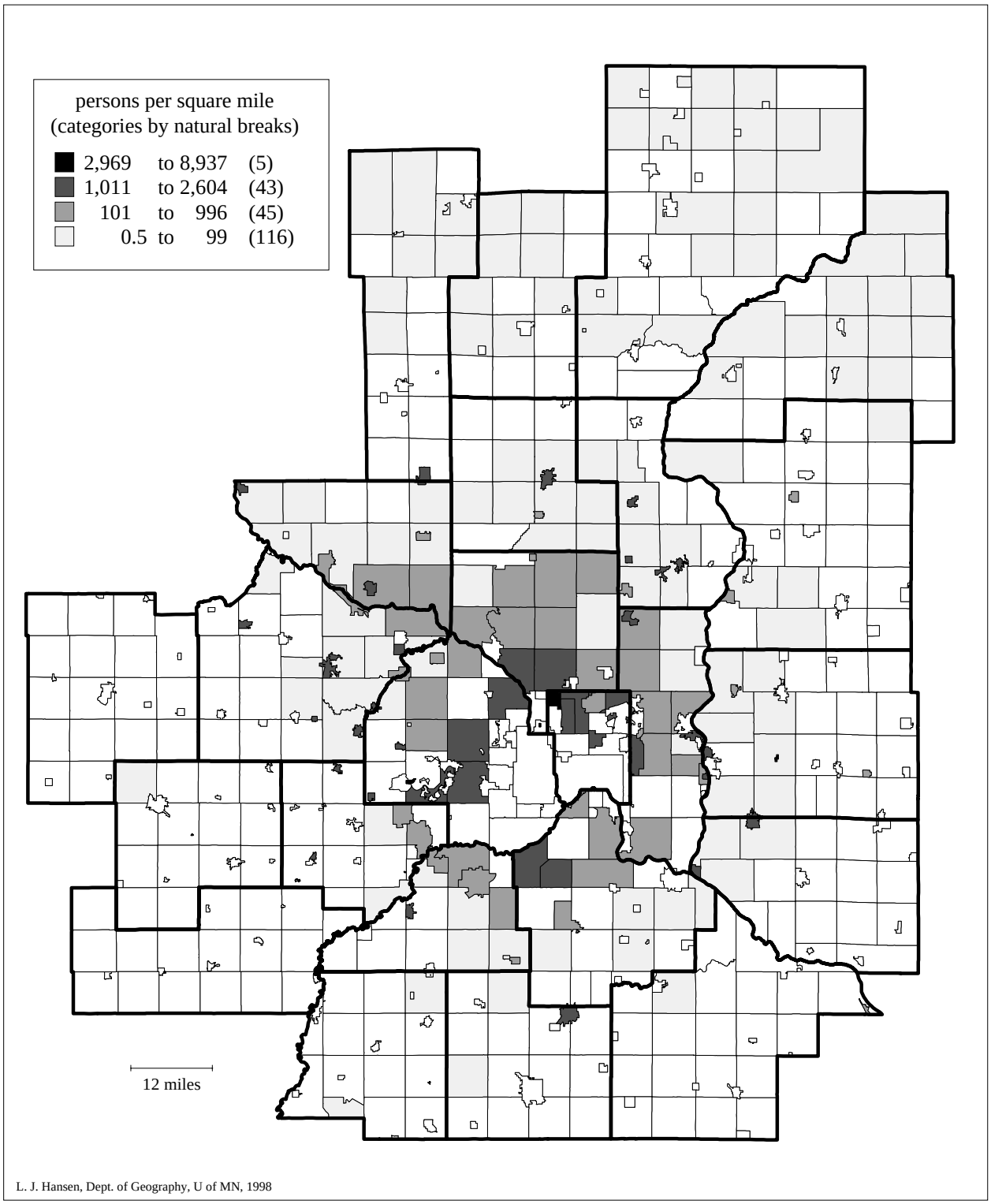


Figure 2.17. Population Density in MCDs with Median Year of Residential Construction 1970-79, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

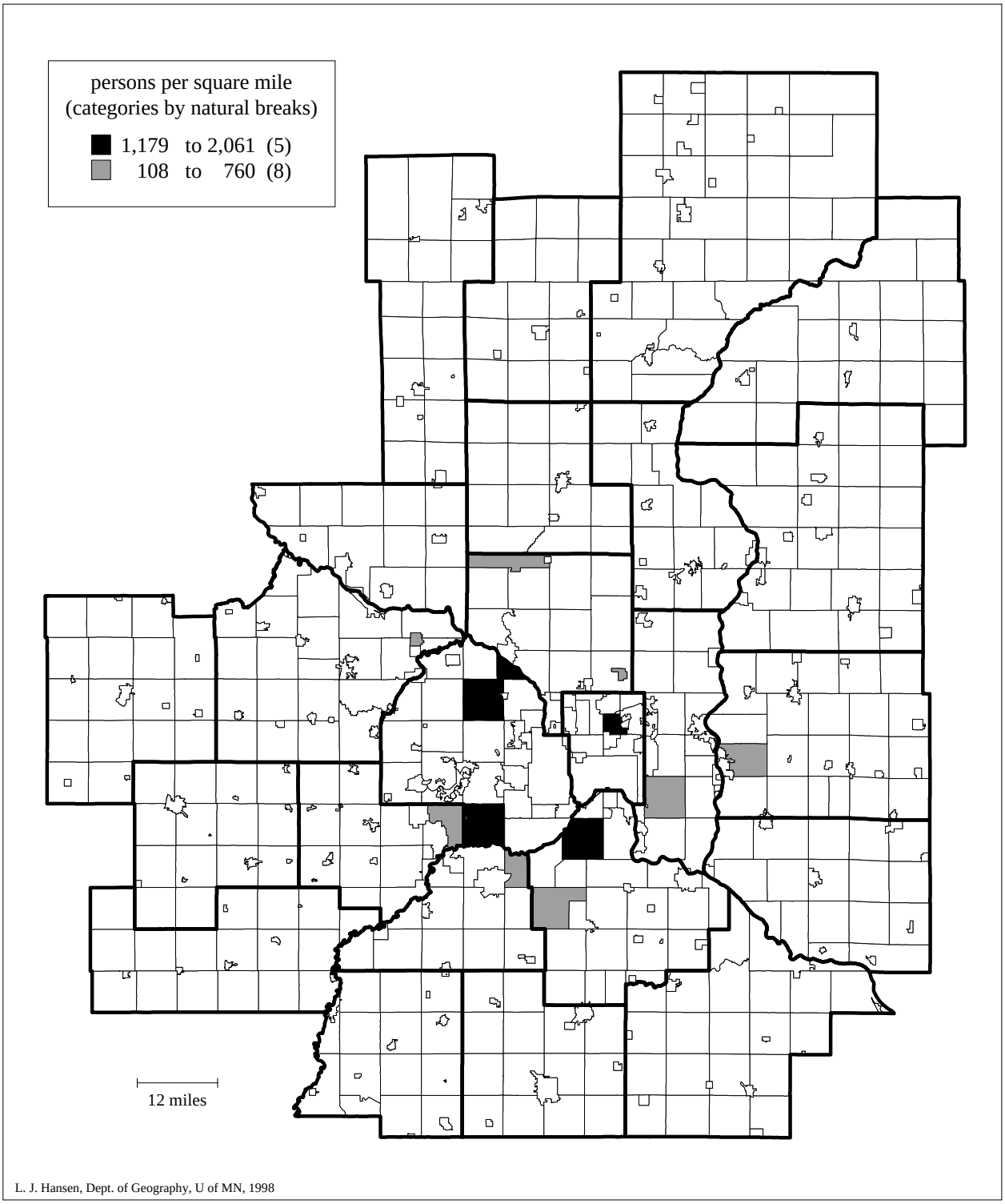


Figure 2.18. Population Density in MCDs with Median Year of Residential Construction 1980-86, 24-County Area, 1990.

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A.

housing built in each of the eight time periods for which the 1990 census provides data (1989-March 1990; 1985-88; 1980-84; 1970-79; 1960-69; 1950-59; 1940-49; 1939 or earlier). The next section looks more closely at this variation in population density among places with similar median years of construction, and highlights variations within places in the ages of their respective housing stocks.

Relation Between Median Year of Housing Construction and Residential Population Density. As residential construction has proceeded during the past century, new development generally has occurred at steadily lower densities (Figure 2.19). When local governmental units in the 7-county area are arrayed according to their respective residential population densities and median years of housing construction, a general trend of lower densities among the more recently built-up places emerges.

The places that depart from the trend include small places with unusual features:

- Landfall and Hilltop: newer housing, high-density mobile home courts;
- Belle Plaine Twp, Blakeley Twp and others: older housing, low-density farming communities;
- the array of extremely low-density places of varying median years of construction, hugging the horizontal axis, which includes formerly dispersed agricultural settlements that have received enough recent construction to move the median year to a later date;
- Minneapolis and St. Paul, with older housing and high residential densities, anchor the high-density end of the array; and
- Places with medians after 1975 bounding the low-density end of the array.

When the analysis is extended to all 631 places inside the 24-county area, the trend that was discernible within the 7-county area is diluted and obscured (Figure 2.20). Densities well below 1,000 per square mile exist in places with median years of housing construction in all years from pre-1940 vintage onward. The large majority of places, regardless of median year of housing construction, contain densities below 3,000 per square mile, densities that have been characteristic of virtually all places with median years of housing from the mid-1970s and later. For comparison, Bloomington (median year 1967) had 2,430 persons per square mile in 1990; Roseville (1964) 2,528; Edina (1965) 2,927; New Brighton (1968) 3,350; St. Louis Park (1957) 4,087; North St. Paul (1961) 4,287; Richfield (1956) 5,190; and Minneapolis (pre-1940) 6,710.

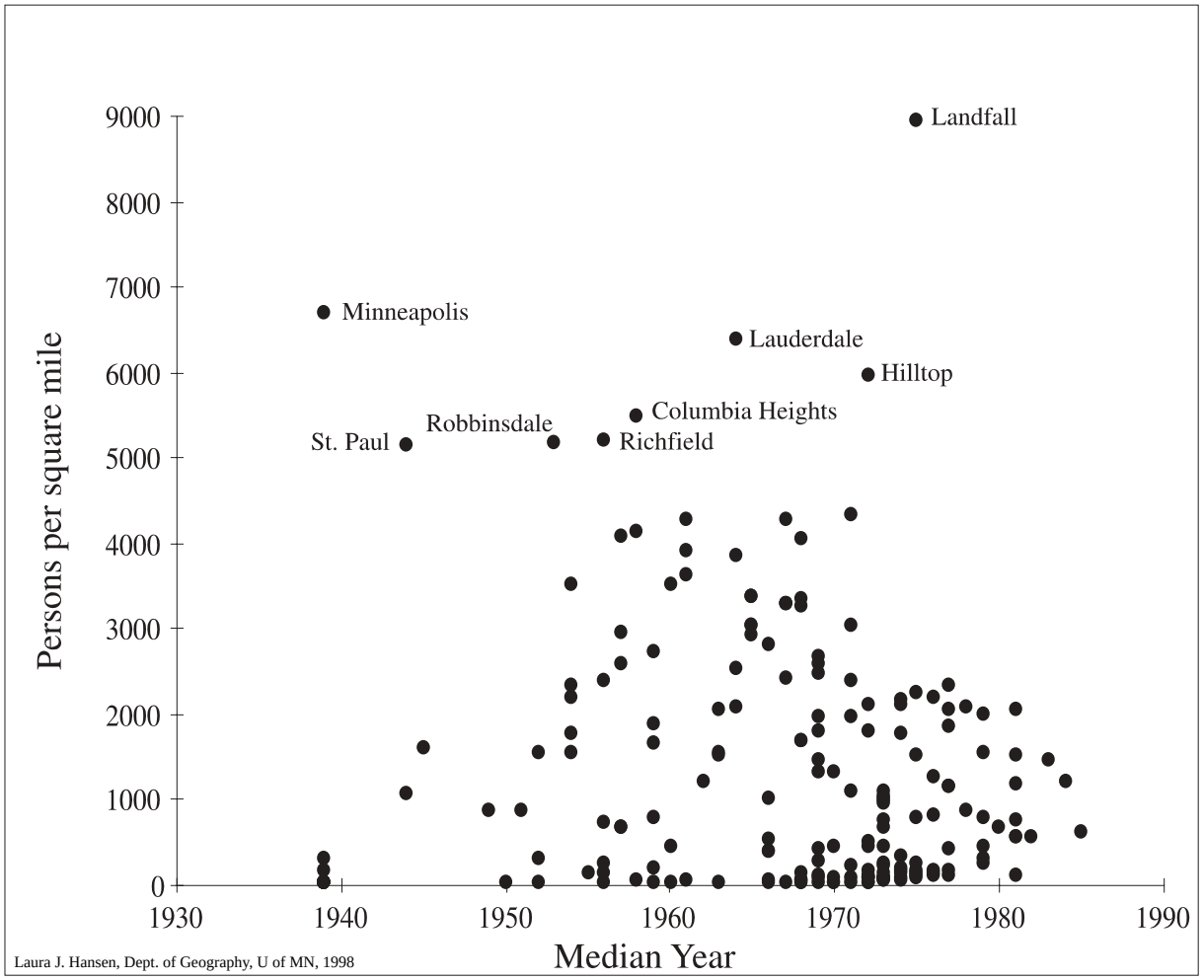


Figure 2.19. MCDs by Persons per Square Mile and Median Year of Housing Construction, 7-County Area, 1990.
Linear regression results indicate an r-squared value of 0.012, with a slope of -15.98. Regression results for a scatterplot excluding the major outliers reveal an r-squared value of 0.115, with a slope of -56.34.
Data Source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

In all cases, these are gross densities that ignore water surfaces. If areas covered by water are deducted from total area, some places will have appreciably higher net residential densities.

Variability in Age of Housing Stock within the 24-County Twin Cities Area. The 1990 Census of Housing reported the number of existing housing units that were built during each of six different time periods for the 631 units of local government in the 24-county Twin Cities area. Some places have housing predominantly from one time period. For example, of Eagan's 18,450 housing units, 62 percent dated from the 1980s. Of Roseville's 14,216 housing units, 57 percent were built from the 1950s and 1960s. Of Minneapolis's 172,666 housing units, 53 percent dated from before 1940. On the other hand, some places have housing stocks that are relatively heterogeneous with respect to age. For example, of Prior Lake's 4,177 housing units, 43 percent dated from the 1980s, but 16 percent were built in the 1950s or earlier.

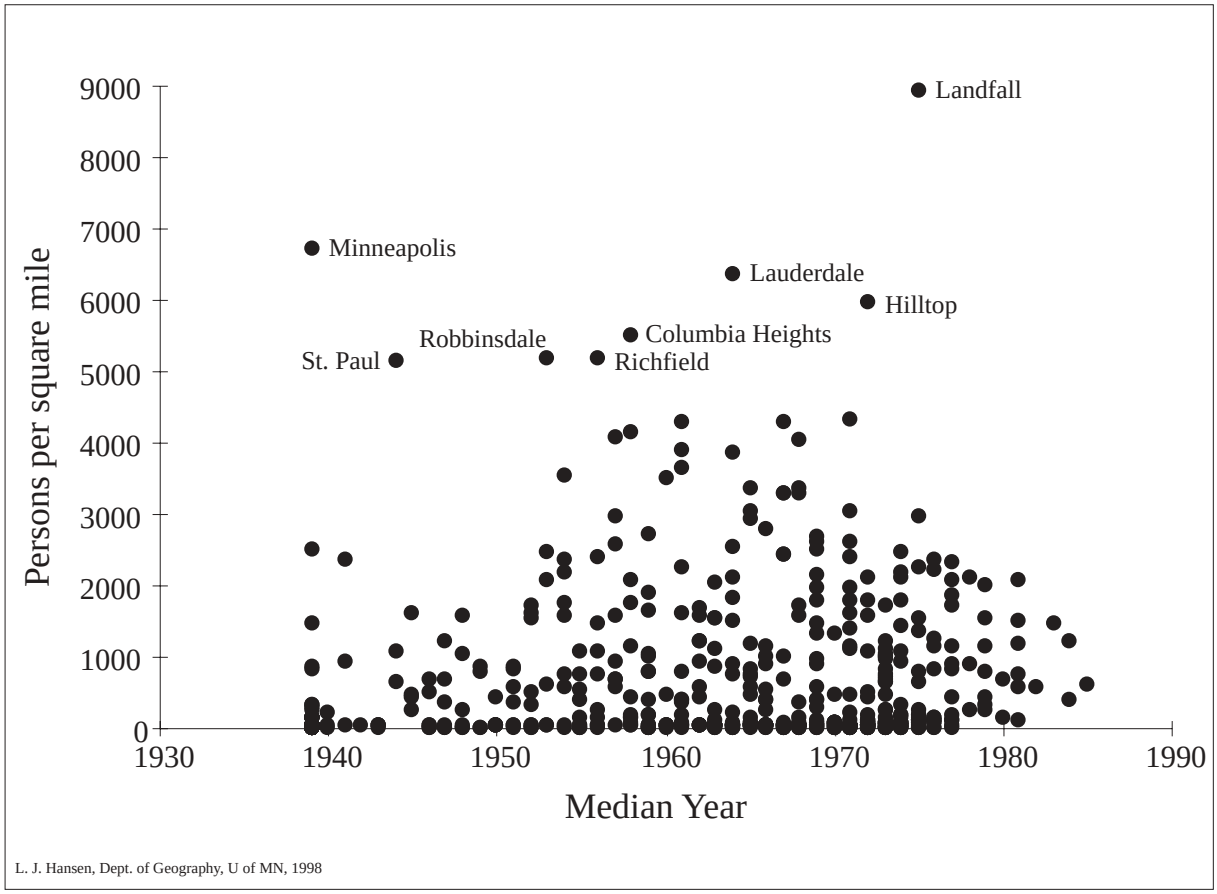


Figure 2.20. MCDs by Persons per Square Mile and Median Year of Housing Construction, 24-County Area, 1990.

Linear regression results indicate an r-squared value of 0.0099, with a slope of 8.94.
Data Source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

One way to assess variability from place to place in the ages of their respective housing stocks is to relate their variance to the median year of housing construction for the 631 local units of government in the 24-county area (Figure 2.21). Each point on the scatter plot represents one city, town, or township. A best-fitting (i.e., ordinary least-squares regression) line was calculated and plotted. A zone above and below the regression line was plotted one standard deviation from the regression line. The open-ended "1939 or earlier" category distorts the scatter plot and probably displaces the best-fitting line to some unknown extent, but there is an unmistakable trend of observations downward and to the right. On average, the more recent the median year of housing construction, the lower the variance, which was calculated from housing counts for the six construction periods for each place.

On Figure 2.21, vertical lines at each census year, plus the three trend lines, divide each column of places into four categories: very high variance, above-average variance, below average variance, and very low variance. A total of 24 cells are identified (six time periods, four levels of

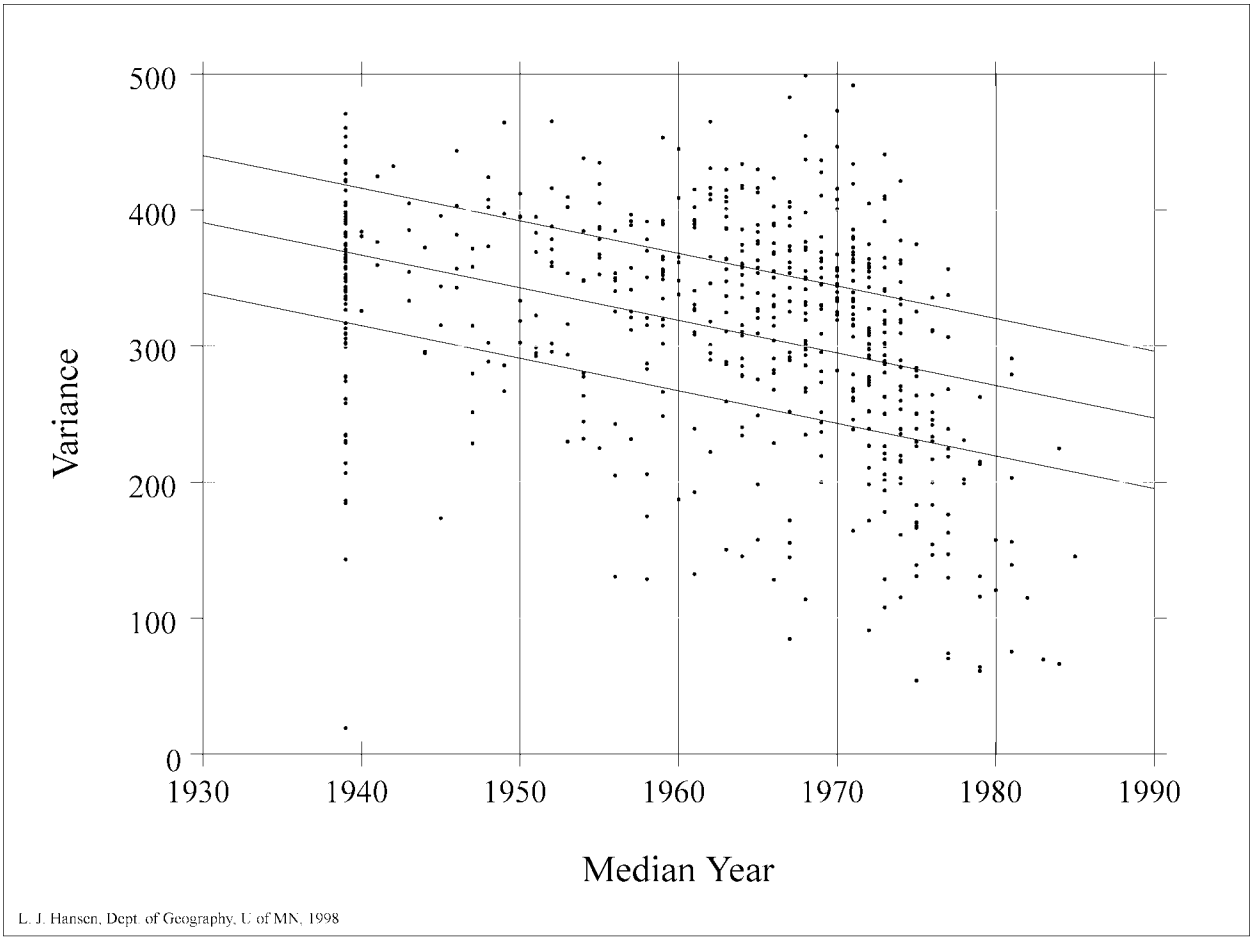


Figure 2.21. MCDs by Variance in MCD Housing Ages and Median Year of Housing Construction, 24-County Area, 1990.

Data Source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

variance). One of the cells (i.e., 1980s; very high variance) has no entries. Each of the remaining 23 cells contains at least one city or township. In the column representing the period 1930 to 1939, for example, there are places at the top of the column that had housing stocks with a median year of construction of "1939 or earlier" and very high variance, which means that although the median year of construction was 1939 or earlier, there was enough housing added to these places in subsequent decades to raise the variance to high levels, indicating a heterogeneous housing stock. At the bottom of the "1939 or earlier" column is an array of places with very low variance, which are places with almost all "1939 or earlier" housing, and not much added in later decades, indicating significant homogeneity in housing ages.

There were 79 local units of government (plus Fort Snelling) in the 24-county area that reported median age of housing as 1939 or earlier at the time of the 1990 census (Figure 2.22). The 26 places with housing stock of a similar age included Minneapolis along with a number of small

cities throughout the area, plus a number of essentially agricultural townships (MN) and towns (WI) that had not received enough new housing construction in later decades to change the median year of construction, or to reduce the variance. At the other extreme were nine places where old housing still predominated, but with enough units added during recent decades to yield measures of high variability in housing age. The other 44 places feature medium or medium-low variance.

There were 40 places with median year of housing construction in the 1940s (Figure 2.23). Low variance existed in St. Paul and a few other small cities throughout the area, plus Grafton Township in Sibley County with its 112 housing units, 58 of which date from before 1950. The 10 high-variance places tend to be agricultural towns (WI) and townships (MN) with one or two hundred housing units, half of them dating from before 1940, and much of the remainder from construction after 1960. The other 21 usually have fewer than 500 housing units, share a median year of construction in the 1940s, and contain a plurality of their units dating from the pre-1940 era, but have received steady increments from each of the decades after 1939.

The 96 local units of government with median year of construction in the 1950s include 16 with very low variance, and within this group are several well-known first-ring suburbs of Minneapolis and St. Paul (Figure 2.24). Each of these places, plus the others in the class, had housing from almost all construction eras, but each had its largest single increment from the 1950s, for example, Robbinsdale (27 percent), South St. Paul (26 percent), Richfield (44 percent), Falcon Heights (24 percent), St. Louis Park (29 percent), Crystal (49 percent), and Columbia Heights (31 percent). Meanwhile, none of the 26 places with high variance and median year of construction in the 1950s were located inside the 7-county area, except for Stillwater city, which contained a bi-modal distribution of housing ages, with 40 percent of its 5,105 units dating from the pre-1940 period and 38 percent after 1969. With the exception of Red Wing, whose housing age experience parallels that of Stillwater, the other 24 tend to be small cities and agricultural townships outside the 7-county area with only a few hundred units, but all of them with units dating from recent decades.

There were 193 local units of government with median year of construction in the 1960s (Figure 2.25). The 63 places with relatively low variance in the age distribution of their housing stock included two types of places. One type was first- and second-ring suburbs of the Twin Cities that experienced their biggest development spurt in that decade, such as New Brighton, Bloomington, New Hope, Fridley, St. Anthony, West St. Paul, and Golden Valley. A second type included

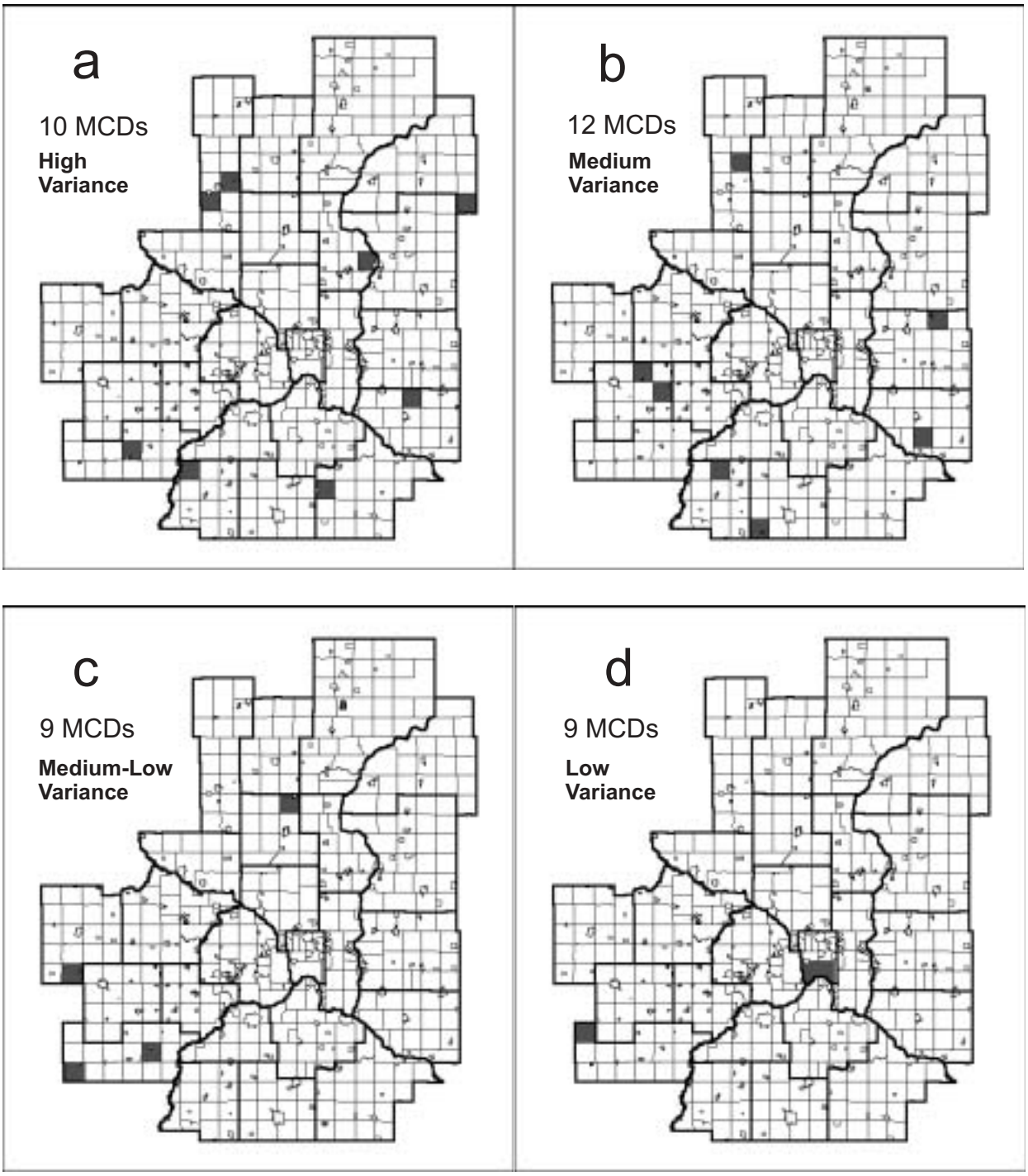


Figure 2.23. MCDs with Median Year of Housing Construction 1940-49, 24-County Area, 1990

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

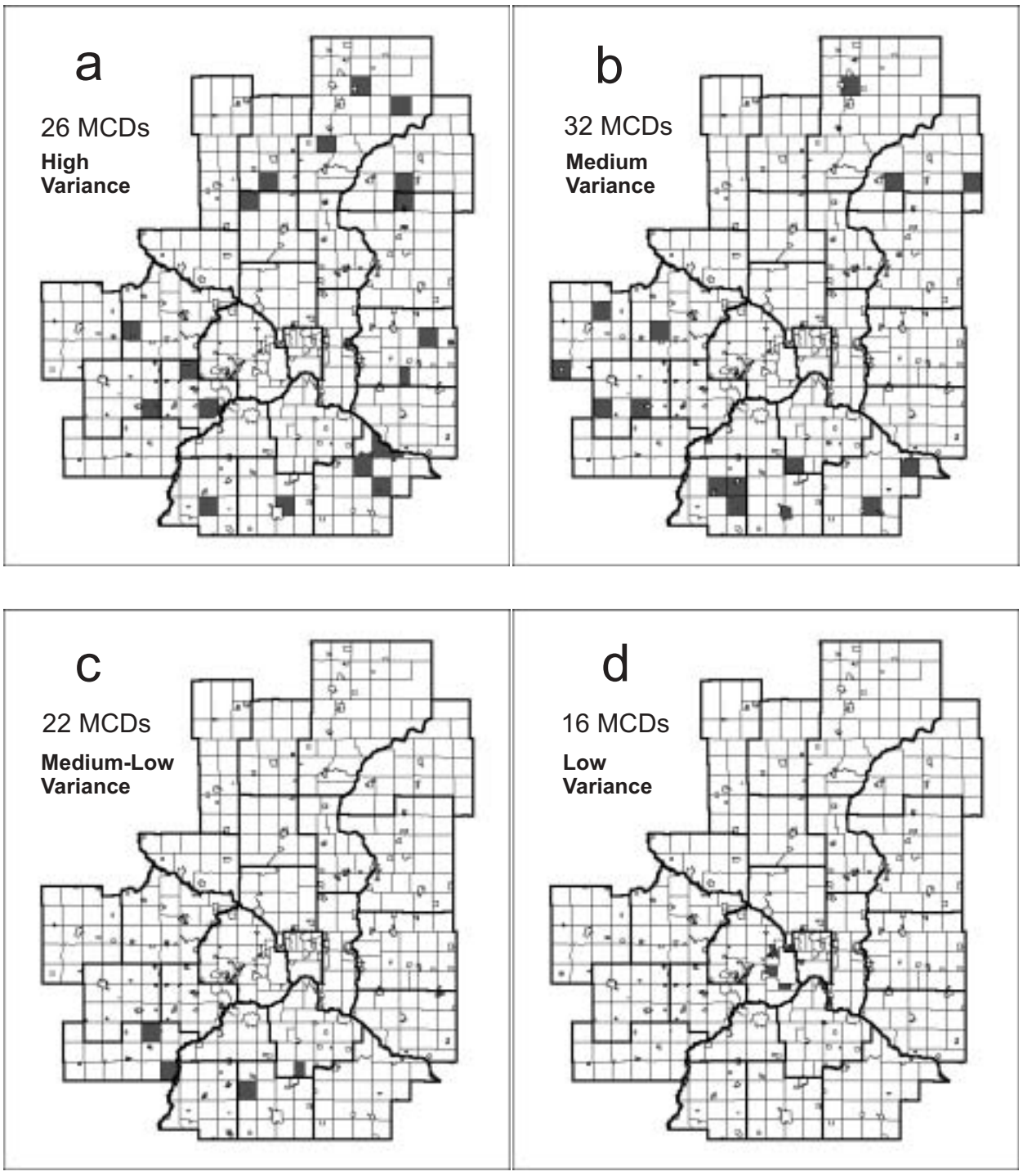


Figure 2.24. MCDs with Median Year of Housing Construction 1950-59, 24-County Area, 1990

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

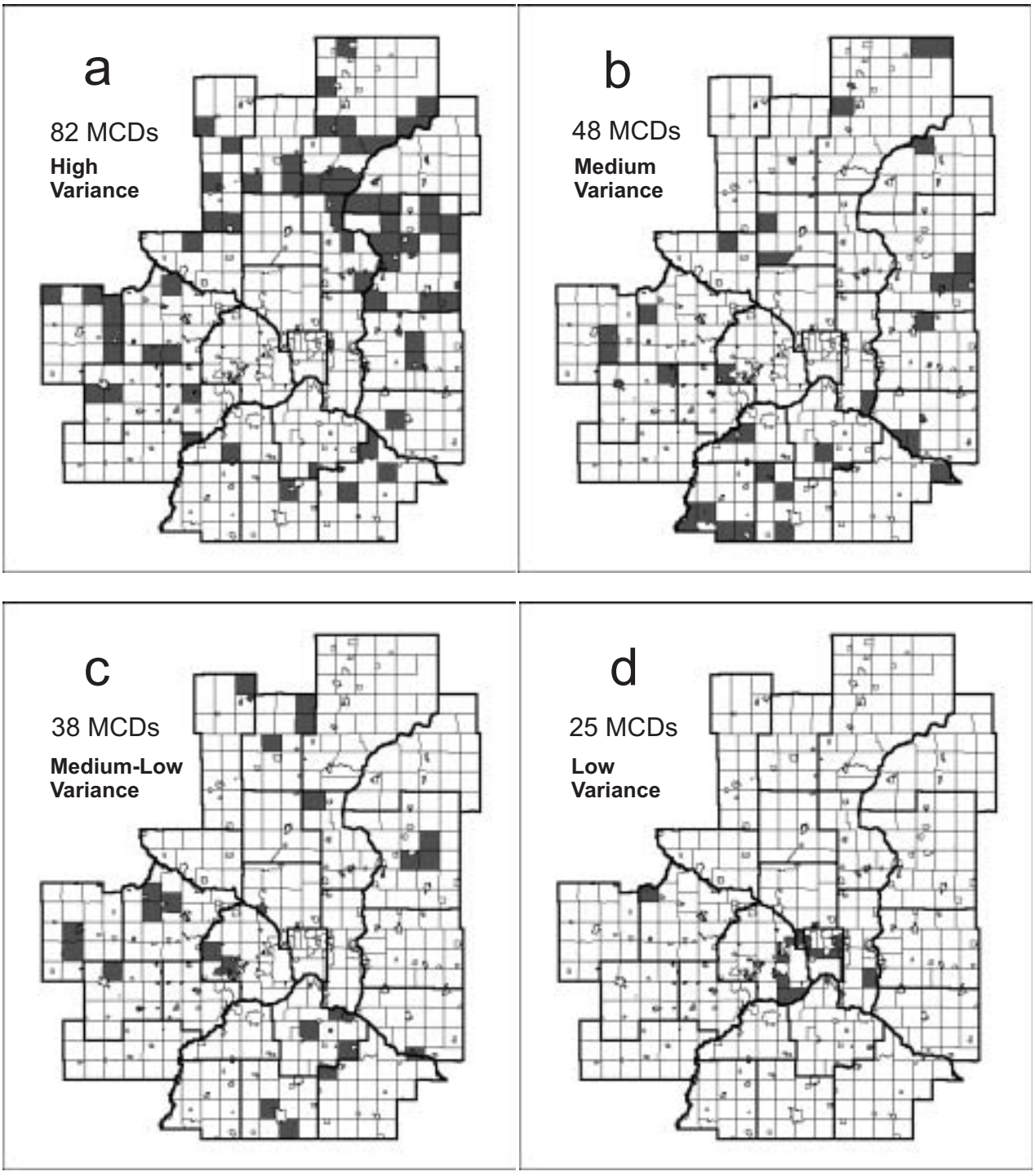


Figure 2.25. MCDs with Median Year of Housing Construction 1960-69, 24-County Area, 1990

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

suburbs with their biggest growth spurt in another decade, but that grew over time in ways such that their respective medians fell within the 1960s: Maplewood (biggest spurt in the 1980s), Hopkins (in the 1970s), Bloomington (1950s), Edina (1950s), Roseville (1950s), Wayzata (1970s), and Brooklyn Center (1950s). Almost all of the 25 places in the low-variance 1960s group were suburbs of the Twin Cities.

The 82 places with median year of construction in the 1960s and reporting a *high* variance in the age structure of their housing stock were, with five exceptions, outlying townships (MN) and towns (WI) with fewer than a thousand housing units. The big places, and most of the small ones, had housing stock distributed bi-modally with respect to age, with a large number of units dating from 1939 and earlier, and a large number from the 1970s and 1980s, but few between. The older housing no doubt represents farm housing and units in small urban places, while the new housing represents replacement of old units, plus exurban development from recent decades.

Places with median year of housing construction in the 1970s numbered 209–almost a third of the total number in the 24-county area (Figure 2.26). The 57 places with *low* variance in their age composition were almost all Twin Cities suburbs—especially on the north side—and included two types once again. First were third- and fourth-ring Twin Cities suburbs that had their most important spurt of residential development in the 1970s: Mounds View, Cottage Grove, Arden Hills, Brooklyn Park, Minnetonka, Little Canada, Ham Lake, East Bethel, and Shoreview. Second were places with a range of housing ages and their major growth spurt in the 1980s, but with a range of ages represented and a median year of construction in the 1970s: Inver Grove Heights, Burnsville, Blaine, Coon Rapids, Prior Lake, Apple Valley, Plymouth, and Rosemount.

The 55 places with *high* variance and median year of construction in the 1970s were—with five exceptions—places with fewer than 1,000 housing units, many of them on the margins of the 7-county area and just beginning to be subjected to suburban and exurban development in a major way. Most of the smaller places had bi-modal housing age distributions, with a substantial number of units dating from the period before 1940, plus major construction in the 1970s and 1980s.

Only 13 places had enough recent development to pull their median year of housing construction into the 1980s, and all of them were Twin Cities suburbs (Figure 2.27). The 10 with *low* variance all had their dominant growth era in the 1980s: Lakeville, Hudson (WI), Maple Grove,

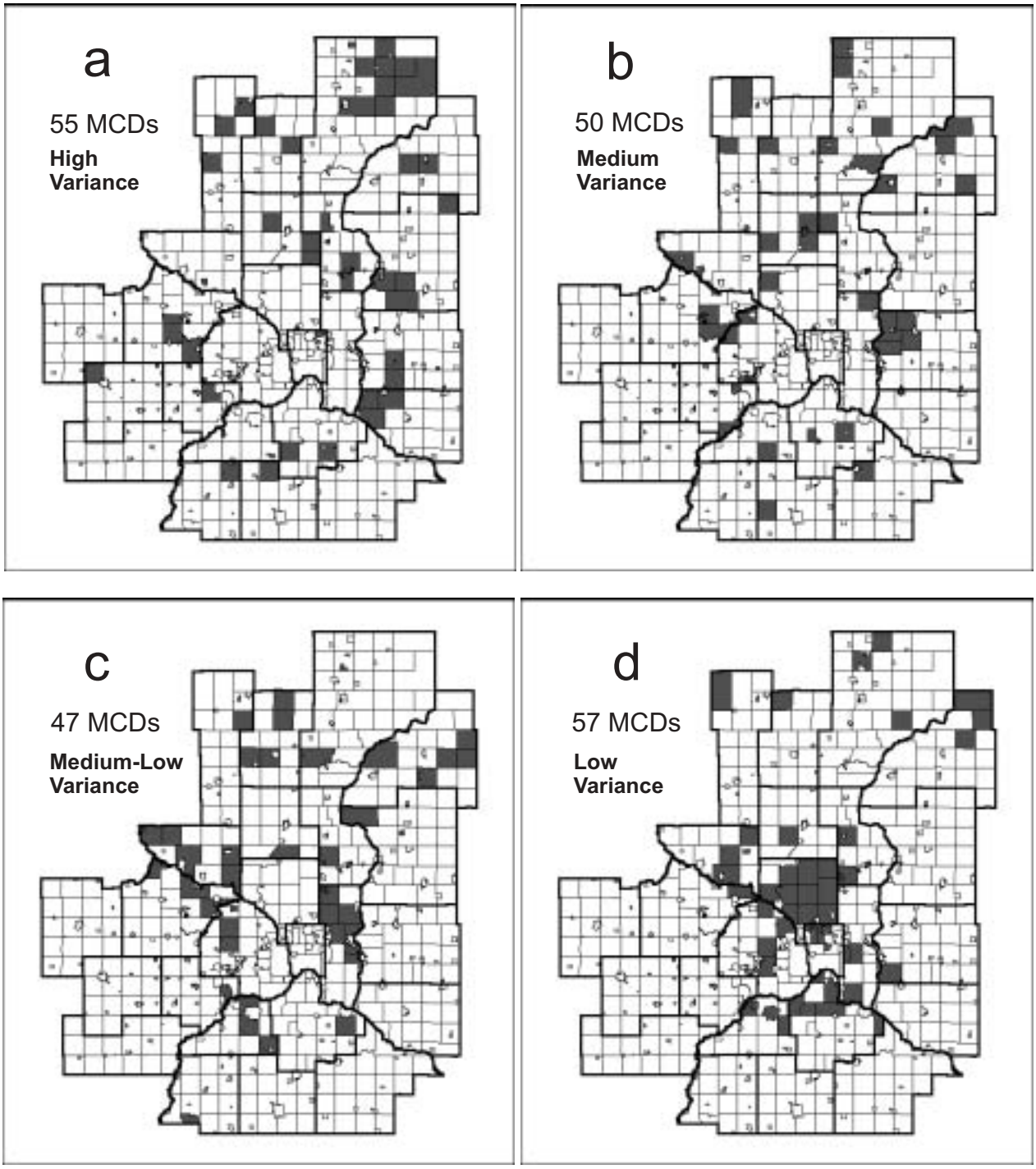


Figure 2.26. MCDs with Median Year of Housing Construction 1970-79, 24-County Area, 1990

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

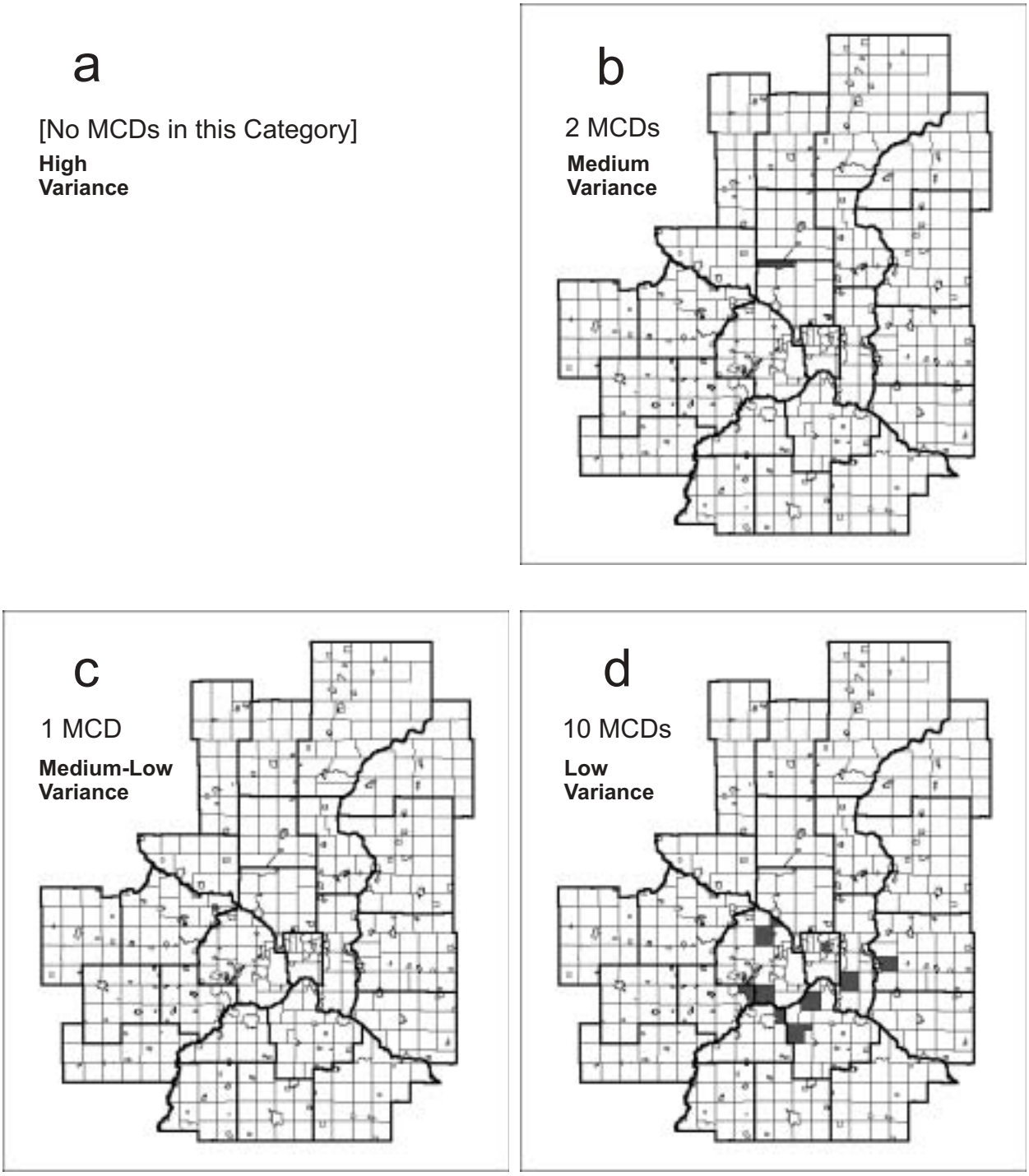


Figure 2.27. MCDs with Median Year of Housing Construction 1980-89, 24-County Area, 1990

Data source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

Champlin, Vadnais Heights, Chanhassen, Woodbury, Eagan, Eden Prairie, and Savage. None of the places with medians in the 1980s featured high variance in housing age structure.

Industrial Construction in the Twin Cities Area, 1970s to the 1990s

Having looked at the residential landscape of our 24-county study area and analyzed the timing of its creation at different locations throughout the region, we now turn to other elements of the built environment—industry, commercial structures, and office development since 1970. We conclude with a preliminary assessment of how patterns of development have been associated with major highway development since 1970.

Industrial construction in the 24-county Twin City area during the 1970s was estimated using building permit data that was reported to the U.S. Department of Commerce for 1972 and 1979 (Figure 2.28). (Appendix 2-B discusses this data in greater detail.) This type of construction includes plants producing, processing, or assembling goods and materials, together with affiliated buildings such as warehouses, garages, administration buildings, and so forth. The Commerce Department series of building permit data relies on voluntary reports from permit-issuing places, and our use of these data to estimate actual construction activity assumes that structures for which permits were issued were actually built, and that all or almost all of the important industrial construction that occurred in the 24-county area took place within jurisdictions that issued permits and reported them to the Commerce Department. We have no evidence that either of these assumptions is unwarranted. Our main interest in these data is to portray the volume and the geographical locations of industrial construction during the 1970s, to compare these early patterns with those of later decades, and to compare geographical patterns of industrial construction activity with patterns of commercial and office construction.

In 1972, total value of permitted industrial construction in the 24-county area was $56.5 million on 293 different permits (all permit values are in current dollars). The largest number of permits issued in a single city or township was 36, and the maximum value of all permits for industrial construction in a single place was $4.9 million. The great majority of industrial permit activity was concentrated in the central cities of Minneapolis and St. Paul, and in suburbs near the central cities but still within the core counties of Hennepin and Ramsey. There were a few notable outliers in Anoka, Washington, Dakota, and Scott counties. Beyond the seven counties, reported industrial construction activity was almost negligible.

In the 1979 series there was $171 million (current dollars) of industrial construction authorized

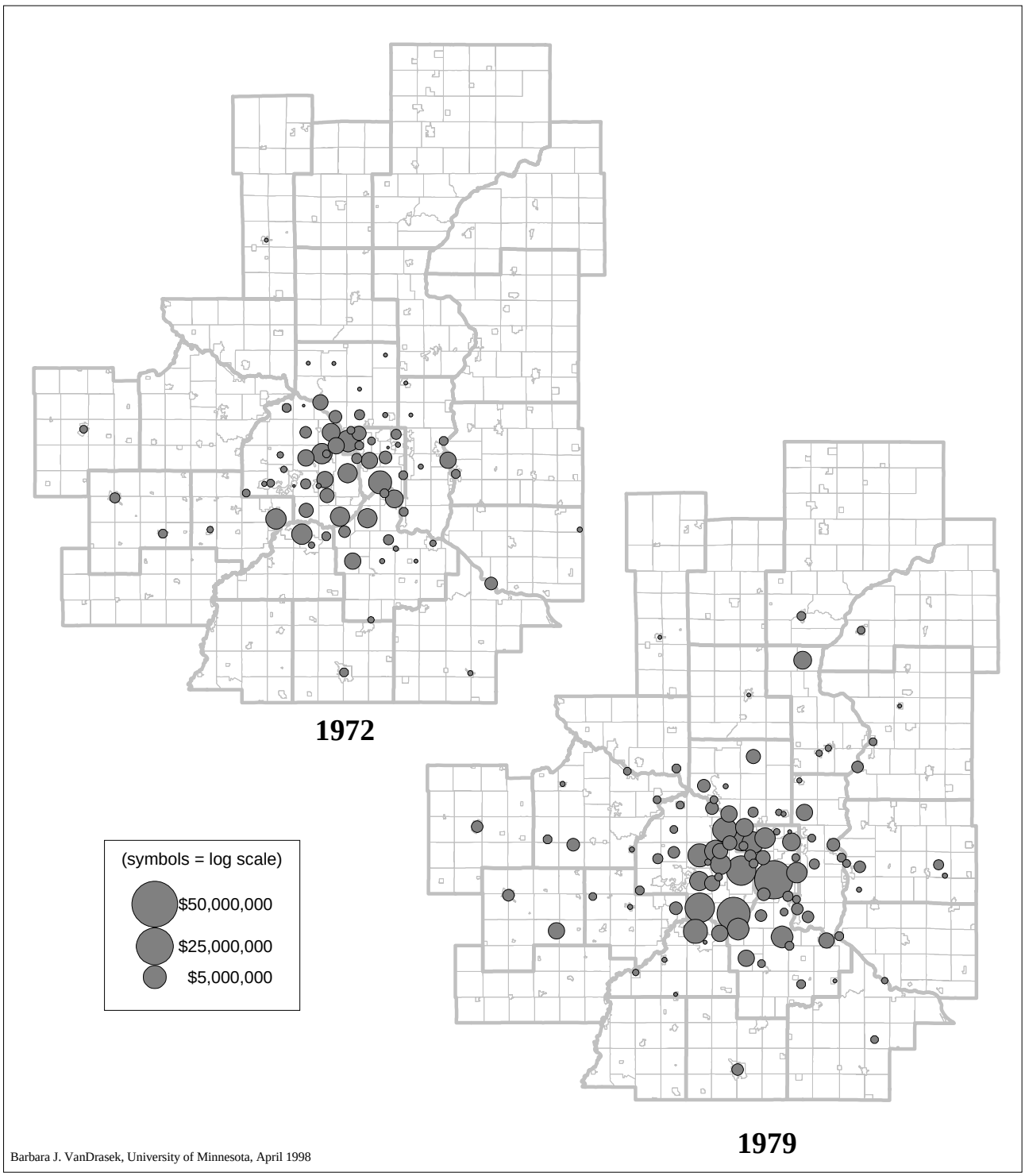


Figure 2.28. Value of Industrial Building Permits Reported, 24-County Area, 1972 and 1979.

1972: Total permits: 293; Total value: $56,506,654; largest number in one MCD: 36 (Minneapolis); largest value in one MCD: $4,876,800 (St. Paul). 1979: Total permits: 398; Total value: $171,034,548; largest number in one MCD: 31 (Minneapolis); largest value in one MCD: $28,809,595 (St. Paul).

Data source: U.S. Department of Commerce, Bureau of the Census, 1972 and 1979 Non-Residential Building Permits, tape file.

by 398 permits reported to the Bureau of the Census from the 24-county area. The places prominent in 1972 again appear, but they are supplemented by widely scattered locations beyond the 7-county area that received significant new industrial investment, places like Litchfield, Hutchinson, Glencoe, and Owatonna. The largest number of permits issued in a single place in 1979 was 31, and the maximum value was $28.8 million. The 1979 distribution of permitted industrial construction may reflect the ways that construction of the interstate highways in the 1960s and 1970s and upgrading of other major radial routes to and from the core made it easier for outlying cities to expand their industrial activity while remaining conveniently linked with the metropolitan core counties.

The first five years of the 1980s saw $467 million of activity reported on 1,106 industrial construction permits (Figure 2.29). Included in the industrial permit data for the 1980s and later years are permits for plants producing, processing, or assembling goods and materials, such as factories, machine shops, paper mills, beverage plants, manufacturing plants, and printing plants. The early 1980s were recession years, and only about a half-dozen places reported significant levels of industrial development.

In the last five years of the 1980s, industrial construction activity rose 17 percent to $548 million, with 1,031 permits (Figure 2.30). All seven core counties reported heightened levels of activity, with many more cities participating. In addition, numerous places outside the seven counties reported industrial building permit activity. The locations of the outlying centers permitting industrial construction appear nicely aligned with major radial highway routes linking them with the 7-county area. The only areas with little or no industrial permit activity in the late 1980s were the northern parts of Mille Lacs, Kanabec, Pine, and Burnett (WI) counties.

The increasingly dispersed patterns of industrial permitting activity of the late 1980s continued in the early 1990s (Figure 2.31). Following the 1990-92 recession, activity dropped sharply compared with activity levels of the late 1980s, reaching only $365 million on 675 permits, about a third fewer than five years earlier. The largest concentrations of industrial building permits were smaller than in the previous period, but activity was widely dispersed throughout most parts of the 24-county area. The seven core counties remained prominent, but notable activity took place in peripheral areas, e.g., Hutchinson and Glencoe in McCleod County, Winthrop in Sibley County, Faribault in Rice County, Pine Island in Goodhue County, and the Hudson area in St. Croix County (WI).

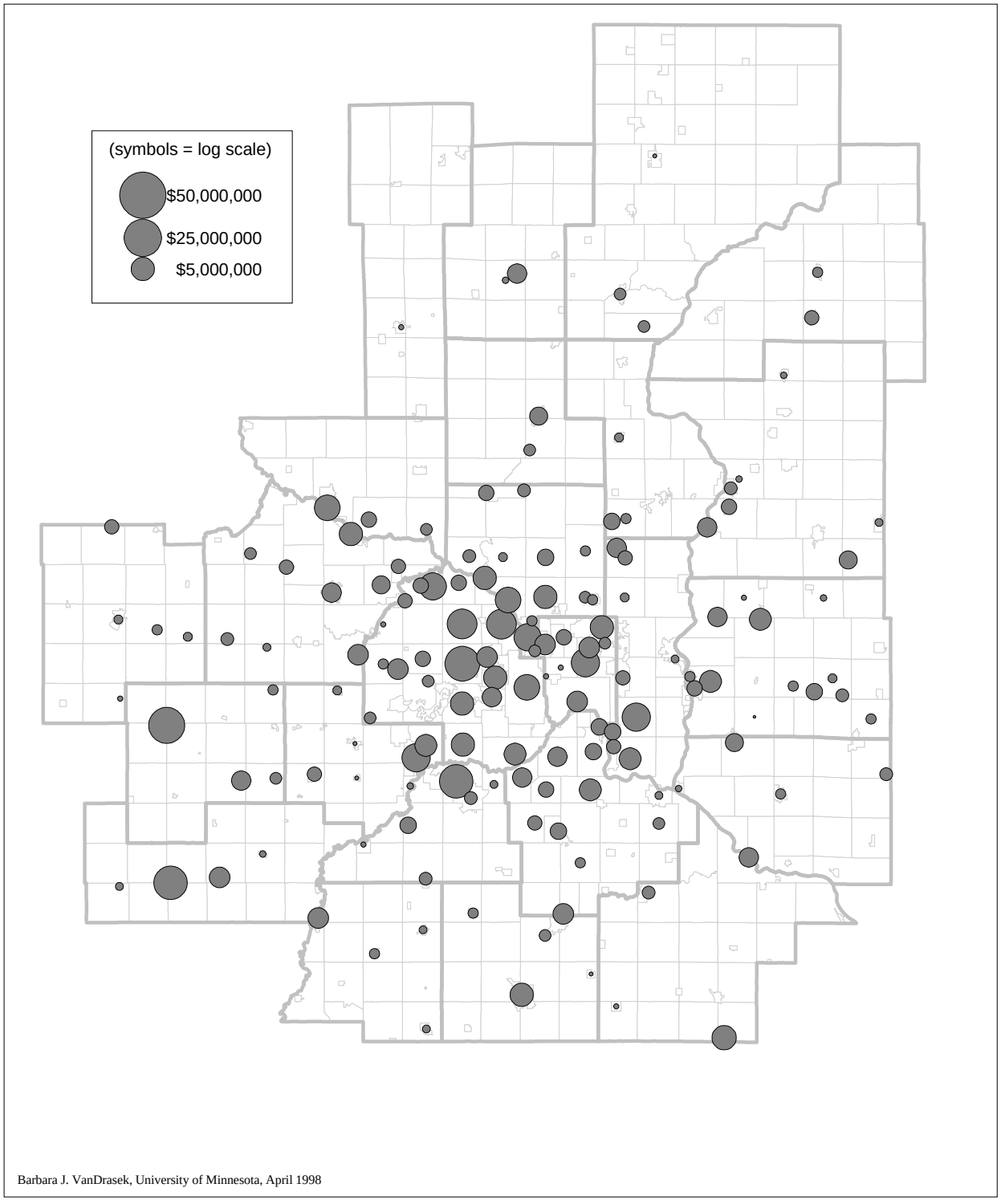


Figure 2.29. Value of Industrial Building Permits Reported, 24-County Area, 1980-84.

Total permits: 1,106; Total value: $466,605,291; largest number in one MCD: 97 (Plymouth); largest value in one MCD: $47,225,937 (St. Paul).
Data source: U.S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

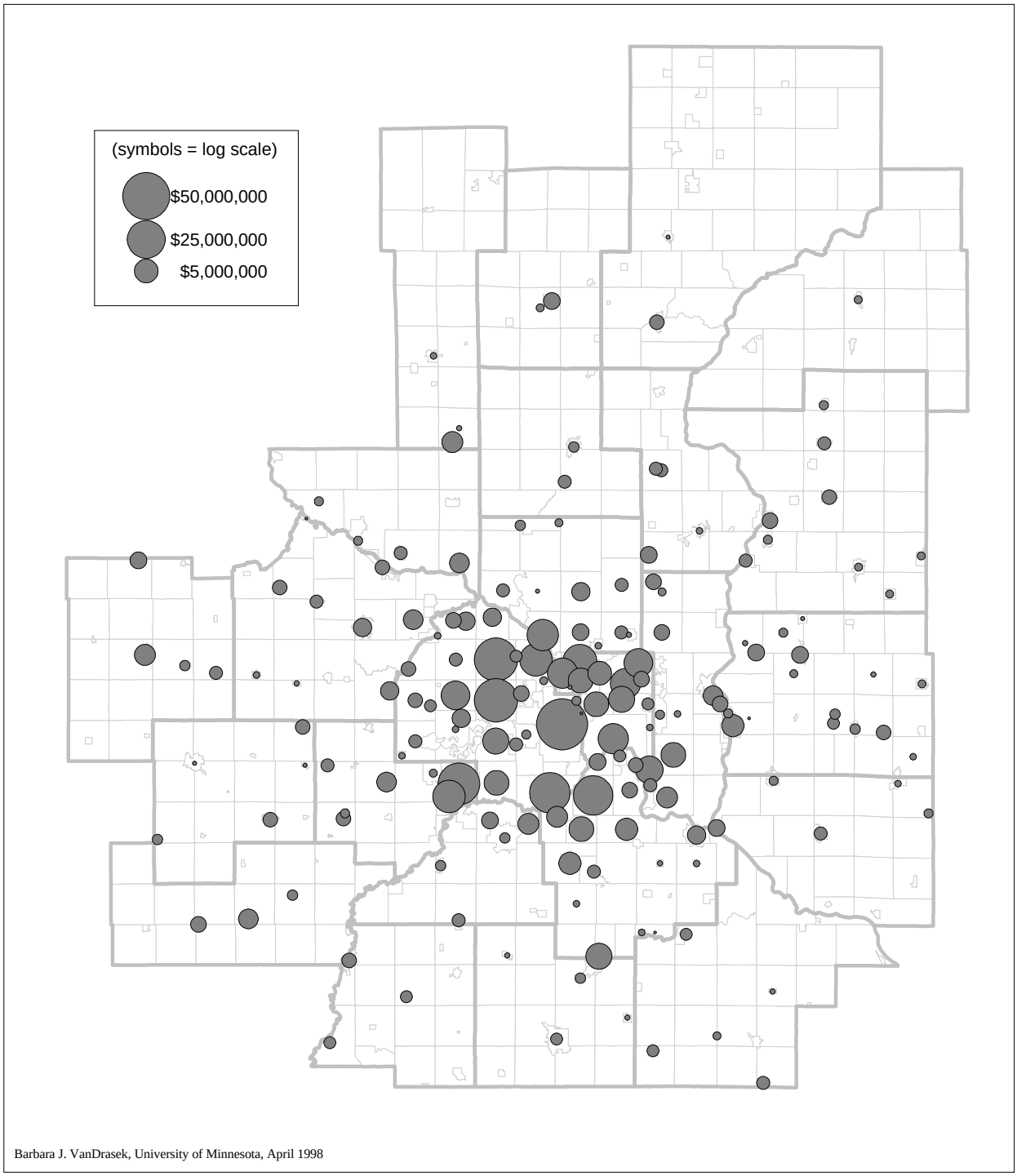


Figure 2.30. Value of Industrial Building Permits Reported, 24-County Area, 1985-89.

Total permits: 1,031; Total value: $548,205,301; largest number in one MCD: 33 (Maple Grove); largest value in one MCD: $63,106,483 (Minneapolis).

Data source: U.S. Department of Commerce, Bureau of the Census, 1985-89 Non-Residential Building Permits, tape file.

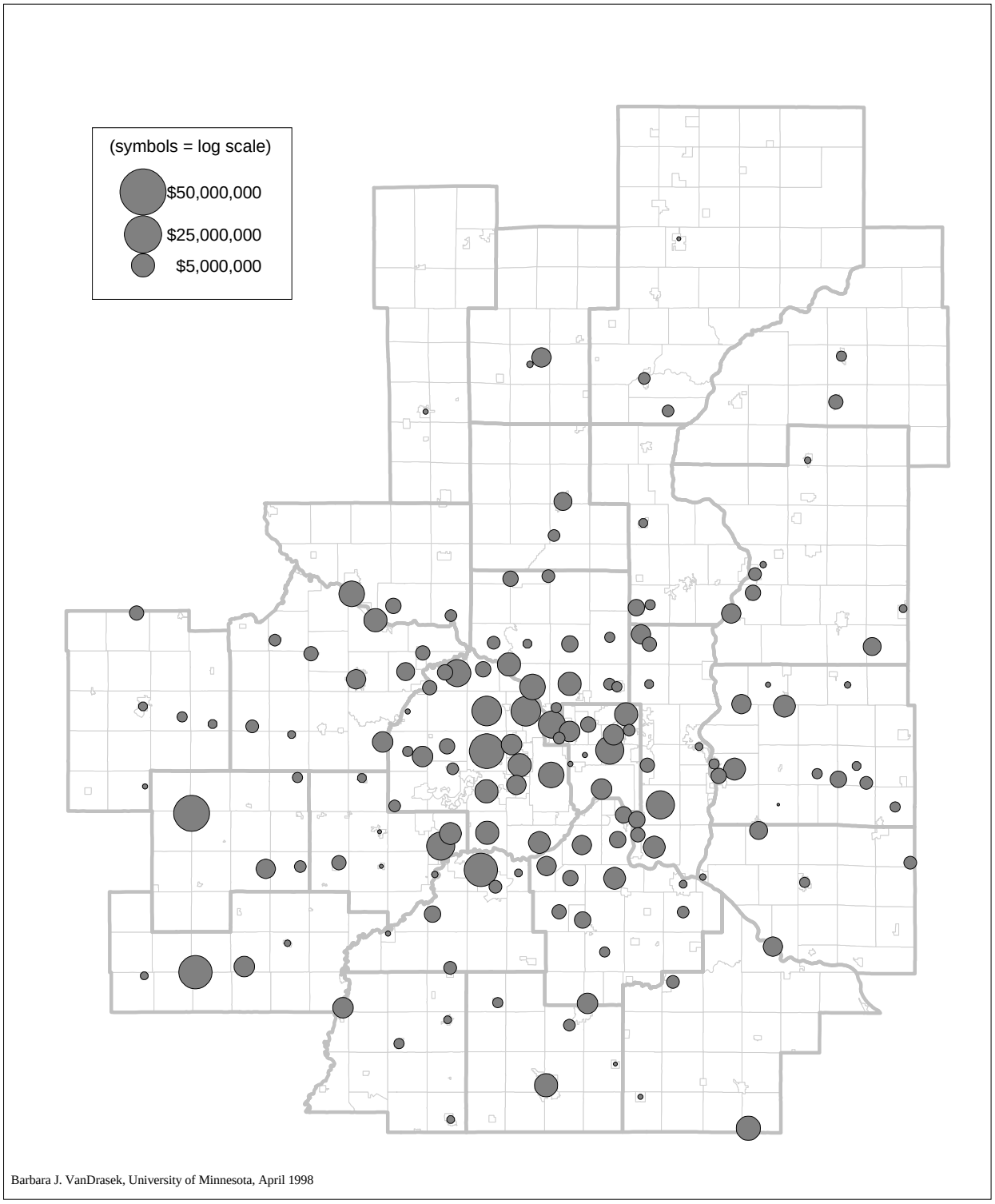


Figure 2.31. Value of Industrial Building Permits Reported, 24-County Area, 1990-94.

Total permits: 675; Total value: $364,856,264; largest number in one MCD: 20 (Rosemount); largest value in one MCD: $22,170,062 (Hutchinson).
Data source: U.S. Department of Commerce, Bureau of the Census, 1990-94 Non-Residential Building Permits.

Commercial Construction in the Twin Cities Area, 1970s to the 1990s

Commercial building permits are issued for stores and other mercantile buildings, which includes buildings used in buying, selling, distributing, or storing of merchandise and materials, or performing customer services such as stores, auto and other show rooms, commercial warehouses, grain elevators, garages for storing commercial vehicles, restaurants, taverns, bakery shops, laundry and dry cleaning shops, barber and beauty shops, animal hospitals, and similar facilities, including affiliated parking garages and administration buildings. There were 306 reported permits issued for $60.4 million of commercial construction in the 24-county area in 1972 (Figure 2.32). The maximum number of commercial permits reported by a single location was 63, and the maximum amount of authorized commercial construction was $10.9 million. In the early 1970s, the locations of a large majority of commercial construction permits were tightly clustered inside the central cities of Minneapolis and St. Paul, and in the close-in suburbs. Activity in outlying counties was almost negligible.

The geographical pattern of commercial permit activity of the early 1970s in the 24 counties was largely repeated in the late 1970s (represented by permit-granting activity in 1979). In 1979, there were 490 commercial building permits reported in the 24-county area, for $133.3 million of planned activity. The maximum number of commercial permits reported by a single place in 1979 was 42, and the maximum value of authorized commercial construction in one place was $12.8 million. A modest volume of activity was reported from some of the larger cities outside the 7-county area, especially to the west in places such as Norwood, Glencoe, Hutchinson, Litchfield, Howard Lake, and Buffalo, but expansion in suburban areas of Washington and Anoka counties was also underway.

In early 1980s, there were 1,080 reported commercial building permits for $335 million of activity, distributed across the 24-county area in a geographical pattern similar to the population distribution (Figure 2.33). The scale on the commercial construction maps differs from the scale used on the industrial maps. There was about the same number of permits, but lower value of construction.

In the late 1980s, the real estate speculation-investment boom of those years appears vividly, with $825 million of commercial construction permit activity—almost two-and-a-half times the volume of the previous period, on 1,711 permits (Figure 2.34). The construction activity is heavily concentrated inside the seven counties—especially in the central cities and close-in suburbs of northern Dakota and Scott counties, northeastern Carver County, southern Anoka county, and several parts of Washington County, including cities along the St. Croix River.

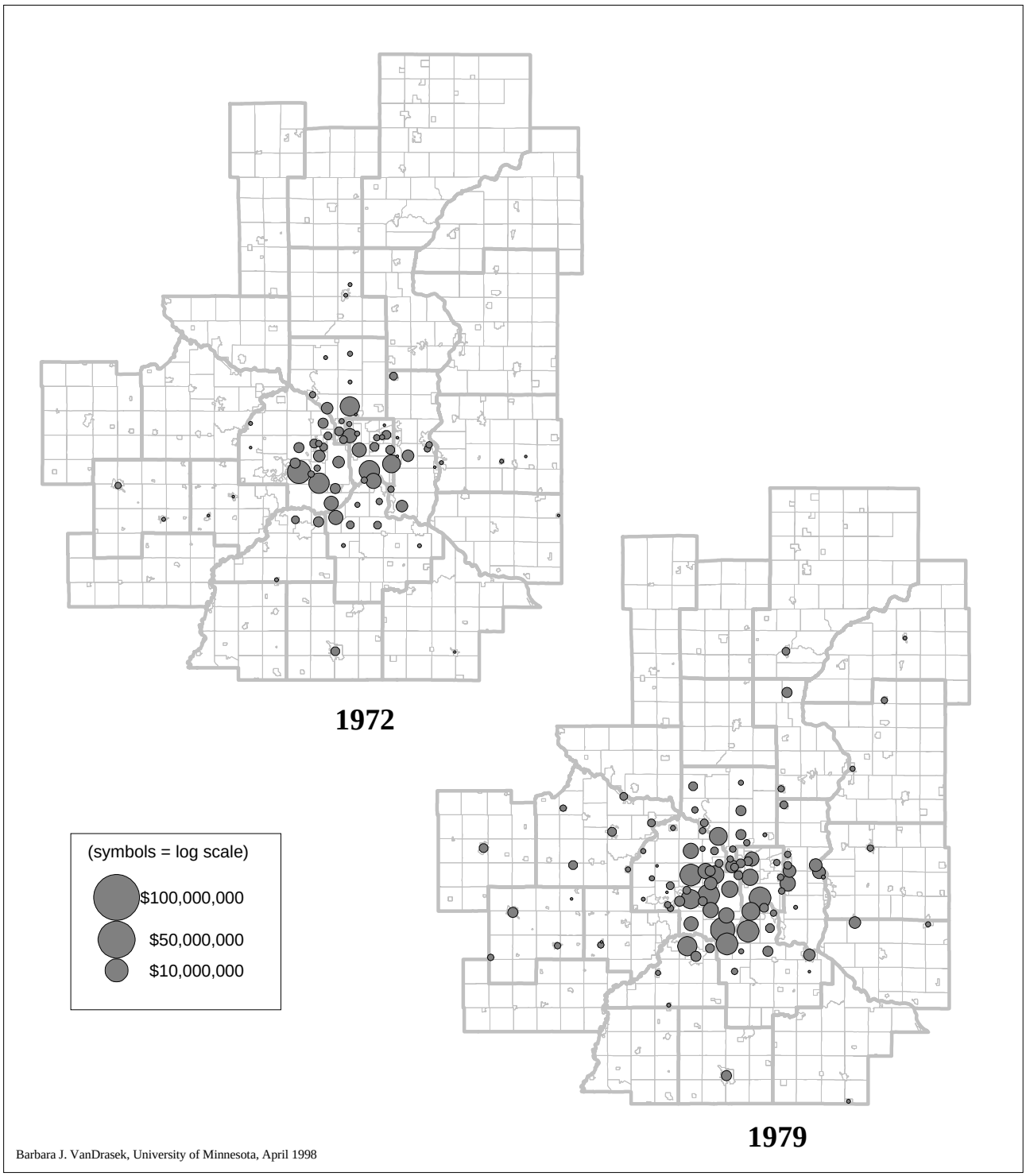


Figure 2.32. Value of Commercial Building Permits Reported, 24-County Area, 1972 and 1979.

1972: Total permits: 306; Total value: $60,475,244; largest number in one MCD: 63 (Blaine); largest value in one MCD: $10,862,895 (Minnetonka). 1979: Total permits: 490; Total value: $133,310,815; largest number in one MCD: 42 (Burnsville); largest value in one MCD: $12,752,835 (Bloomington).

Data source: U.S. Department of Commerce, Bureau of the Census, 1972 and 1979 Non-Residential Building Permits, tape file.

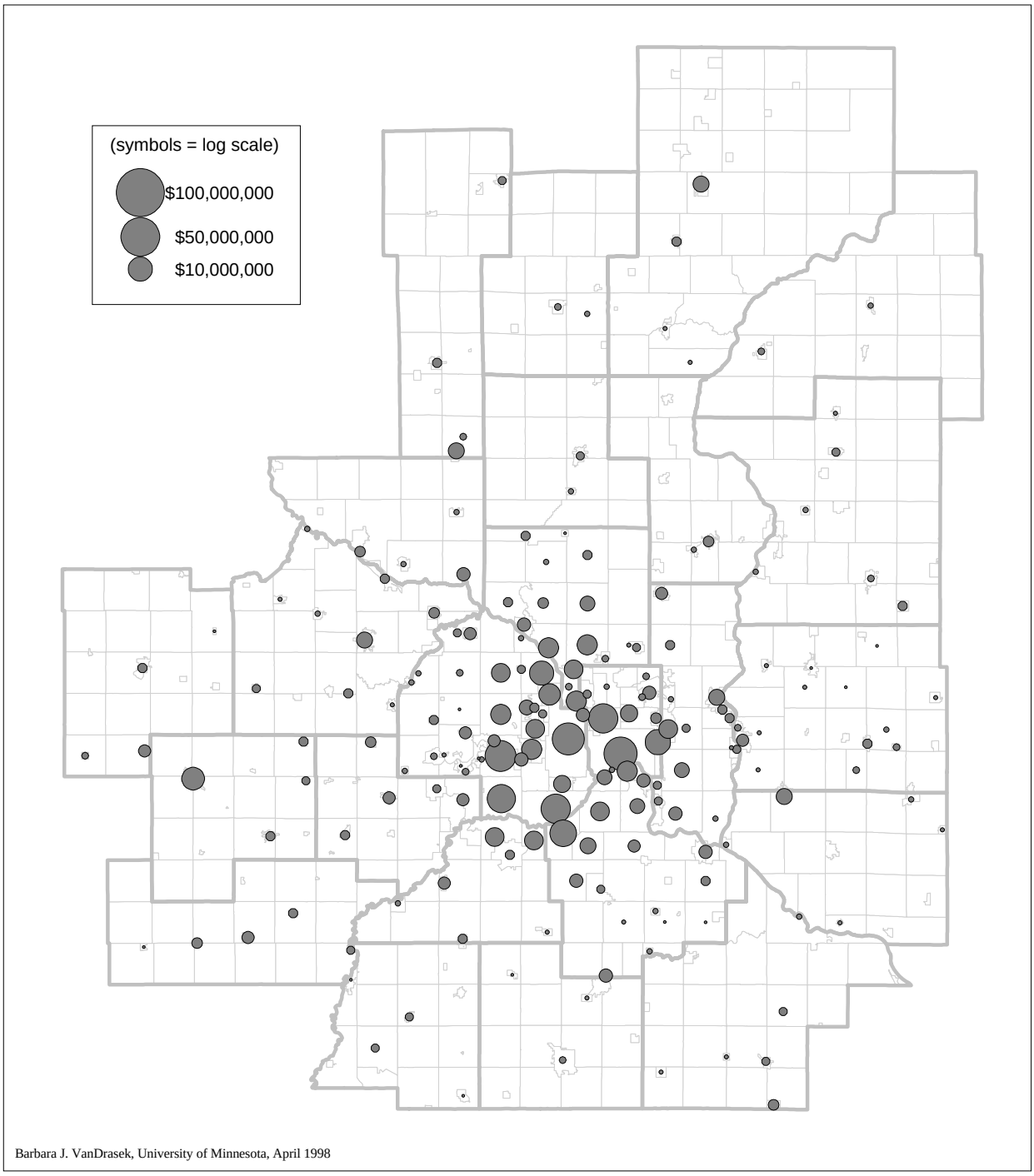


Figure 2.33. Value of Commercial Building Permits Reported, 24-County Area, 1980-84.

Total permits: 1,080; Total value: $334,863,588; largest number in one MCD: 64 (Minnetonka); largest value in one MCD: $28,046,261 (St. Paul).

Data source: U.S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

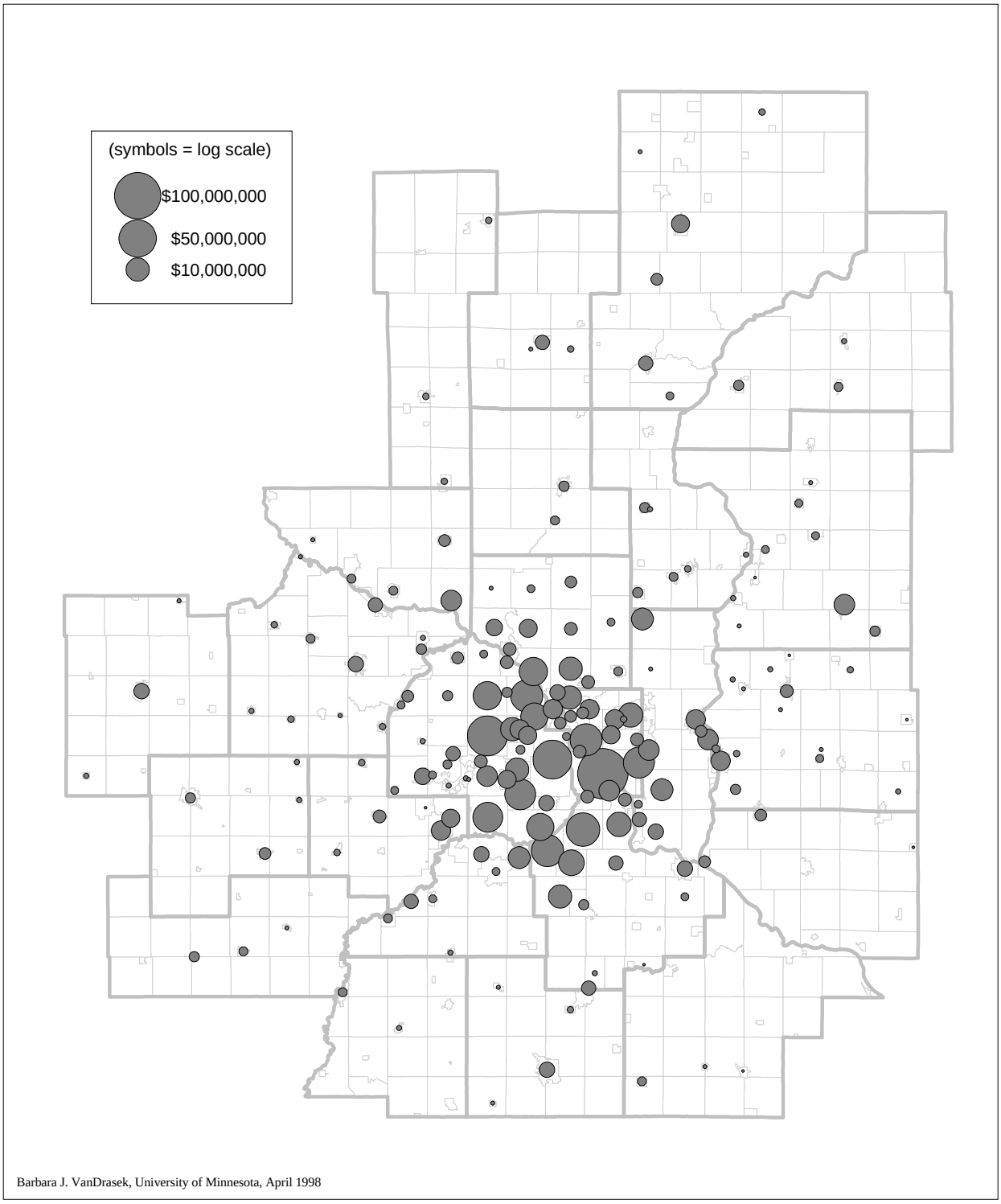


Figure 2.34. Value of Commercial Building Permits Reported, 24-County Area, 1985-89.

Total permits: 1,711; Total value: $825,457,710; largest number in one MCD: 92 (St. Paul); largest value in one MCD: $128,707,151 (St. Paul).

Data source: U.S. Department of Commerce, Bureau of the Census, 1985-89 Non-Residential Building Permits, tape file.

In the 1990s, vigorous commercial development continued, with $731 million of activity on 1,158 permits (Figure 2.35). Bloomington's Mall of America accounts for a large part of the total. The overall pattern remained concentrated inside the 7-county core counties, especially the close-in suburbs.

Office Construction in the Twin Cities Area, 1970s to the 1990s

Office building permits are issued for office, bank, and professional buildings, but not for office buildings affiliated with industrial buildings. Of the four categories of building permits—residential, industrial, commercial and office—it was office construction (represented by permits issued in 1972) that displayed the most concentrated geographical pattern in the early 1970s (Figure 2.36). In 1972 there were 98 permits reported from the 24-county area covering $57.4 million of planned office construction, but office construction permit activity was reported in only three places outside the 7-county area. The maximum number of office construction permits issued by a single place in the 24-county area in 1972 was 17, and the maximum dollar volume of permitted office construction activity was $29.1 million.

The same general geographical patterning of permit activity (represented by permits issued in 1979) continued into the late 1970s, when there were 273 permits reported for $280 million of planned office construction in the 24-county area. The largest reported permit values within the 7-county area were in Minneapolis, St. Paul, Edina, Bloomington, Maplewood, and several other close-in suburbs west and southwest of Minneapolis. But beyond the 7-county area building activity was surging, with eleven counties reporting activity. The maximum number of office construction permits issued by a single place in the 24-county area in 1979 was 33, and the maximum dollar volume of permitted office construction activity in any place was $54.5 million.

The volume and location of office construction permits changed in major ways in the early 1980s compared with the 1970s (Figure 2.37). The volume of activity was higher, with more than $1 billion of permitted office building activity on 883 permits. Most of the activity occurred in the two central cities, or in suburbs west and south of Minneapolis, but there was activity in most other parts of the 24-county area as well.

The office building boom continued through the late 1980s, with $1,157 million of activity on 796 permits, again with most of the activity in Minneapolis, St. Paul, Bloomington, Eagan, Eden Prairie, and suburbs north, west, and south of Minneapolis (Figure 2.38). Outlying areas displayed negligible activity compared with the core areas of the seven counties.

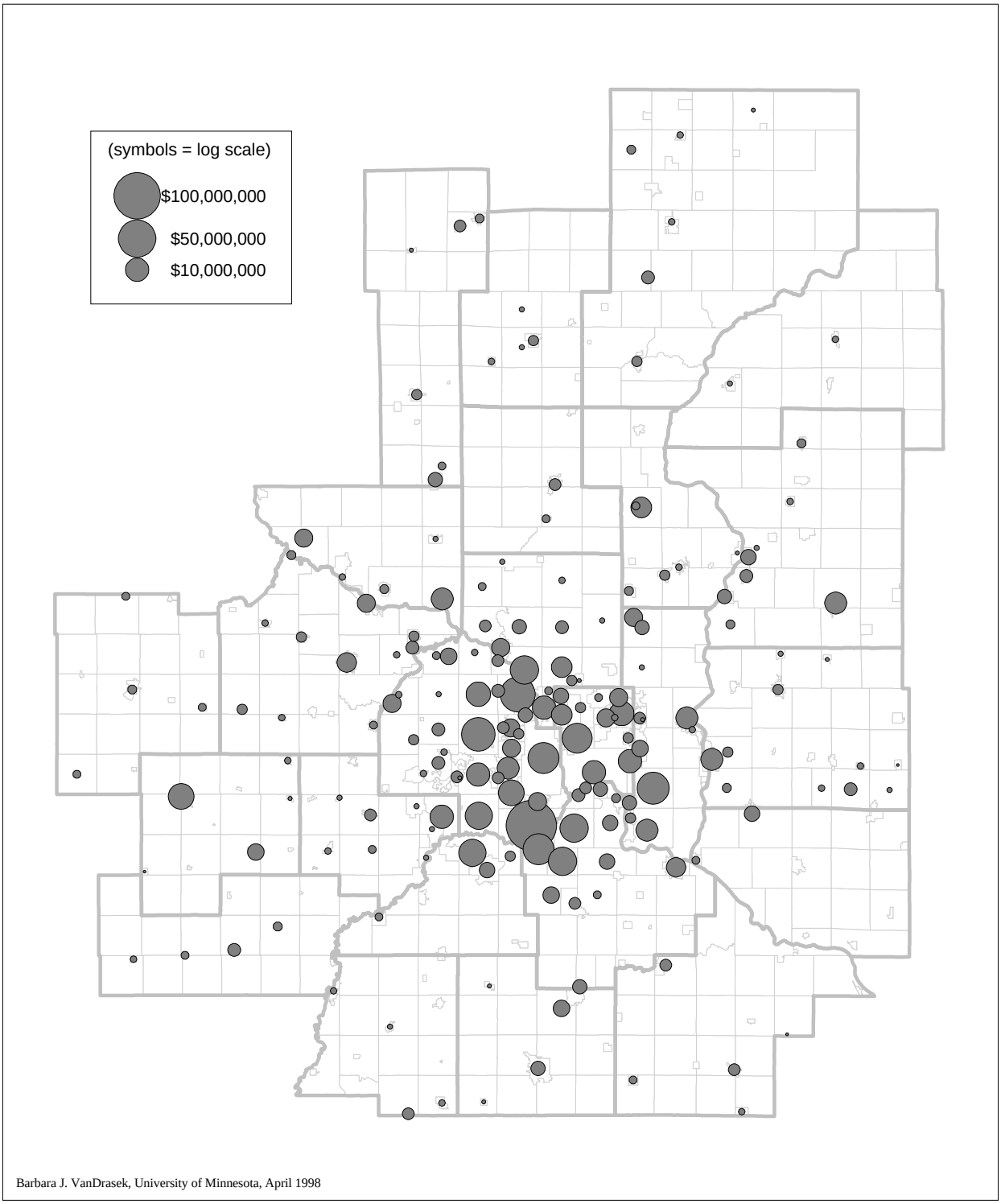


Figure 2.35. Value of Commercial Building Permits Reported, 24-County Area, 1990-94.

Total permits: 1,158; Total value: $730,871,842; largest number in one MCD: 42 (Plymouth); largest value in one MCD: $126,136,499 (Bloomington).

Data source: U.S. Department of Commerce, Bureau of the Census, 1990-94 Non-Residential Building Permits, tape file.

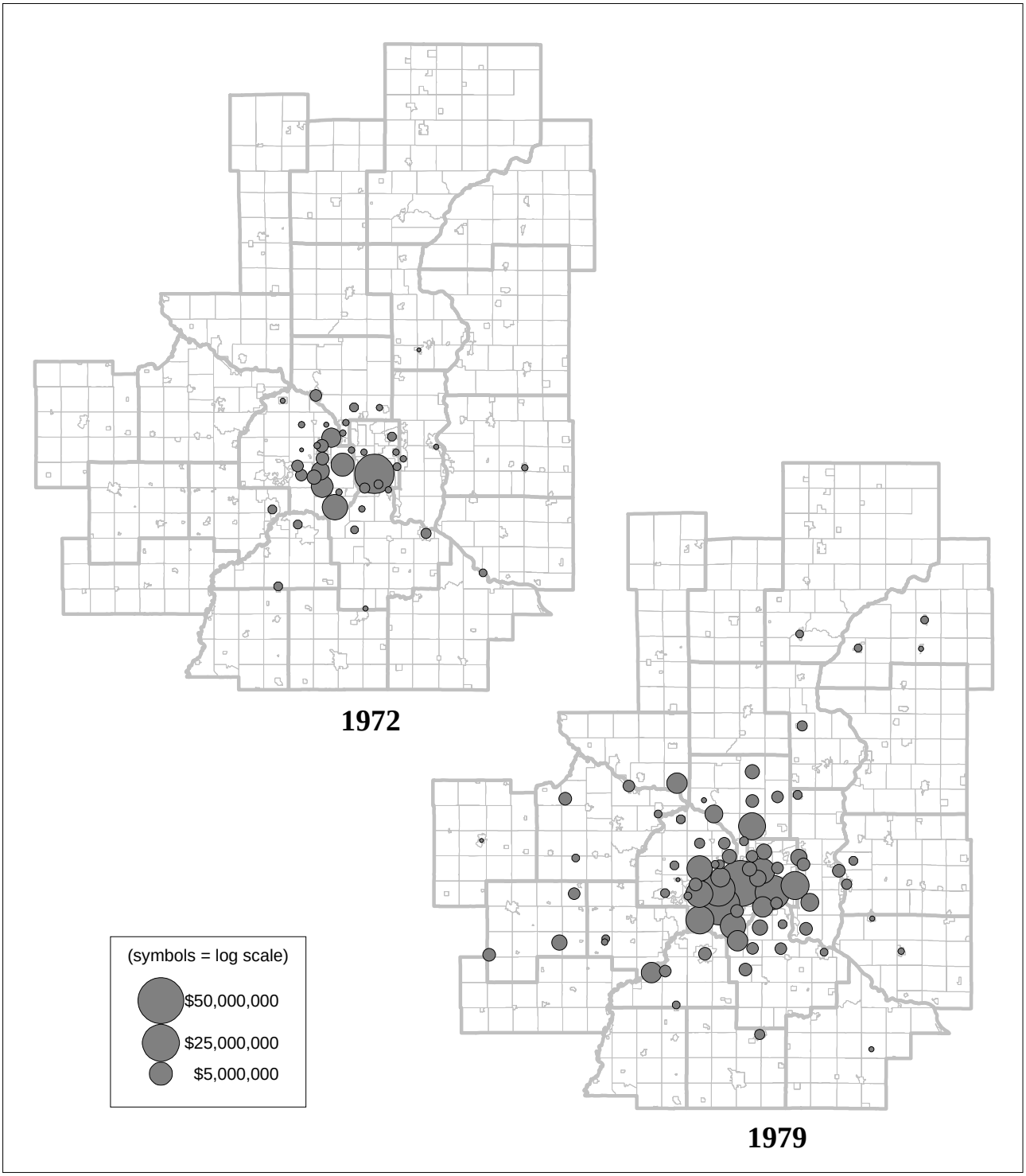


Figure 2.36. Value of Office Building Permits Reported, 24-County Area, 1972 and 1979.

1972: Total permits: 98; Total value: $57,392,225; largest number in one MCD: 17 (St. Paul); largest value in one MCD: $29,082,106 (St. Paul). 1979: Total permits: 273; Total value: $279,563,923; largest number in one MCD: 33 (Minneapolis); largest value in one MCD: $54,513,630 (Mille Lacs County Unincorporated Area (see Table 2.1)).
Data source: U.S. Department of Commerce, Bureau of the Census, 1972 and 1979 Non-Residential Building Permits, tape file.

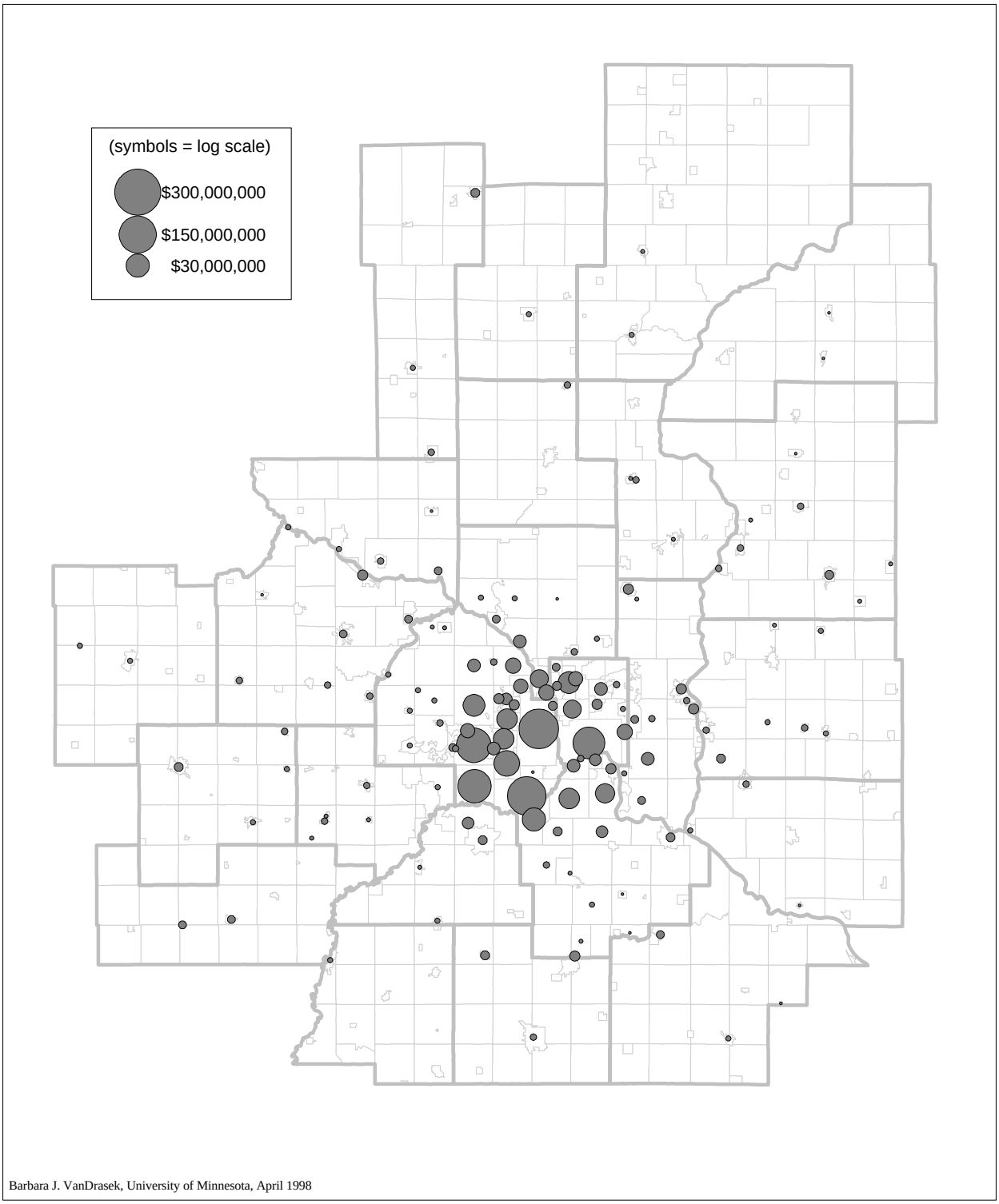


Figure 2.37. Value of Office Building Permits Reported, 24-County Area, 1980-84.

Total permits: 883; Total value: $1,015,107,964; largest number in one MCD: 86 (Eden Prairie); largest value in one MCD: $191,314,171 (Minneapolis).

Data source: U.S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

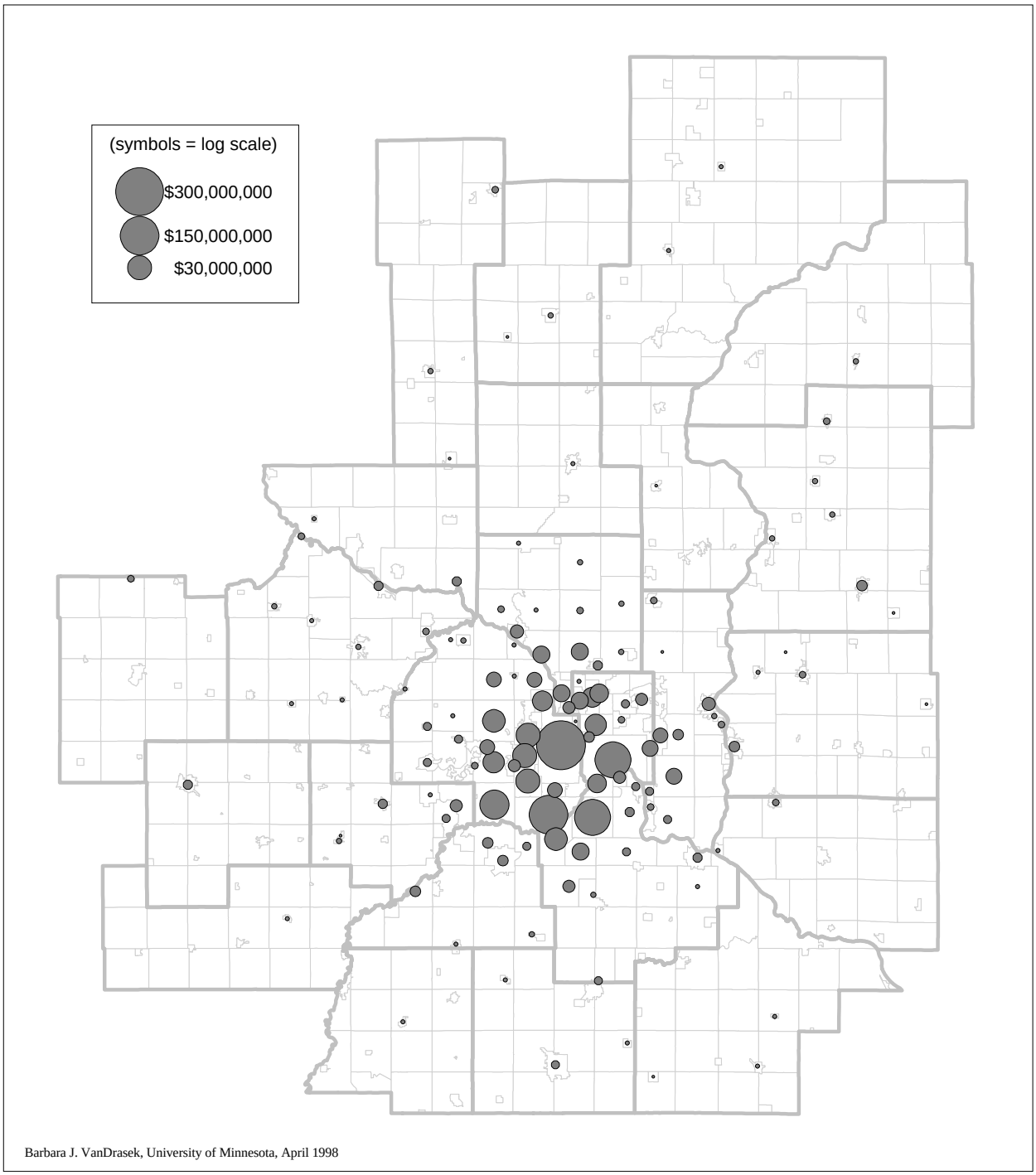


Figure 2.38. Value of Office Building Permits Reported, 24-County Area, 1985-89.

Total permits: 796; Total value: $1,157,220,675; largest number in one MCD: 59 (St. Paul); largest value in one MCD: $314,951,312 (Minneapolis).
Data source: U.S. Department of Commerce, Bureau of the Census, 1985-89 Non-Residential Building Permits, tape file.

Office permit activity slowed dramatically during the recession of 1990-92, but for the early 1990s period overall, Minneapolis, Woodbury and Eagan led the reported $737 million of reported permitted activity on 543 permits, a drop of over 35 percent from the previous period (Figure 2.39). The geographical concentration of major office construction activity continued into the 1990s, with most of the activity not only within the 7-county area, but especially in Ramsey county, inner Hennepin county, and other parts of the 7-county area closest to the central cities of Minneapolis and St. Paul. With development patterns described by timing and by geographical location, we turn to the record of highway building from 1970 onward and evaluate its correspondence with development activity.

Development Related to Highway Improvements, 1970 to 1998

The following maps (Figures 2.40-2.43) describe the growth and geographical distribution of residential, industrial, commercial and office activity from the 1970s to the present. Those profiles of economic and demographic growth and land development undoubtedly reflect various cumulative and circular causal relationships with highway infrastructure improvements that accompanied that growth. Chapter 5 in this report analyzes the timing of the improvements in the major highway system serving the 24-county area, and assesses the ways that highway improvements appear to lead as well as follow regional growth and development patterns as revealed by construction activity. Here we simply describe the timing and locations of major highway improvements that occurred during four time periods from 1970 onward. Appendix 2-B describes the process by which we obtained the data on highway improvements.

Five stretches of interstate highways were completed in the 1970s (Figure 2.40). They included I-94 (Hudson Road) east of St. Paul to the St. Croix River; I-35E north of I-694; a stretch of I-694 north of St. Paul; I-35W through East Minneapolis; and I-94 northwest of Minneapolis to St. Cloud. Meanwhile, other major routes were upgraded to multi-lane status. On the Minneapolis side of the metropolitan area, there were eight major improvements, compared with only four on the St. Paul side. The imbalance is associated with the disproportionate growth of population and development in western areas during the 1970s. Highway upgrades included portions of US12, S55, Hennepin County 18 (now US169), S100 (Normandale Road), and US169 to Shakopee.

Major improvements in the early 1980s included the completion of I-94 through North Minneapolis to I-694; the completion of I-35E from St. Paul to I-35 south of Minneapolis; the

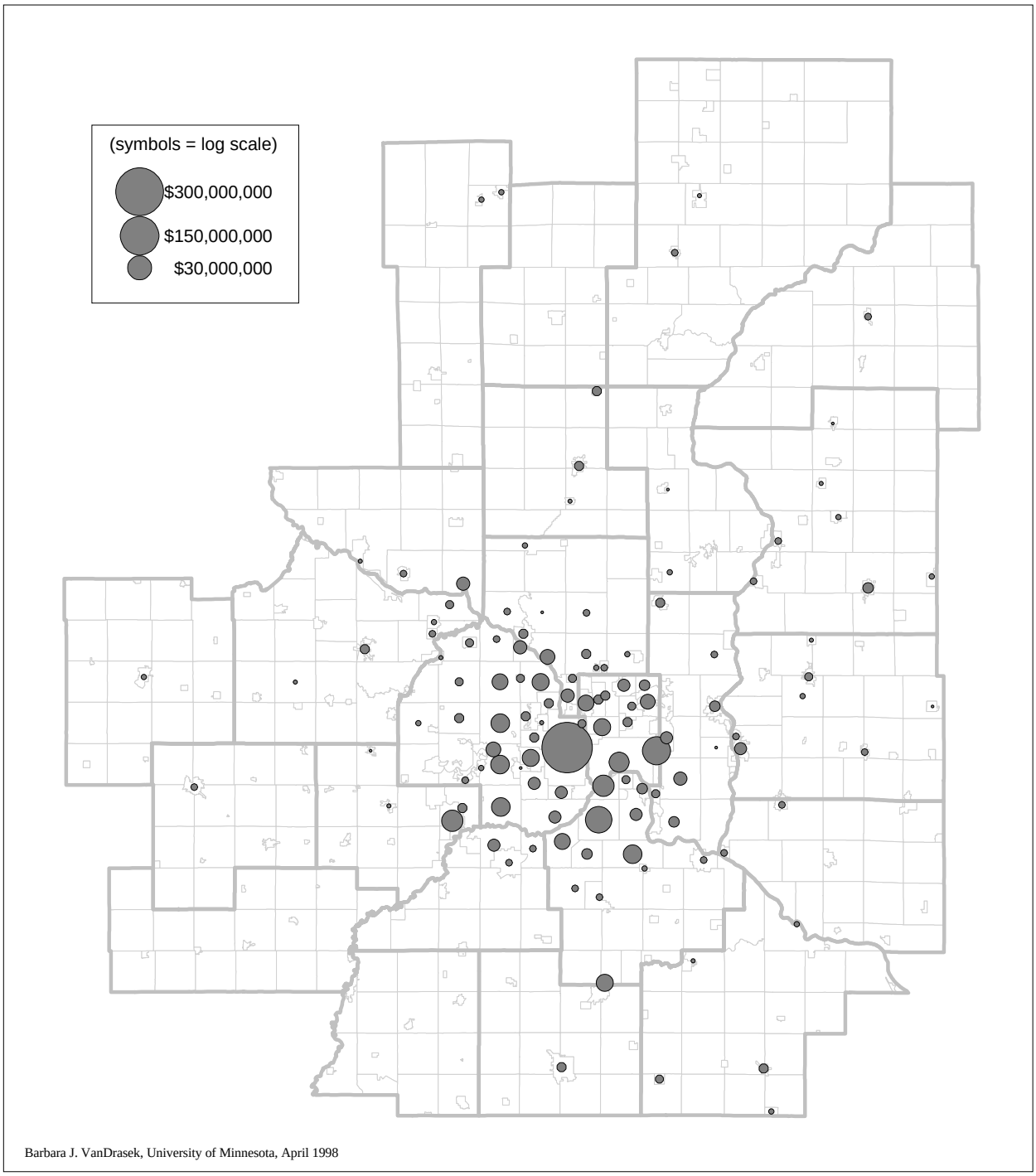


Figure 2.39. Value of Office Building Permits Reported, 24-County Area, 1990-94.

Total permits: 543; Total value: $737,466,321; largest number in one MCD: 39 (Edina); largest value in one MCD: $350,475,800 (Minneapolis).

Data source: U.S. Department of Commerce, Bureau of the Census, 1990-94 Non-Residential Building Permits, tape file.

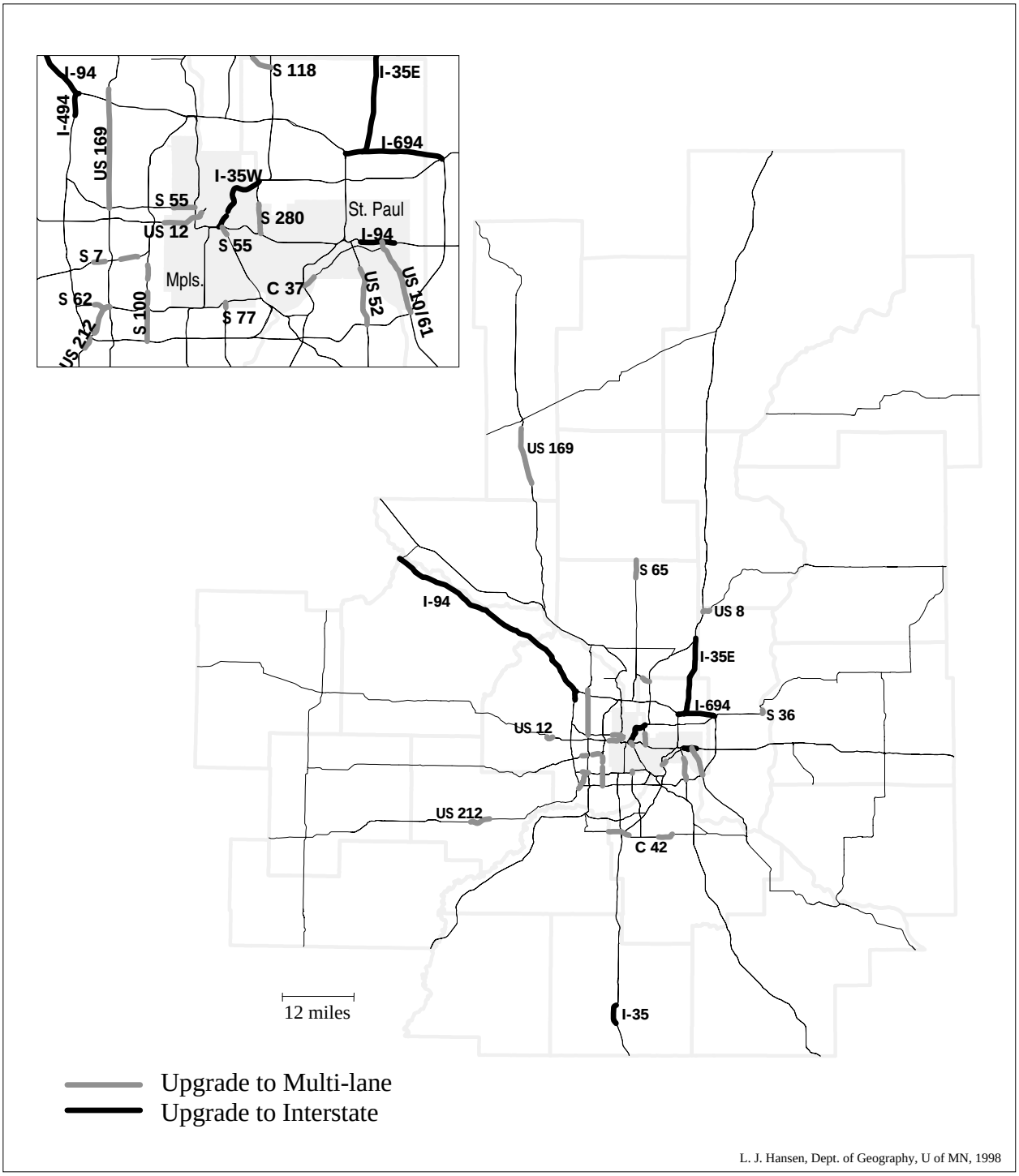


Figure 2.40. Highways Upgraded to Multi-lane or Interstate Status, 24-County Area, 1970-1979.

Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97. Wisconsin Department of Transportation, 1:100,000-scale Roadway Chain, 1993. Highway upgrades determined by authors.

upgrading of S77 (S Cedar Avenue) from Richfield across a new Minnesota River bridge and into Dakota County; east-west improvements in Eagan; and a new bridge across the Minnesota River southeast of the airport, allowing I-494 to intersect I-35E in Mendota Heights (Figure 2.41). The completion of three new bridges over the Minnesota River (S77, I-494, I-35E) and two interstate highways serving Mendota Heights, Eagan, and other areas of northern Dakota County undoubtedly facilitated vigorous development in those areas in the 1980s and 1990s. These improvements also may have boosted development in St. Paul's eastern suburbs, which have expanded vigorously since the late 1970s.

A controversial link of I-35E southwest from St. Paul's Summit Hill, plus a short stretch of I-494 serving Mendota Heights and Sunfish Lake in northern Dakota County were the major interstate projects completed in the late 1980s (Figure 2.42). Other notable upgrades of the late 1980s were US169 north and south of Milaca in Mille Lacs County; a short stretch of S62 linking western Edina with I-494; S252/S610 linking Brooklyn Center and I-94 over the Mississippi River to Coon Rapids and US10 to Anoka; and an improvement of Hennepin County 18 (now US169) in Brooklyn Park, improving that city's access to I-94.

The biggest highway project completed in the late 1980s was I-394 from downtown Minneapolis west to I-494 (Figure 2.43). Another of the largest projects has been the extension of US169 (rerouted to the renamed Hennepin County 18) along the boundary between west Bloomington and Eden Prairie, then across the Minnesota River to Shakopee, thereby facilitating development in northern Scott County. Another major upgrade project includes segments of east-west C42, which runs from Prior Lake on the west to Rosemount on the east, passing through and serving Savage, Burnsville and Apple Valley. As development proceeded in northern Dakota and Scott counties, C42 has been regularly upgraded; and as it is upgraded, development proceeds apace. US61 north and south of Red Wing in Goodhue County was upgraded in the early 1990s. Within the city of Minneapolis, the upgrading of S55 (Hiawatha Avenue) continued as plans developed for transit innovations along that route between the downtown and the airport.

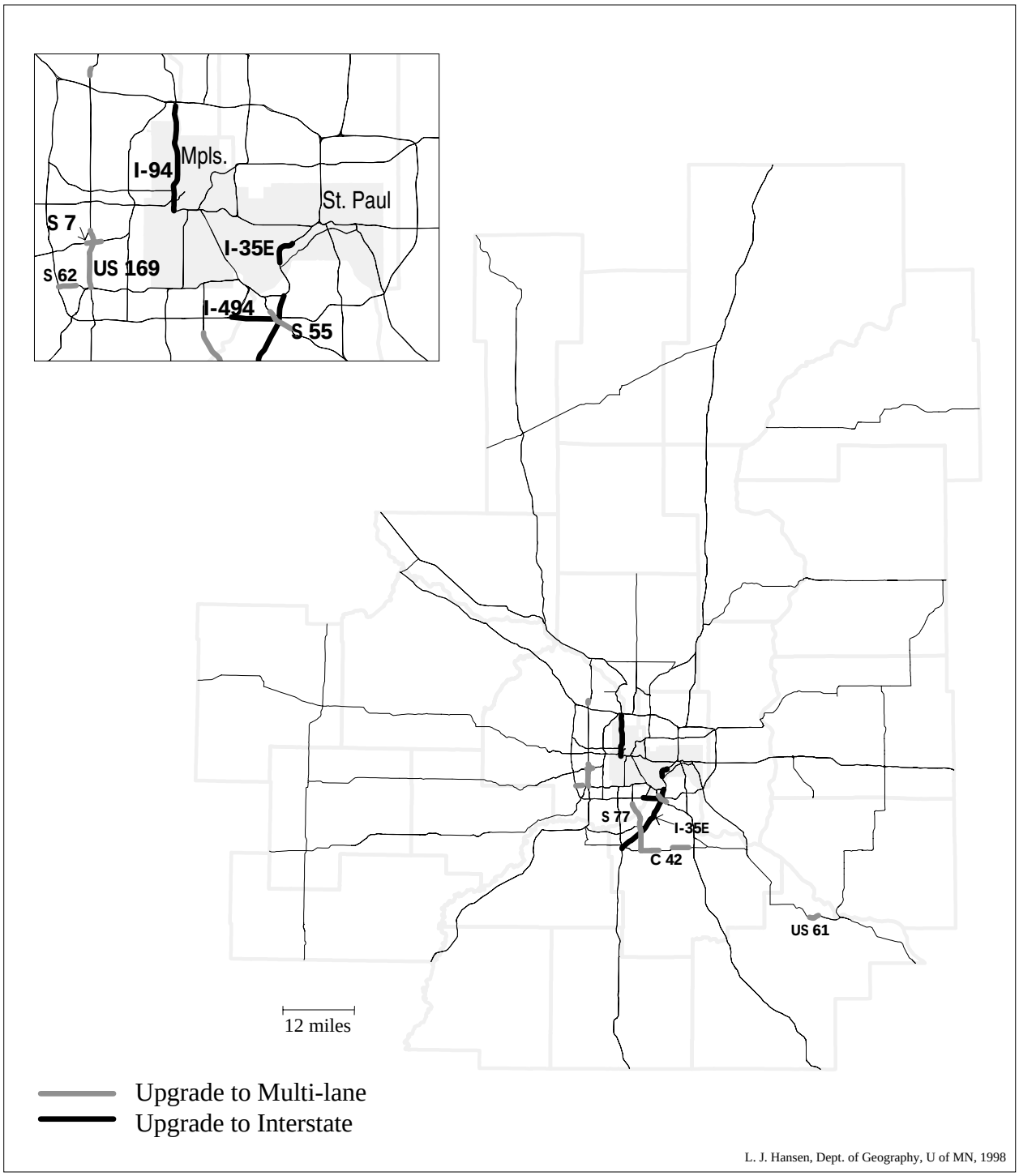


Figure 2.41. Highways Upgraded to Multi-lane or Interstate Status, 24-County Area, Early 1980s.

Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97. Wisconsin Department of Transportation, 1:100,000-scale Roadway Chain, 1993. Highway upgrades determined by authors.

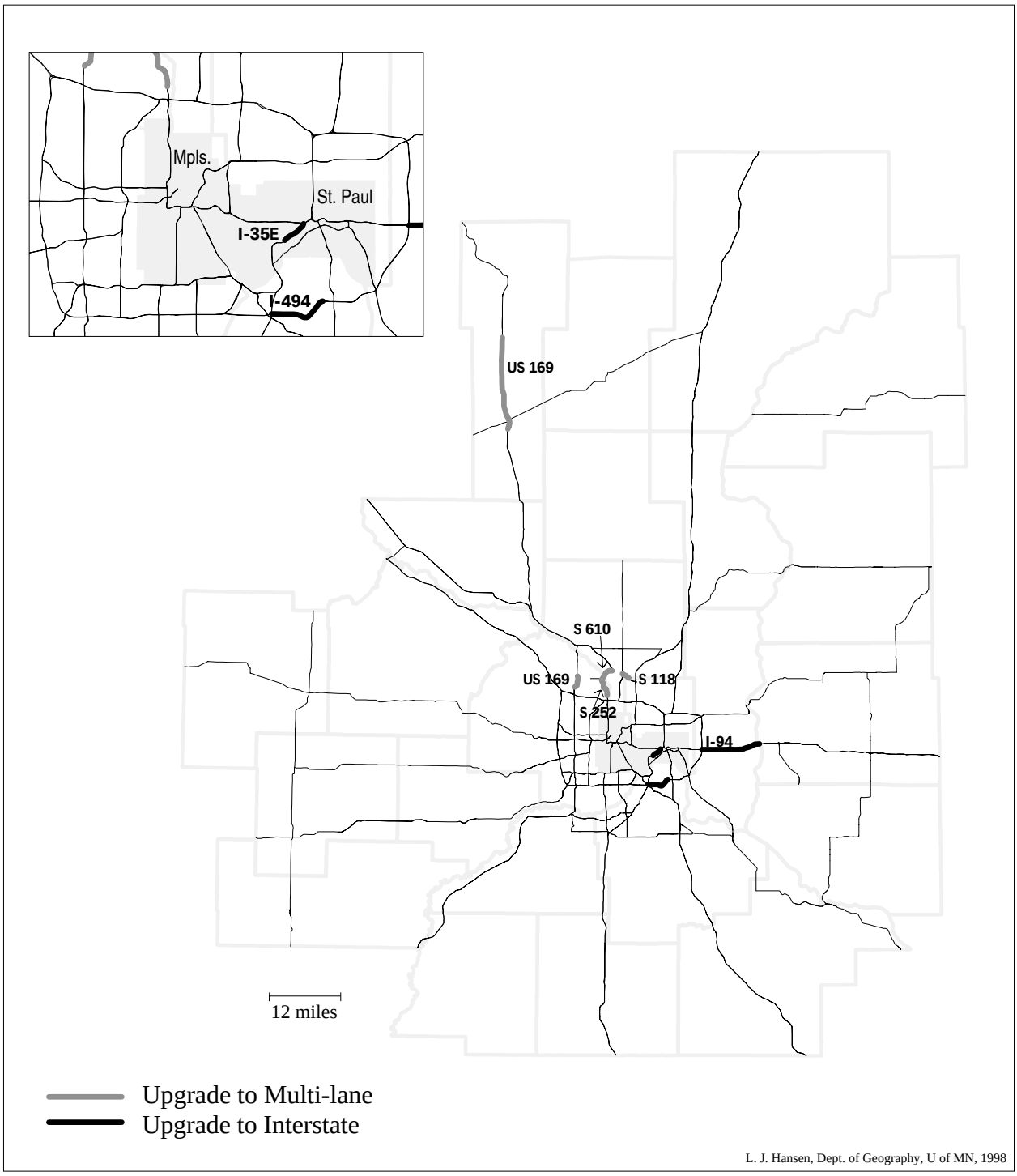


Figure 2.42. Highways Upgraded to Multi-lane or Interstate Status, 24-County Area, Late 1980s.

Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97. Wisconsin Department of Transportation, 1:100,000-scale Roadway Chain, 1993. Highway upgrades determined by authors.

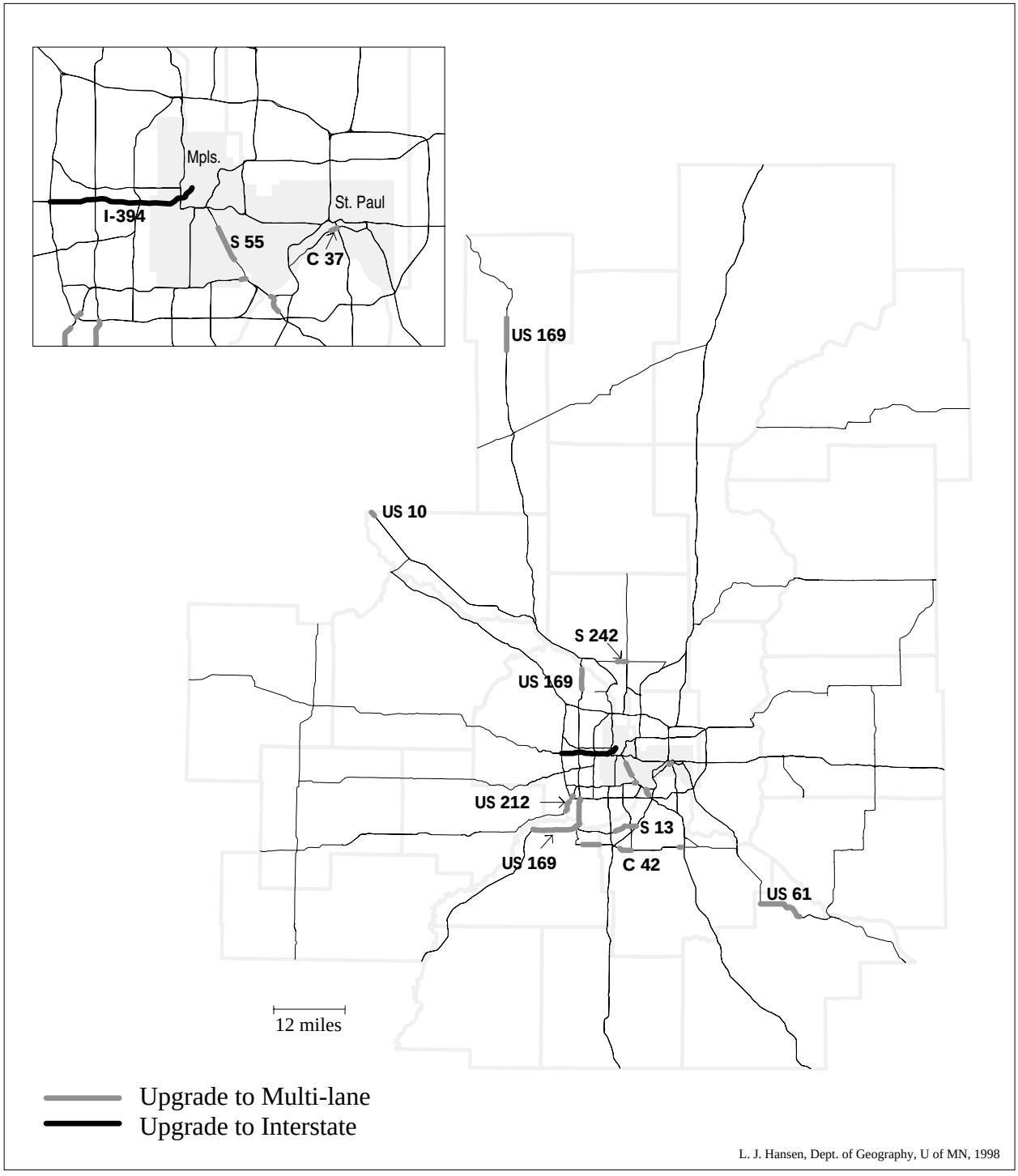


Figure 2.43. Highways Upgraded to Multi-lane or Interstate Status, 24-County Area, 1990s.

Data source: Minnesota Department of Transportation, State of Minnesota BaseMap 97. Wisconsin Department of Transportation, 1:100,000-scale Roadway Chain, 1993. Highway upgrades determined by authors.

Conclusions

In this chapter we first examined the geographical position of the Twin Cities metropolitan area within the Upper Midwest region, and noted its continuing growth and its adjacent metropolitan competitors. Until recent years, it has been possible for Twin Cities population and economic expansion to be accommodated with new developments on the edges of the previously built-up area, and by constructing major highway transportation infrastructure to handle the steadily increasing traffic loads.

Two things have been happening in recent years that represent new, unfamiliar and unpleasant experiences for Twin Citians: congestion is building rapidly to levels not previously seen in the area, and for financial and other reasons it is exceedingly unlikely that it will be possible to "build our way out of congestion" in the decades ahead.

Yet new development goes forward in the familiar low-density fashion. Residential development linked with the Twin Cities-based labor markets has been spreading into at least a 24-county area in Minnesota and Wisconsin. Commercial development has been following population and purchasing power. Office development continues to be rather tightly concentrated in the central cities and the close-in suburbs. Industrial development of the past three decades has steadily dispersed, but not as fast as population and new housing.

Highway improvements seem to follow as well as lead development, but the causal linkages usually are difficult to demonstrate. It appears that the relationship between land development patterns and highway improvements is one of circular and cumulative causation, a topic to be examined in detail in Chapter 5.

Chapter 2

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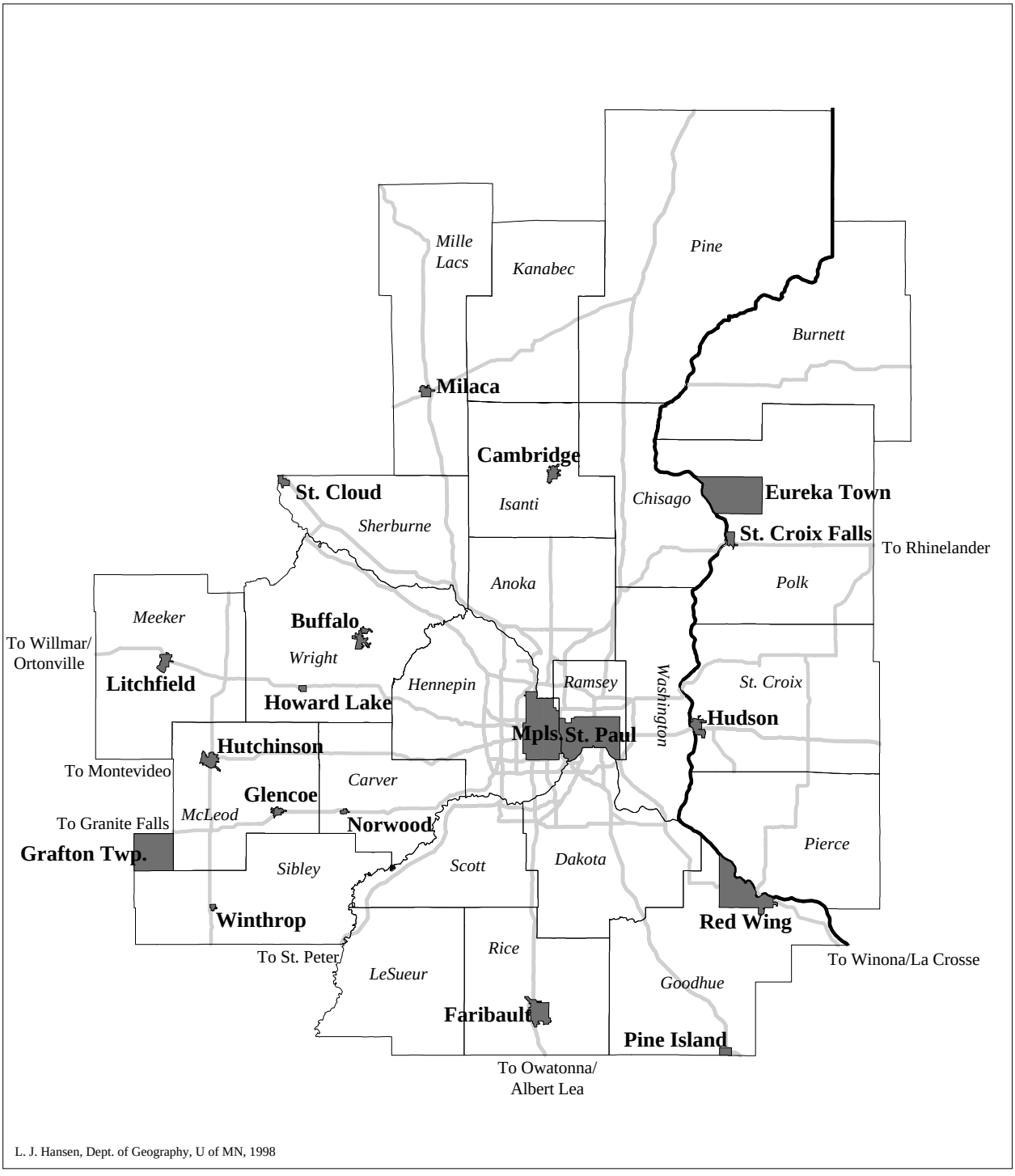
13. Metropolitan Council, *Maintaining Our Competitive Edge for the 21st Century*, Pub. No. 74-98-014 (St. Paul: Metropolitan Council,1998): 195-206.
14. Ibid., 21-2.
15. Ibid., 19-22.
16. Adams and VanDrasek, *People, Place and Public Life*, 20.
17. Metropolitan Council, *Competitive Edge*, 21.
18. See J. R. Borchert and W. Casey, *Real Property Value in the Heart of the Upper Midwest*, Pub. No. CURA 94-2 (Minneapolis: Center for Urban and Regional Affairs, University of Minnesota, 1994). This study portrays geographical relationships between highway access, development, and land values in a 23-county region from St. Cloud to Rochester and spilling into Wisconsin.
19. Schmid, *Social Sagas*, 61-74.
20. Adams and VanDrasek, *People, Place and Public Life*, 56-89.
21. We use the terms “place,” “local unit of government,” “MCD” (minor civil division), and “city or township” interchangeably, though they may have different definitions according to the census or other data sources.
22. Metropolitan Council, *Transportation Policy Plan, Twin Cities Metropolitan Area*, Pub. No. 35-97-010, St. Paul, Minnesota: Metropolitan Council,1996: 100.

APPENDIX 2-A
Counties and Selected Local Units of Government
of the 24-County Area



APPENDIX 2-B

NOTES ON DATA AND METHODS

Building Permit Data
The three types of non-residential building permit data that we mapped included the following types of structures:

Industrial: Industrial Buildings – Includes plants producing, processing, or assembling goods and materials, such as factories, machine shops, paper mills, beverage plants, manufacturing plants and printing plants.

Office: Office, Bank, and Professional Buildings – Includes offices, banks, professional buildings, financial institutions, administration buildings and medical office buildings.

Commercial: Stores and Customer Services – Includes buildings used in buying, selling, distributing, or storing of merchandise and materials, or performing customer services such as: stores, auto and other showrooms, warehouses, grain elevators, restaurants, taverns, night clubs, bakery shops, laundry and dry cleaning shops, laundromats, beauty and barber shops and kennels.

Other categories of building permits not included in our analysis:

Amusement, Social, and Recreational Buildings
Churches and Other Religious Buildings
Parking Garages
Service Stations and Repair Garages
Hospitals and Institutional Buildings
Public Works and Utilities Buildings
Schools and Other Educational Buildings
Other Nonresidential Buildings
Structures Other Than Buildings
Additions, Alterations, and Conversions
Additions of Residential Garages and Carports

Data Sources
Statistics on building permit data are based upon reports submitted by local building permit officials in response to a mail survey by the Bureau of the Census. If an official fails to respond and the permit-issuing place is in the Bureau's Residential Permit Use Survey (SUP), then the residential housing unit data are obtained from that survey and nonresidential data are imputed.

Most of the permit-issuing jurisdictions are municipalities; the remainder are counties, townships, or unincorporated towns. For the municipalities, and townships or towns, the area subject to building permit requirements to which the figures pertain is normally that of the governmental jurisdictions. A small number of municipalities have authority to issue building or zoning permits for areas extending beyond their corporate limits. In such cases, the data relate to the entire area within which the permit-issuing authority is exercised. Similarly, a small number of townships issue permits for only a part of the township and the data normally covers only the area subject to the township's permit system.

Data limitations: The portion of construction measurable from building permit records is inherently limited since such records obviously do not reflect construction activity outside of the area subject to local permit requirements. Some building permit jurisdictions close their books a few days before the end of the month/year, so that the time reference for permits is not, in all cases, strictly the calendar month/year.

Road Improvement Data

In making the road improvement and upgrade maps, we considered all roads in the 24-county area classified as Principal Arterials according to the Functional Classification system of the Minnesota Department of Transportation. Principal Arterials are defined as the high-capacity highways that make up the metropolitan highway system; this includes the categories of Federal and Interstate, Other Freeway Expressway, and Other Principal Arterial [22]. Principal arterials for the Minnesota portion of the 24-county area were identified using the 1998 General Highway Maps by county produced by Mn/DOT. Principal Arterials for the four Wisconsin counties were determined using the 1997 Urban and Rural Functional Systems Maps by urban area and county produced by the Wisconsin Department of Transportation.

We collected data on changes to these Principal Arterials (based on the categories of 2-lane highways, multiple-lane highways, limited-access freeways, and interstates) using Minnesota and Wisconsin Official State Highway Maps. These maps were compared across the years of 1970, 1979/80, 1985/86, 1989/90, 1997/98 to determine any new construction of arterials or upgrades to existing arterials. This data was overlain on digital base map files obtained from the Minnesota and Wisconsin Departments of Transportation (Basemap 97, 1:100,000-scale Roadway Chain) to produce Figures 40-43.

APPENDIX 2-C
Reported Permit Number and Value for County Unincorporated Areas, 1972, 1979, and 1980-1994

County	1972						1979					
	Industrial		Office		Commercial		Industrial		Office		Commercial	
	Permits	Value	Permits	Value	Permits	Value	Permits	Value	Permits	Value	Permits	Value
Carver	1	4,400	0	0	1	73,800	1	81,496	0	0	1	104,970
Chisago	3	51,500	0	0	2	21,000	2	145,000	0	0	1	96,000
Goodhue	0	0	0	0	0	0	0	0	0	0	0	0
Isanti	0	0	0	0	0	0	2	21,000	0	0	4	8,000
Le Sueur	0	0	0	0	0	0	1	7,000,000	0	0	0	0
McLeod	*	*	*	*	*	*	14	310,775	0	0	3	169,000
Meeker	5	868,295	1	1,720,346	3	439,686	3	715,862	1	1,720,346	3	439,686
Mille Lacs	*	*	*	*	*	*	2	1,034,800	6	54,513,630	6	1,089,686
Rice	2	36,300	0	0	1	15,000	0	0	0	0	1	28,000
Scott	2	107,000	0	0	6	122,000	2	160,000	0	0	3	466,000
Sherburne	0	0	0	0	0	0	1	447,270	0	0	13	409,200
Sibley	0	0	0	0	0	0	*	*	*	*	*	*
Washington (pt.)	*	*	*	*	*	*	*	*	*	*	*	*
Wright	6	261,200	0	0	1	18,000	1	62,000	2	110,000	0	0
Burnett (WI)	0	0	0	0	0	0	0	0	0	0	0	0
Pierce (WI)	0	0	1	25,000	1	11,000	0	0	1	25,000	1	11,000
Polk (pt.) (WI)	1	5,500	0	0	1	12,000	0	0	1	129,000	2	42,000

County	1980-1984						1985-1989					
	Industrial		Office		Commercial		Industrial		Office		Commercial	
	Permits	Value	Permits	Value	Permits	Value	Permits	Value	Permits	Value	Permits	Value
Carver	1	415,600	0	0	0	0	0	0	0	0	2	81,000
Chisago	5	1,579,888	2	107,766	9	1,502,029	19	1,921,296	5	265,052	9	462,148
Goodhue	1	300,000	4	631,000	0	0	0	0	6	416,000	2	183,000
Isanti	1	888,000	0	0	1	10,000	0	0	1	34,560	4	166,500
Le Sueur	1	200,000	3	433,000	1	3,414,000	0	0	0	0	0	0
McLeod	8	596,887	1	729,478	1	197,993	10	622,300	0	0	3	78,000
Meeker	19	6,463,976	0	0	0	0	18	5,469,205	0	0	3	400,623
Mille Lacs	1	323,953	2	1,433,740	0	0	3	819,140	3	946,313	5	721,400
Rice	4	218,000	0	0	5	117,300	1	1,625,000	0	0	1	10,000
Scott	7	630,000	2	186,000	38	730,100	8	937,000	0	0	7	416,000
Sherburne	4	539,000	4	118,000	4	133,000	5	404,000	1	84,000	3	65,000
Sibley	5	160,000	0	0	1	250,000	0	0	0	0	0	0
Washington (pt.)	0	0	0	0	0	0	0	0	3	209,500	1	336,500
Wright	6	362,582	2	366,000	7	213,283	21	1,322,913	2	174,000	1	750,000
Burnett (WI)	0	0	1	704,262	3	580,182	0	0	2	1,141,248	5	866,107
Pierce (WI)	6	44,376	1	250,000	5	191,500	1	20,000	0	0	3	304,500
Polk (pt.) (WI)	0	0	2	19,500	1	1,500	2	89,000	1	60,000	5	370,000

County	1990-1994					
	Industrial		Office		Commercial	
	Permits	Value	Permits	Value	Permits	Value
Carver	0	0	0	0	1	112,000
Chisago	7	1,070,000	4	212,503	5	296,683
Goodhue	3	77,000	1	1,250,000	12	695,000
Isanti	2	115,000	0	0	4	212,000
Le Sueur	0	0	0	0	0	0
McLeod	8	727,319	2	104,500	13	146,100
Meeker	4	2,011,499	0	0	1	216,694
Mille Lacs	1	364,822	2	421,749	13	2,888,554
Rice	5	740,500	0	0	17	501,420
Scott	2	61,529	1	362,188	12	426,237
Sherburne	6	1,395,000	4	194,000	10	997,000
Sibley	0	0	0	0	0	0
Washington (pt.)	1	34,000	2	264,000	6	1,515,500
Wright	13	1,300,369	5	413,637	11	824,820
Burnett (WI)	3	1,209,471	0	0	2	495,403
Pierce (WI)	2	143,000	1	15,000	4	772,717
Polk (pt.) (WI)	0	0	2	118,000	4	100,000

Data source: U.S. Department of Commerce, Bureau of the Census. Non-Residential Building Permit Data, 1972, 1979, 1980-1994, tape files.

Notes: These figures are included in the totals shown below each figure in this chapter that depicts industrial, office, and commercial building permit activity. * indicates no report for the time period.

Chapter 3

DEVELOPMENT AND LOCAL GOVERNMENT FINANCE IN THE GREATER TWIN CITIES METROPOLITAN AREA, 1970-1997

INTRODUCTION

This chapter examines ways in which the development process has been associated with trends in local government revenues and expenditures as patterns of metropolitan population growth and local land use change played out within a sample of 28 local units of government in Minnesota and Wisconsin since 1970. We ask: (1) what have been the impacts through time of population growth and accompanying residential, commercial, industrial, and office development on the revenue and expenditure patterns of a sample of local units of government at different locations around the 24-county Twin Cities area, and (2) how do those fiscal profiles differ depending on average age of housing in local areas, and on variations in the age of local housing stocks?

To answer these questions, we describe and interpret profiles of change since 1970 in revenues and expenditures for a sample of 28 local units of government. These places are drawn from the seven core counties and from the surrounding 17 counties in Minnesota and Wisconsin that sent at least five percent of their daily commuters to the 7-county core in 1990. We evaluate fiscal profiles in terms of per-capita revenues and expenditures as they changed during the population growth and land development process. We then relate the fiscal profiles to rates of population growth. (In later reports in this series we will analyze changes in housing value rankings as the development process proceeds from early to current stages.)

UNDERLYING ISSUES

Development—Pros and Cons

Some interest groups see local economic expansion and land development in their economic and political interest, while others oppose rapid and disruptive rates of development, the forms it takes (e.g., types and mixes of housing styles; different land use types), or other development features (e.g., damage to natural environments; failure to accommodate different kinds of households; architectural and aesthetic forms). During the development process, local elected

officials and their staffs are conscious of the requirement that they balance revenues and expenditures and contain tax increases. Yet despite controversies over development, the scholarly literature remains unclear about how exactly the land development process affects a local unit of government's short-term and long-term ability to pay its bills as development proceeds, even though advocates and opponents of growth often assert that they know the answers.

Development—Costs and Benefits

There is no question that growth produces benefits as well as costs, yet questions persist. Will new revenues cover new costs? What are the relationships over space and time between who pays and who benefits? Even though we have a sense that development costs and benefits are distributed among different locations and different interests, it remains unclear who does pay? Who should pay? And how?

Impact Fees, Exactions, and Assessments. The popularity of impact fees (i.e., direct charges on developers to pay for additional needed infrastructure), exactions (e.g., mandatory on-site infrastructure improvements to serve new development, or off-site land allocations by developers for additional parks and schools), and special assessments (e.g., for city street improvements, curb and gutter, trees along boulevards) to pay for improvements on or adjacent to newly improved properties has risen briskly since the late 1980s, and for several reasons. State and local governments around the country have imposed limits on tax hikes; governments at all levels have issued mandates against increasing spending without provisions for accompanying revenues; and—perhaps most important—elected officials are reluctant to raise taxes.

Despite the post-World War II experience with suburban population growth and land development across the United States, the full fiscal impacts of the development process remain poorly understood. Nevertheless, studies during the past 25 years from all parts of the nation are unanimous that growth raises taxes, with commercial development even more expensive than residential development. That outcome results because development brings with it additional costs. One Oregon study estimated additional infrastructure requirements per new house at $24,500 [1]. Of course, new houses also pay new taxes, and often are charged special assessments to pay for some of the required infrastructure on or adjacent to the property.

Sometimes developers are charged impact fees, which often can be passed on in whole or in part in the form of higher prices for new housing or reduced payments to land owners as they convert

their land to urban uses [2]. But development impact fees, exactions, and assessments take different forms in different states and local jurisdictions, and many states forbid their use [3]. A later report in this series will more closely examine development impact fees and how they are implemented across the country.

Tax Increment Finance. Another device used by local governments to finance development and redevelopment is tax increment finance (TIF). TIF allows communities to "capture" the increased property-tax revenues (i.e., the "tax increment") generated by a development in order to finance some of the costs of that development. The process begins when a city council defines a TIF district by local ordinance, and determines the total tax capacity of the properties within the TIF district *prior to* development (or redevelopment). An estimate is made of probable tax capacity *after* development; then the council calculates the annual augmented property tax that will be made available. That extra tax revenue is used to back locally-issued bonds that provide the city with the money needed for clearance, city-supplied infrastructure, subventions to developers, and other purposes associated with development within the TIF district.

The increases in tax capacity and tax revenues from the TIF district are not available for general city expenses or to other taxing jurisdictions such as the county or school district. This practice can mean higher taxes on non-TIF property because increased tax revenues due to higher local government expenditures and corresponding higher tax rates are reserved for TIF-related expenditures for the life of the TIF district, which can range up to 25 years [4].

There were 1,509 TIF districts in Minnesota in 1997, with 550 of them in the Twin Cities metropolitan area [5]. In the 7-county Twin Cities area, 7.5 percent of the tax base was captured in TIF districts in 1997. Metro-area-captured tax capacity grew at 8 percent in 1997, which was more than twice the rate of growth in the previous year. Minnesota cities with the highest TIF tax base were Minneapolis, Bloomington, St. Paul, Duluth and Brooklyn Park.

Metropolitan Growth, Land Development, and Increased Highway Traffic

One consequence of rapid growth accompanied by low-density development and segregation of different classes of land use connected by limited-capacity highways is increasing congestion—that is, levels of traffic that reach or exceed road design capacities. The Metropolitan Council and Mn/DOT expect that the number of congested miles of freeway in the seven counties will more than double by 2020. Some analysts view this congestion as the cost we inevitably pay for creating the settlement system, activity patterns and daily activity orbits that we think we want.

For the foreseeable future, therefore, highway congestion in the greater Twin Cities area seems to be here to stay [6].

The Twin Cities area is not alone in experiencing rapid metropolitan growth, increasing highway traffic, and other growing pains. The Brookings Institution has launched a "Metropolitan Initiative" aimed at forging metropolitan solutions to urban and regional problems, with program elements that are closely aligned with the Transportation and Regional Growth Study [7]. Maryland and other states have recently initiated efforts to curb low-density suburban development and to promote "smart growth", in order to preserve farmland and open space and to steer infrastructure investment and private development into established communities [8]. The underlying concern of scholars, planners and many local officials is that although current patterns of metropolitan growth and development seem to be popular with a majority of citizens and business interests, there appear to be mounting inefficiencies and notable inequities in the ways that we build and use our metropolitan areas.

Looking ahead, projections of present development trends and the price tags attached to different growth and development scenarios suggest that as a society we are probably heading for trouble if we persist in our present course—that is, planning to grow and develop during the coming years as we have during the past thirty. The contemporary American metropolis is largely a creation of market-distorting government tax expenditures and subsidies, and some scholars believe that troublesome trends might be more easily reversed by less government presence at the local level [9].

Resolution of these metropolitan planning and management questions might have been facilitated by Congress, but recent Congressional action that shifted federal powers to state and local levels has had the effect of imposing new burdens on local jurisdictions. In several cases these duties would better be assigned to metropolitan jurisdictions, thereby strengthening them and improving efficiencies in metropolitan infrastructure provision while enhancing attention to regional issues such as general comprehensive planning for metro areas, design and historic preservation, community development, environmental quality, housing, human services and transportation [10].

Theoretical and Empirical Literature on Land and Tax Policy

The two most important functions of MCD governments (e.g., cities, villages, townships) in the U.S. arise from their power to tax and from their power to regulate land uses within their

jurisdictions [11]. Local governments raise taxes to support various local public services. They regulate land use to segregate different types of land uses, to restrict various types of land uses, and sometimes to slow the pace of local land development. Regulatory tools normally are used to achieve various land use goals, while local tax instruments are used mainly to raise revenues. Land use policy and local taxation interact in complicated ways, some intended, some unintended, and some poorly understood.

Why Examine These Interactions?

The interactions between local *land policy* and local *tax policy* are interesting from both theoretical as well as policy perspectives. The 19th-century social reformer Henry George found it natural to examine land policy and tax policy together [12]. He argued that a tax on land rents would provide the correct incentives for land owners to use their land most productively, and it would simultaneously eliminate the need for other taxes. He felt that many taxes distort economic behavior, including the property tax, which usually applies to improvements to land (i.e., structures) in addition to land itself. Thus, good tax policy would be the same as good land policy.

The second reason to examine land policy and tax policy together is that local land use regulation, as implemented through zoning, subdivision regulation, development-management systems, and other mechanisms, often is carried out explicitly to promote the fiscal goal of keeping revenues up and local government costs down by discouraging certain land uses like low-priced housing that are thought to generate more municipal costs than they provide in local revenues.

A third reason for examining the interactions of land policy and tax policy is the widespread belief that taxes used by state and local governments might have significant effects on land use, by affecting locational decision making by firms and their customers. Not only do business leaders argue that tax policy affects their expansion plans and sometimes prompts relocation decisions, but state and local governments frequently use tax policy in the form of tax abatements to promote development. Meanwhile, on the edge of expanding metropolitan areas, preferential tax treatment for agricultural land often is used to slow development and preserve farm land and open space.

Controversies: Land and Property Taxation

A local government's power to tax local residents, land and activities derives from state rather than from federal constitutions and laws. As a result, these powers vary from state to state.

Within states, there may be variation among local units of government in the types of taxes they use. States confer home-rule powers on selected municipalities, which give them more freedom to choose their local taxes. State law may enable local governments to enact supplemental taxes, but does not require them to do so. In Minnesota and Wisconsin, counties, cities, villages (WI), townships (called towns in Wisconsin), school districts and other special-purpose districts have taxing, spending and regulatory powers specified by state statute, or—as in the case of "home-rule" cities—granted according to the terms of their charters.

Counties. The principal territorial subdivision of the state for purposes of carrying out state government functions at the local level is the county, of which there are 87 in Minnesota. The county's primary functions include courts, welfare, public health, sanitation, roads and bridges, parks, and a range of additional functions depending on the setting and character of a county, which can range from northern forest and recreation areas, to western agricultural counties, to those on the expanding margins of the greater Twin Cities area. In certain respects, there appears to be a steady convergence in the mix of activities and services assumed by cities, townships and counties when they are located in and around rapidly developing metropolitan areas.

Cities. There are more than 800 cities in Minnesota. About 50 of these municipalities are "home-rule" cities that have been granted charters from the state and govern their internal affairs according to the terms of their charters. The remainder of Minnesota's municipalities are "statutory cities," of which there are several variants, each of which provides a different pattern of rights and responsibilities under state law.

Townships. In the Midwest, congressional townships were established as a component of the Northwest Ordinance land survey, which subdivided federal lands to facilitate land sales, homesteading, settlement and railroad land grants. In Minnesota and Wisconsin most townships were square 36-square-mile land subdivisions of counties. Sometimes at their center by the "town hall" a cluster of homes and businesses established itself as a separate bounded municipality. State statutes specify the limited taxing and spending powers of townships, which usually are devoted mainly to local roads and bridges serving agricultural areas. Recent Minnesota legislative action broadened the range of activity of certain "urban townships," especially in the vicinity of expanding metropolitan areas, to permit them to carry out additional city-like functions while allowing them to preserve temporarily some of their agricultural countryside atmosphere.

Special Districts. Special-purpose districts for schools, watersheds, fire protection, transit,

water, waste control, parks, and other functions make up the remainder of substate jurisdictions. Each of the general-purpose local governments (cities, villages, townships, towns, counties) and the special-purpose local governments in Minnesota and Wisconsin generally have the power to tax, and property taxes historically have been the dominant tax sources for local governments [13]. In 1927, the property tax nationwide accounted for over 97 percent of total local taxes and 69 percent of local government revenues, but there has been a steady decline in the property tax share of general revenues as other revenue sources have risen in importance [14]. Although the percentage of local taxes nationwide coming from property taxes remains high for counties (74 percent), municipalities (53 percent), townships (93 percent), school districts (97 percent) and special districts (68 percent), as a percentage of general revenues, property taxes have been declining as intergovernmental and other revenues have increased.

Fiscal Trends and Fiscal Pressures

Several trends have narrowed the local property tax base, including the exemption of personal property (household goods, motor vehicles, business equipment, inventories), homestead exemptions, special treatment of farms, property owned by churches, schools and other nonprofits, and property tax abatements to promote economic development. Besides policies that narrow the property tax base, some states impose caps on local property tax rates, or on the rate of increase of local property taxes.

At the same time that state legislatures are tempted to impose limits on local property tax rates and their rates of increase, some large cities around the country and in Minnesota find themselves in difficult fiscal condition due to demands for expanded expenditures escalating faster than their ability to raise revenues from local taxes, fees and charges. As older central cities and first-ring suburbs find themselves in a fiscal crunch, Congress has acted to devolve a number of federal responsibilities (especially Medicaid, AFDC, and welfare) to state and local governments. If the states respond to devolution of program responsibility by using their own revenues to offset federal aid cuts, they will be forced to raise state taxes or to find other programs to cut, which may lead to declines in state aids to cities and other local governments. Program devolution will in all likelihood lead to greater competition among local jurisdictions for economic activity that they can tax, thereby increasing the pressure to use tax abatements to attract new activity, as well as zoning out low-income households.

Fiscal pressures on developing communities motivate them to find additional revenue sources that can be linked directly to the development activity itself, and be supported by current voters.

Such communities increasingly turn to exactions and development impact fees charged to developers to finance additional public services required as a consequence of new development. Exactions on developers are not new. Large developers have traditionally been required to supply on-site infrastructure such as local streets, curbs and gutters, and occasionally water and sewer pipes. But jurisdictions today are increasingly seeking to obtain funds from developers for off-site infrastructure such as parks and schools [15].

One interpretation of development impact fees is that they are comparable to zoning regulations, justified by the "police power" of a municipality, and slow down development by passing more of its direct costs onto its direct beneficiaries, namely the developers and their customers. One objection to such fees is that by raising development costs such fees harm low-income households that are unable to pay the higher costs.

A second interpretation of development impact fees argues that they facilitate growth because in their absence communities are prompted to engage in fiscal zoning; that is, accommodating only what is seen as profitable development while discouraging development that promises to raise local government costs faster than local revenues. In the absence of impact fees, the costs of growth shift to the general property tax and apply to old as well as new development. To the extent that new development fails to pay its way, it imposes new burdens on established residents and provides them with a motive to curtail or to limit development. Thus, appropriately set impact fees can reduce tax burdens on old residents, and make new development more politically acceptable [16]. The general political argument advanced by both economists and political scientists is that the flexibility of impact fees—when skillfully applied—can transform arguments over development from a zero-sum contest between pro- and anti-development forces into a distributive game in which differences can be reconciled depending on the balance of local forces [17].

Still another view of impact fees observes that today's "old residents" gained temporary financial advantage at an earlier time when their neighborhoods were new and the cost of the infrastructure serving their house and neighborhood was charged to them on an "average cost basis" rather than on a "full marginal cost basis." According to this view, that earlier unpaid-for gain is now offset (how much is difficult to estimate) by their present subsidy to new developments and new residents on the growing edges of the metropolitan community. Thus, it is argued, there may be a kind of rough intergenerational equity produced by the traditional ways we have charged for the costs of growth.

This argument is weakened in part by the process of residential mobility. There is no certainty that today's residents of old-settled areas are the same households as those that gained the financial benefits from the underpricing of urban infrastructure one or more generations ago.

Conventional Wisdom (CW) on Local Land Use and Tax Policy

One of the country's leading authorities on widely-held beliefs concerning the intertwining of local-government land-use and tax policies surveyed those views, then checked whether recent research supports them [18]. (This report does not research these views further.) In general, the smaller and more spatially fragmented are the local jurisdictions and the greater the spending responsibilities they bear, the larger is the impact on land use of local fiscal decisions. In addition, the effects of land policies on land prices and taxes vary with the size of the jurisdiction and the mobility of people and households across the jurisdictions. Some other findings follow [19].

CW: A Tax on Land Does Not Distort Land Use Decisions. The traditional view, advanced by the 19th-century social reformer Henry George, holds that a tax on the return to land (i.e., land rents) will not distort behavior of a landlord because he will continue to develop or improve his site to take full advantage of the land in order to maximize his profits. Recent research suggests that the conventional wisdom—that a tax on land rent has no effect on the intensity of land use—remains intact. However, a tax on the capitalized value of expected future returns may affect the *timing* of development. So whether a tax on land value is likely to distort a land owner's development decisions depends largely on how land value is determined for purposes of taxation [20].

CW: In Contrast to a Tax on Land Alone, a Tax on Property (Including Improvements to Land) Distorts Land Use Decisions. This standard view has been challenged by an argument that local property taxes are like a benefits tax when there are many local governments in a metropolitan area and each one zones its land to ensure internal homogeneity of housing value. Under such restrictive and unlikely conditions, taxes paid by residents of a community act like a user charge for locally-provided services, and do not distort economic decisions. There remains disagreement, though, about the extent to which zoning achieves this goal, so in general the conclusion stands that property taxes distort investment and housing decisions.

CW: Property Tax Is Regressive. A regressive tax is one that imposes a larger proportional burden on low-income households than on higher-income households. Implicit in the

conventional view that the property tax is regressive is an assumption that the property tax is not a benefits tax–that is, one for which the burden of the tax across all households is perfectly offset by the benefits one receives from local public spending. The conclusion that the property tax is regressive seems to be valid, but only from the point of view of relatively small jurisdictions from which business and other capital investment can easily be withdrawn in favor of lower-tax areas. For the country as a whole, though, the property tax seems to be a tax on capital, the burden of which is distributed among households in an essentially progressive manner. Thus, any federal effort to reduce reliance on property taxes is likely to benefit high-income households more than low-income households [21].

CW: New Development Generates a Fiscal Profit for Local Governments. Many studies of the fiscal impact of local development have shown that with the exception of low-priced housing, new residential development typically pays its fiscal way, and business property yields an excess of new revenues over added expenditures. This generally-accepted conclusion has recently been challenged in the United States by changing economic circumstances and by a spate of increasingly sophisticated analyses suggesting that new development may impose greater fiscal burdens on local governments than was earlier believed. Specifically, new development may require more additional public infrastructure spending than was previously believed, and may cost more than the additional revenues generated by the new development. Other recent studies support the conventional view, so the question remains an open one [22].

The issue is complicated by the increasing use of local government subsidies for real estate development, especially for offices and retail trade. It is likely that the widespread use of such subsidies by many municipalities in a fragmented metropolitan region like the Twin Cities, with its 191 local governments within the 7-county area, expanded the total volume and floor area of such facilities beyond what the commercial real estate market might otherwise have demanded, with the result of prematurely lowering the asset value (and tax capacity) of older existing facilities.

For example, the Mall of America abruptly and dramatically increased the amount of retail floor space in the Twin Cities area. The mall no doubt attracted new business from tourists coming from other parts of the Upper Midwest, the United States, and from abroad, but it also seems to have weakened the retail markets supporting existing retail facilities. Thus, the fiscal profit for the city of Bloomington is probably substantial, and there may be a net gain for the entire metro region depending on the amount of tourist traffic, but some retail facilities have lost value, and

the jurisdictions within which they are located certainly failed to profit from the mall.

CW: High-Density Development Imposes Less of a Fiscal Strain on Local Government Than Low-Density Development. The conventional view of modern city and regional planners has been that compact development is more efficient for providing public facilities and services than spread-out development. It follows from this view that compact development should be encouraged as a way to reduce local taxes and spending. Recent research by economists finds that public-sector costs may bear a U-shaped relationship with population density—that is, sparsely settled and densely settled areas may lead to higher cost than those settled at moderate densities [23].

The reasons why per-capita costs of city governments can decline with growth–for a while– before rising are fairly clear. If the costs of equipment and personnel for a small city are spread over only a few people, the costs per capita can be quite high. With populations of only a few hundred or few thousand, cities operate inefficiently. There may be insufficient work to keep a city clerk busy full time, yet someone must be on duty to answer the phone. Law enforcement needs may be modest, but personnel is needed for emergencies. Small budgets usually mean modest compensation for personnel, and low pay cannot attract the best-trained and most efficient employees. Once the services are staffed, additional population can be accommodated with little additional personnel. Extra tax revenues can be used to upgrade the skills of personnel and their equipment, and per-capita costs of city services can decline as economies of scale are achieved. Beyond a certain city size, per-capita costs of running a city begin to rise. Public safety expenditures increase as cities become larger and more complex. Law enforcement personnel are on duty 24 hours per day. Building inspection outlays rise as the city's buildings age. Demand for emergency services rises. Aging infrastructure requires more maintenance than it did when new. And so it goes.

CW: Variations in State and Local Tax Rates Have Little Effect on Location and Investment Decisions of Firms. Economic theory long held that variations among jurisdictions ought to affect the location and investment decisions of firms. Early empirical studies found that whereas differences existed and were often significant, other decision criteria clearly dominated locational decision making. Recent studies challenge this conventional wisdom, confirming the theoretical prediction that taxes significantly affect the location decisions of firms among states and among localities within metropolitan areas [24].

A widely discussed local example is a number of manufacturing firms that moved east across the St. Croix River into Wisconsin, reportedly to avoid some of the costs of worker compensation premiums that until recently were substantially higher in Minnesota than in Wisconsin. Other firms have apparently moved from Minnesota to the Dakotas to take advantage of tax treatments that they judged to be favorable to their businesses.

CW: Tax Policy Alone is an Ineffective Tool for Achieving Land Use and Related Social Goals. Tax policies such as tax abatements for businesses locating or expanding in enterprise zones, or preferential treatment of agricultural lands, are frequently used as tools of land policy. The conventional wisdom of economists, although not always of policy makers, is that tax policy is not a very effective tool for helping disadvantaged residents in economically distressed areas, and that view seems to be supported by recent research. Meanwhile, study of farmland preservation by means of tax abatement seems to show that more land remains in farming than would be without the program. It is not clear, however, that the farmland that is preserved from development is the land that should provide the positive externalities that justify the program. It all depends on which lands are preserved [25].

Sometimes the land that is targeted for preservation is directly in the path of a high-value residential expansion corridor and the tax abatements for a period of years merely postpone an inevitable conversion and development with capital gains for the owners that may be even more lucrative than would have occurred without the policy. Meanwhile, tax expenditures used to keep marginally productive, low-amenity-value farmland in production may cost local governments revenue without yielding much of a public benefit. Moreover, not all farmland gets converted to urban uses at the same rate. Some lands will stay in agriculture for many years even without a farmland preservation policy, depending on their location and their site characteristics compared with other available developable areas.

CW: A Shift Away from the Property Tax in Favor of More Reliance on the Land Tax Could Reinvigorate Declining Cities. The conventional view of land economists argues that shifting away from a tax on improvements to a tax on land would yield positive effects on developing and redeveloping urban land. They are quick to point out, though, that the benefits arise from the reduction of the tax on improvements, rather than from the increase in the tax on the land. Theoretical work argues that tax restructuring is most likely to increase land values if the jurisdiction making the change is small relative to the metro region of which it forms a part. Empirical analysis of such a restructuring program is difficult to obtain because few cities have

experimented with this form of tax-base shifting. The Pittsburgh experience is consistent with expectations, but the evidence is insufficient to eliminate other explanations for Pittsburgh's recent economic vitality [26].

There are such a large number of separate and competing municipal jurisdictions within the 7-county Twin Cities area that the example from Pittsburgh probably has little or no practical significance for this region. Minnesota's Fiscal Disparities law, which has been in effect for a quarter of a century, does have some effect on the fiscal incentives influencing land development within the seven counties, but as the metropolitan area spreads into 24 or more counties and into Wisconsin, the effects of even this innovative and effective law are becoming increasingly modest.

CW: Development Impact Fees Are an Effective Way to Shift the Burden of Paying for New Infrastructure onto New Residents Who Require It. Many fast-growing communities impose exactions (that require developers to install one or more components of infrastructure or to allocate land for public purposes such as schools or parks) or development impact fees (direct charges) on new development with the goal of shifting the cost of added infrastructure and services to new residents. However, it seems that more than half of the burden of the fees is likely to fall on the owners of undeveloped land [27]. If one jurisdiction imposes a development impact fee, either housing prices or land prices must adjust to maintain developers' profits. The increase in the price of housing that accompanies new infrastructure normally will be insufficient to compensate a developer fully for the associated impact fee, so the price of land must drop to preserve developers' profits.

In principle, the burden on landowners can be reduced by means of tax increment financing if TIF is used to pay for the various infrastructure improvements associated with the new development. But TIF cannot in general eliminate the burden on landowners entirely, because the infrastructure-induced increase in the price of housing will lead to a decrease in the quantity of housing consumed. As the quantity decreases, the property tax collected on house-value increments falls short of what is needed to eliminate the burden on land owners.

Tax increment financing is impractical in these instances because of assessment difficulties plus the difficulty of isolating the benefit areas of infrastructure improvements. In addition, it is possible that existing residents would harvest unearned capital gains on their properties when development impact fees are imposed on new development to pay for new infrastructure,

because new houses will raise the tax base. If total property tax revenues were held constant, tax rates on existing homes would decline and the value of those houses would rise by the capitalized value of the tax reduction.

Special assessments to pay for new infrastructure may be a fairer way to finance new infrastructure because they fall entirely on the people who benefit, and established residents receive no capital gains.

The conventional wisdom attempting to explain the central relationships that are thought to exist between land development processes and local fiscal structures is sometimes supported by carefully designed contemporary research, and sometimes not. Much of the research that has been carried out by the nation's leading scholars of local government has failed to consider the spatial (*where* did the development occur?) and temporal (*when* did it occur?) settings within which land development and fiscal relations evolve. Part of the gaps in the literature can be traced to the fact that the urban economists and public administration scholars who study state and local fiscal affairs generally fail to consider the geographical settings of their case studies. On the other hand, the geographers who study urban evolution usually avoid analysis of local fiscal issues. In the case studies that follow, we evaluate fiscal structures and local growth processes with attention to geographical settings that might shed light on the basis for variations among the places examined.

Revenues and Expenditures Profiles of a Sample of Local Units of Government, 1970-Present

The Study Area and Methods

Diversity in the Study Area. The study area includes the 7-county Twin Cities area under the jurisdiction of the Metropolitan Council, plus 17 surrounding counties in Minnesota and Wisconsin that were linked to Twin Cities-area job markets according to commuting data collected by the 1990 U.S. Census of Population and Housing. The settlement pattern within the 24-county area includes:

- the fully built-up core of Minneapolis, St. Paul, and the older suburbs;
- currently developing suburban municipalities within the 7-county Metropolitan Urban Service Area (MUSA);
- low-density areas of restricted development beyond the MUSA but inside the 7-county area;

- rapidly developing cities, townships, villages (WI), and towns (WI) adjacent to the 7-county area but beyond the jurisdiction and development-management controls of the Metropolitan Council; and
- essentially agricultural townships, towns (WI), and small municipalities that are basically locally focused, but with some residents engaged in long-distance commuting to jobs outside their local areas.

Population densities generally decline from the Minneapolis-St. Paul core to the edges of the 24-county area, with the trend interrupted by small cities and villages scattered across the area, and by a ring of rapid growth and higher densities just beyond the edges of the 7-county area, where relatively rapid and uncoordinated development from a metropolitan planning viewpoint has been underway for more than a decade. Within the 7-county area there are 191 local units of government, and within the 24-county area there are 631 such local units. It is from this set of 631 that we selected our sample of 28 to examine trends in local government finance since 1970 (Figure 3.1).

Median Age and Variability in Age of Housing. As explained in the previous chapter, we examined the average age (and variability in age) of the housing stocks in each of the 631 local areas using 1990 census data. Then we sorted the local areas into six groups or *vintages* according to the median ages of their housing stocks: pre-1940, 1940s, 1950s, 1960s, 1970s, and 1980s. Each of the local areas developed at different times, and the *median age* of their housing stocks in 1990 reflects the time of their development. For example, Minneapolis built up early, so the median age of its housing stock in 1990 was pre-1940. St. Paul had extensive areas of undeveloped land at the end of World War II so its median age of housing in 1990 was in the 1940s. Many of the small towns and villages in outlying parts of the 24-county area grew up as farm-service centers in the 19th century and contain an aging housing stock, while newly developing suburbs at the margins of the built-up Twin Cities area had median ages of housing in the 1980s at census time.

The second measure of housing age for local areas is variability. Some cities such as Richfield built up over a short period of time in the 1940s and 1950s, so the 1990 census disclosed relatively little variability in housing age. Other places received new construction steadily over a long period of time, so at census time they reported significant shares of their housing stock from each of the six time periods, or high variability in housing age. By calculating the *variance* in the age of the housing stock in each of the 631 local areas we recognize the diversity of their

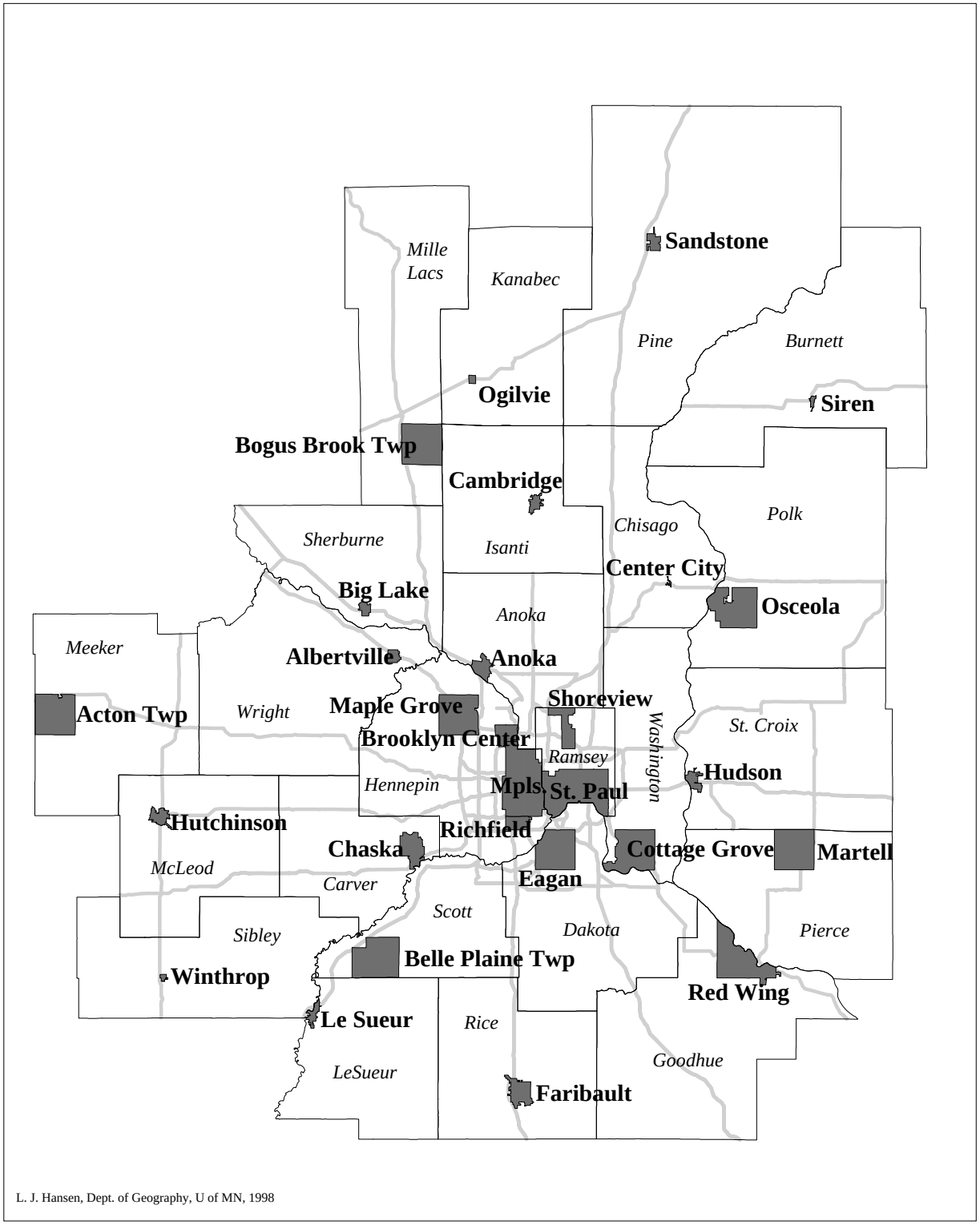


Figure 3.1. Sample Local Units of Government.

histories of development, and the consequent degree of homogeneity or heterogeneity of housing ages.

A Sample of Local Units of Government. We plotted the 631 local areas according to their *median age* (horizontal axis) and the *variance* in age of their housing stocks (Figure 2.21). A best-fitting (ordinary least-squares regression) line slopes downward to the right, illustrating the general trend of newer places as more homogeneous in their housing ages, while older places contain a greater diversity of housing ages. Parallel lines were drawn at a distance of one standard deviation above and one standard deviation below the best-fitting line. Next, lines were drawn at decennial census dates (1940, 1950, etc.) to divide the plotted array of local areas into six vintages (pre-1940, 1940s, 1950s, etc.).

Among the pre-1940 areas, for example, there were 79 places in the 24-county area that reported median year of housing construction as 1939 or earlier at the time of the 1990 census. The 26 places with housing of essentially similar age (i.e., low variance) included Minneapolis along with a number of small cities and villages (WI) throughout the area, plus a number of essentially agricultural townships and towns (WI) that did not receive enough new housing construction in later decades to change the median year of construction or to increase the variance. At the other extreme were nine places where pre-1940 housing still predominated, but with enough units added during recent decades to yield measures of high variability. The other 44 local areas of pre-1940 median year of construction feature medium-high or medium-low variance in housing.

To summarize, each of the six vintages was subdivided into four parts according to degree of variability in housing ages (high variability, medium-high, medium-low, low variability). The three downward-sloping trend lines along with the five vertical lines divided the array into 24 cells, and it is from each of these cells that the sample local areas were drawn. Some cells had large numbers of members (e.g., 1960s-high variance; 1970s-medium-high variance; 1970s-medium-low variance), some had almost none (e.g., 1940s-low variance; 1950s-low variance), and one cell had no members at all (1980s-high variance).

Identifying the final sample of 28 places followed a two-step process. First, we examined the list of members of each cell and selected a preliminary sample of about one in five places. We examined the list of places in each cell, selecting about one in five on the basis of their size (very small places ignored), location (selecting places from different counties), and significance (selecting well-known places). Secondly, we went through the list of over 100 places and made a

final non-random selection, obtaining at least one place from each county, including large and small places, cities and unincorporated towns and townships, places close to the center and some in outer regions, and with all sides of the Minnesota-Wisconsin 24 county-area represented (Figure 3.1). These selection procedures were followed in an effort to include different types of minor civil divisions (MCDs) in different geographical settings and at varying stages in the development process, ranging from those that have been fully developed for years (e.g., at the metro core, and at remote locations on the edges), to those at intermediate locations and those in the midst of the development process during recent decades.

The sample includes the following places, their county, their median year of housing construction, and their populations in 1990 (see Appendix 3-A for complete details on sample places). Places are grouped by decade of median year of construction (pre-1940, 1950s, etc.), and within decades they are sequenced from the place with the largest variance in housing ages to the smallest:

Pre-1940	Bogus Brook township (Mille Lacs), (1939), 886 (largest variance)
Era [28]:	Acton township (Meeker), (1939), 444
	Center City city (Chisago), (1939), 443
	Belle Plaine township (Scott), (1939), 675
	Minneapolis city (Hennepin), (1939), 368,383 (smallest variance)
1940s:	Martell town (Pierce WI), (1948), 870
	Sandstone city (Pine), (1945), 2,057
	Winthrop city (Sibley), (1948), 1,291
	St. Paul city (Ramsey), (1944), 272,235
1950s:	Red Wing city (Goodhue), (1958), 15,103
	Faribault city (Rice), (1956), 17,085
	Le Sueur city (Le Sueur), (1959), 3,720
	Richfield city (Hennepin), (1956), 35,710
1960s:	Hudson village (St. Croix WI), (1961), 6,378
	Ogilvie city (Kanabec), (1962), 508
	Siren village (Burnett WI), (1965), 844
	Hutchinson city (McLeod), (1969), 11,523

Anoka city (Anoka), (1969), 17,192
Brooklyn Center city (Hennepin), (1961), 28,887

1970s: Osceola town (Polk WI), (1972), 1,337
Big Lake city (Sherburne), (1974), 3,057
Cambridge city (Isanti), (1975), 5,094
Chaska city (Carver), (1976), 11,339
Shoreview city (Ramsey), (1976), 24,587
Cottage Grove city (Washington), (1973), 22,935

1980s: Albertville city (Wright), (1984), 1,252
Eagan city (Dakota), (1983), 47,409
Maple Grove city (Hennepin), (1981), 38,736

With the sample of local areas drawn and grouped by median year of construction of their housing, the next step in the analysis is to examine ways that revenues and expenditures changed over time since 1970.

Local Government Revenues. As local areas grow, the profile of revenues of their local governments changes in amount and in composition. We group various categories into four main types, plus a residual category of other revenues. The sum of the five equals total annual revenues.

Total local government revenues and revenues per capita can be expected to vary depending on the size of a community, its location with respect to the built-up portion of the Twin Cities metropolitan area, its rate of growth, the variability in age and condition of its housing stock, and the needs and expressed wants of its population. Our analysis is an effort to portray how revenues and costs vary by type of community and by geographic location within the development process underway in the greater 24-county Twin Cities region.

- *Taxes:* include property taxes (land and buildings), property tax from tax increment districts, sand and gravel extraction tax, franchise fees paid by public utilities in lieu of taxes, special assessments, local sales taxes, and hotel-motel taxes. *Property taxes* form a component of total taxes, but are separately identified so that they may be analyzed as they change in total and on a per-capita basis during the development process.
- *Intergovernmental Revenues:* include federal grants (community development block

grants, public safety, transportation, sanitation, public housing and other federal grants); state grants (local government aid (MN), state shared revenues (WI), homestead credits, highway funds, sanitation (WI), health and human services, public housing (WI), payments for municipal services (WI), and other), county grants (highway, bridges and other), and occasional payments from one local unit to another local unit for the purchase of services such as snow plowing.

- *Service Charges and Fees*: include moneys received from individuals, organizations and businesses for publications, highway materials, snow plowing, refuse collection, sanitary sewer, landfill fees, airports, swimming pool fees, library fees and park use fees.

- *Licenses, Permits, Fines, Other*: includes regulation and compliance revenues such as liquor and malt beverage licenses, building permits, occupational licenses, court fines, public safety contract revenues such as fire and ambulance revenues from other governments, and highway maintenance and construction revenues from other governments.

- *All Other Revenues*: includes interest income on investments, rental income, sale of property, insurance recoveries, donations, sale of bonds and short-term debt, and other revenues not classified elsewhere. Because of scale considerations, this category of revenue is portrayed in the third graph for each sample city.

Local Government Expenditures. As local areas grow and mature, the profile of expenditures and expenditures per capita by local governments changes in amount and in composition along with the revenue picture. On the expenditure side, we group various categories into four main types, plus a residual category of other expenditures. The sum of the five categories equals total expenditures and other uses of funds.

- *General Government*: includes operating expenditures and capital outlays spent for boards, elections, councils, judicial, legal counsel, clerk, treasurer, assessor, financial administration, planning activities, building maintenance, and unallocated insurance.

- *Public Safety:* includes operating expenditures and capital outlays for police, fire, ambulance, inspection, correctional facilities, civil defense, and emergency communications and services.

- *Streets and Highways*: includes money spent for street and highway maintenance and construction, snow plowing, street lighting, and parking facilities.

- *Culture and Recreation:* includes operating and capital outlays for libraries, parks, and recreation.

- *All Other Expenditures:* includes all capital and operating outlays that are not included in the other four categories, such as sanitation, health, enterprise funds, unallocated insurance and judgments, airports, unallocated pension contributions, housing and redevelopment authorities, short-term and long-term debt service (principal and interest), and transfers to enterprise funds and to government funds of various kinds. Because of scale considerations, this category of expenditure is portrayed in the third graph for each sample city.

These five categories sum to *Total Expenditures and Other Uses of Funds.* Together with the revenue data, they provide a summary profile of local government fiscal relationships during the study period. In the sections that follow, we examine how revenues and expenditures changed on a per-capita basis for the sample of 28 local units of government. The local governments are grouped by the average age of their housing stocks. Those with the oldest median year of housing construction (i.e., pre-1940) are presented and discussed first.

Within each group, there are differences among places in the degree of heterogeneity or homogeneity in the age of their housing stocks. Places with *heterogeneous* stocks (i.e., medium-high or high variance) are sometimes early-settled areas that have received a major influx of new housing recently and therefore display a bi-modal housing age structure, as well as places that contain significant shares of housing dating from most or all of the six different vintages. Places with relatively *homogeneous* housing stocks (i.e., medium-low or low variance) typically are old-developed places that received relatively little recent development, or places with a majority of their housing built over one or two decades during the post-WWII era.

Pre-1940 Housing—Bogus Brook Twp, Acton Twp, Center City, Belle Plaine, and Minneapolis

The cities and townships in this first group are old-settled areas that received insufficient recent development to change their median year of housing construction. They include outlying areas beyond the built-up suburbs of the metropolitan area, plus the central city of Minneapolis.

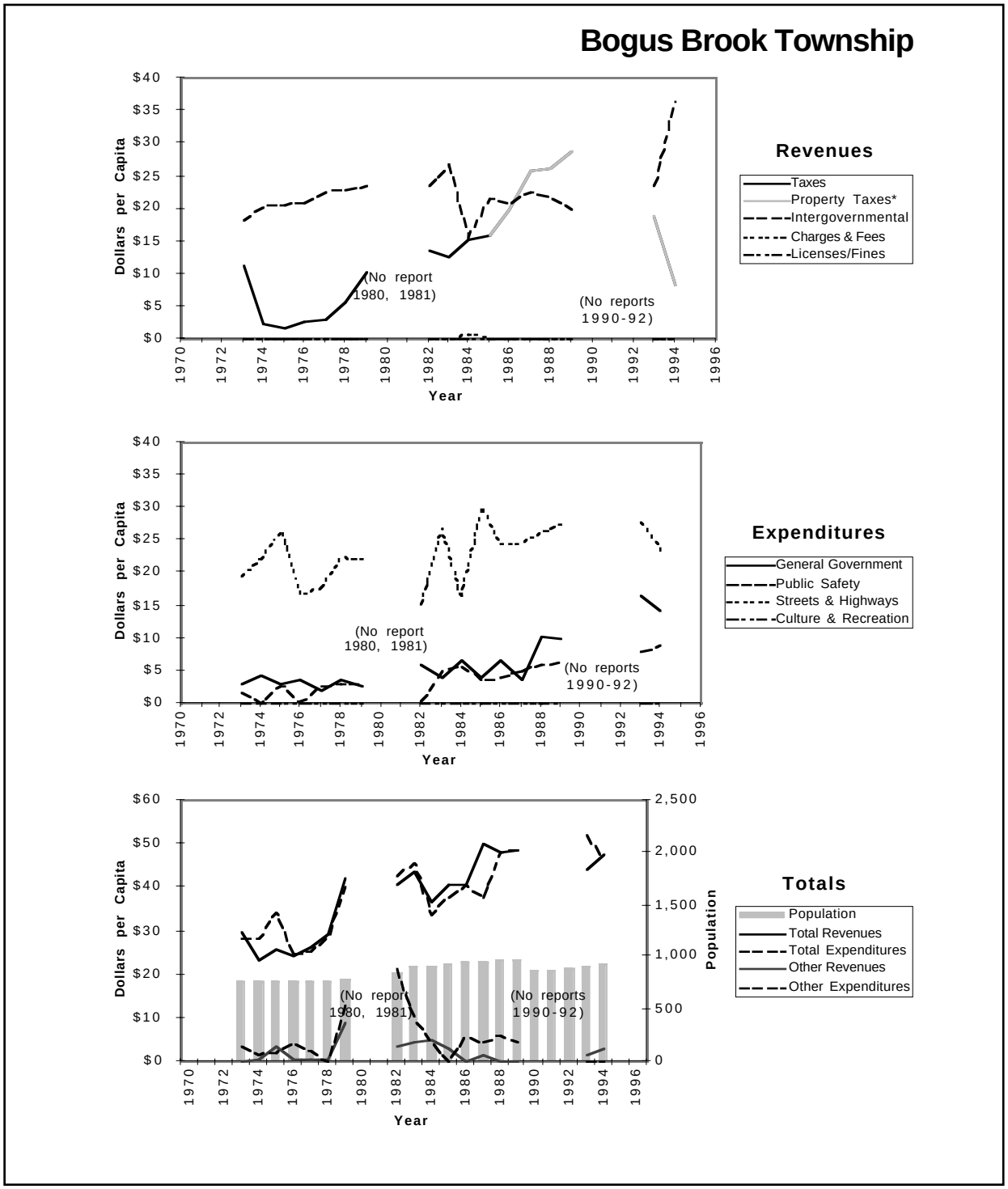


Figure 3.2. Major Local Government Revenues and Expenditures, Bogus Brook Township, MN, 1973-1994.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

Bogus Brook Township is a sparsely-populated township along US169 in southern Mille Lacs County near the outer edge of the 24-county study area, with a population that grew from 761 in 1973 to 926 in 1994. Over half of its 299 housing units date from before 1940, but almost a hundred have been built since 1980, which produces a large variance in housing ages. Despite gaps in the data record, there is a clear upward trend in annual per-capita revenues and expenditures in *current* dollars over the study period, from $28 to $48 between the mid-1970s and the early 1990s (Figure 3.2). Most of the spending is on road maintenance. The largest single source of revenue is intergovernmental, which is typical of small places with very small property tax bases.

Recall that producer prices rose steadily over the study period. The Producer Price Index for finished goods stood at 39.3 in 1970 (1982 = 100), at 88.0 in 1980, and at 123.2 in 1992 [29]. For capital equipment, the corresponding indices are 40.1, 85.8, and 129.1, respectively. These indices show that producer prices for finished goods rose by more than three times during the study period. In *constant* dollar terms, Bogus Brook township revenues and expenditures per capita actually *declined* over the study period because they rose in current dollars at 1.7 times, which is well below the rates of increase of producer prices.

Acton Township is located in Meeker County, west of Litchfield along US12 at the westernmost edge of the study area. It had just under 400 residents in the early 1970s, and grew only modestly in subsequent decades. Population density is low, with more than half of its housing units dating from before 1940. There has been a clear upward trend in per-capita revenues and expenditures in current dollar terms during the study period, with most spending going to streets and highways, and revenues coming mainly from property taxes and intergovernmental aids (Figure 3.3). When expenditures per capita are adjusted by the price indices, per-capita revenues and expenditures have *declined*.

Center City is located along US8 in southern Chisago County. It had a population of only 324 in 1970, but grew steadily and reached 568 by 1996. Almost 7 of 10 housing units date from before 1940 so variance in housing age is below average, but there have been modest amounts of new housing construction since 1960. Annual revenues and expenditures per capita rose from an annual average of $97 in the early 1970s to $546 in the mid-1990s (Figure 3.4). This is more than a *five-fold rate of increase* and substantially exceeded inflation during the period. Several abrupt but short-term increases in spending in the middle 1970s and in the period 1988 to 1990 correspond to simultaneous infusions of intergovernmental revenues.

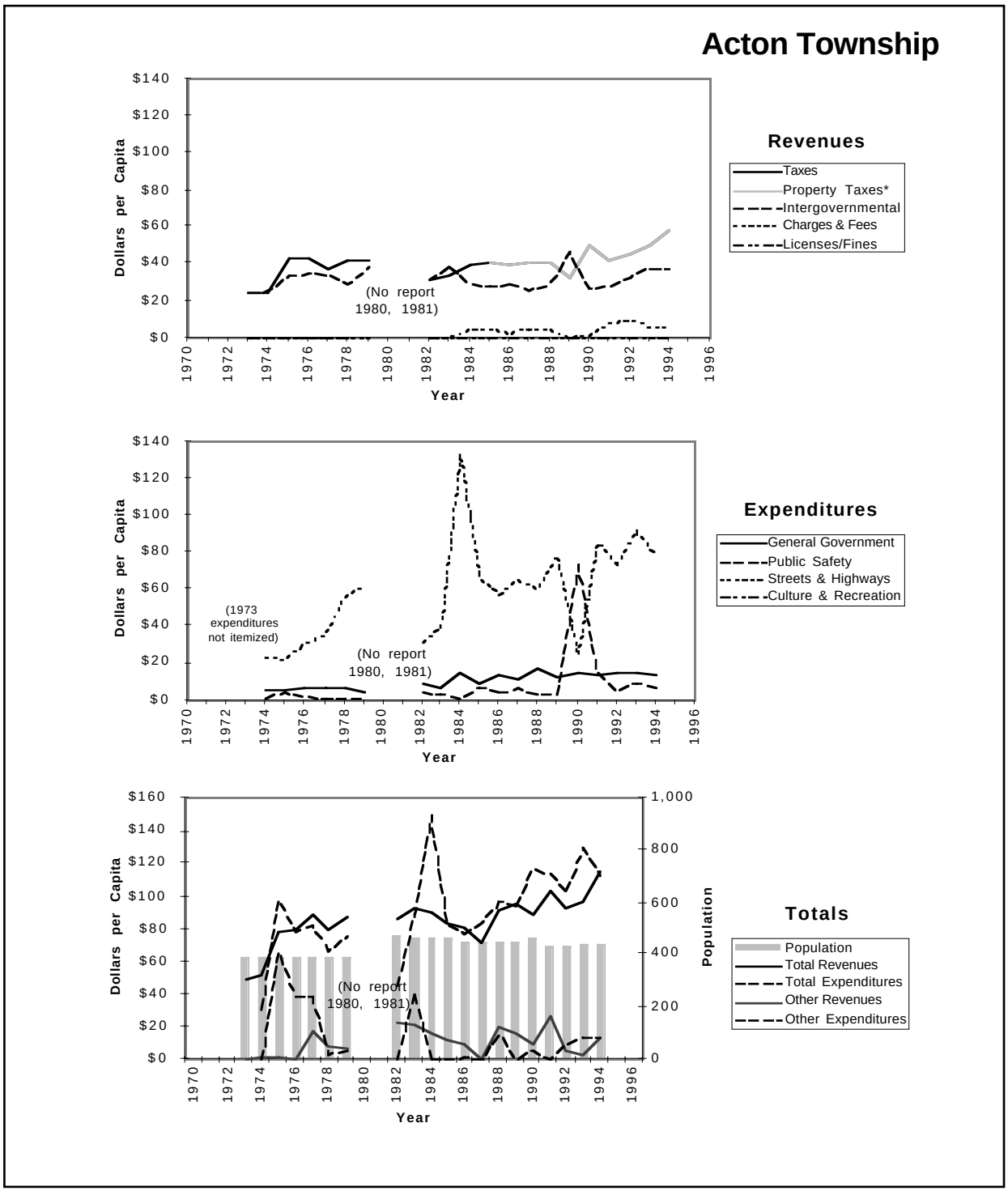


Figure 3.3. Major Local Government Revenues and Expenditures, Acton Township, MN, 1973-1994.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

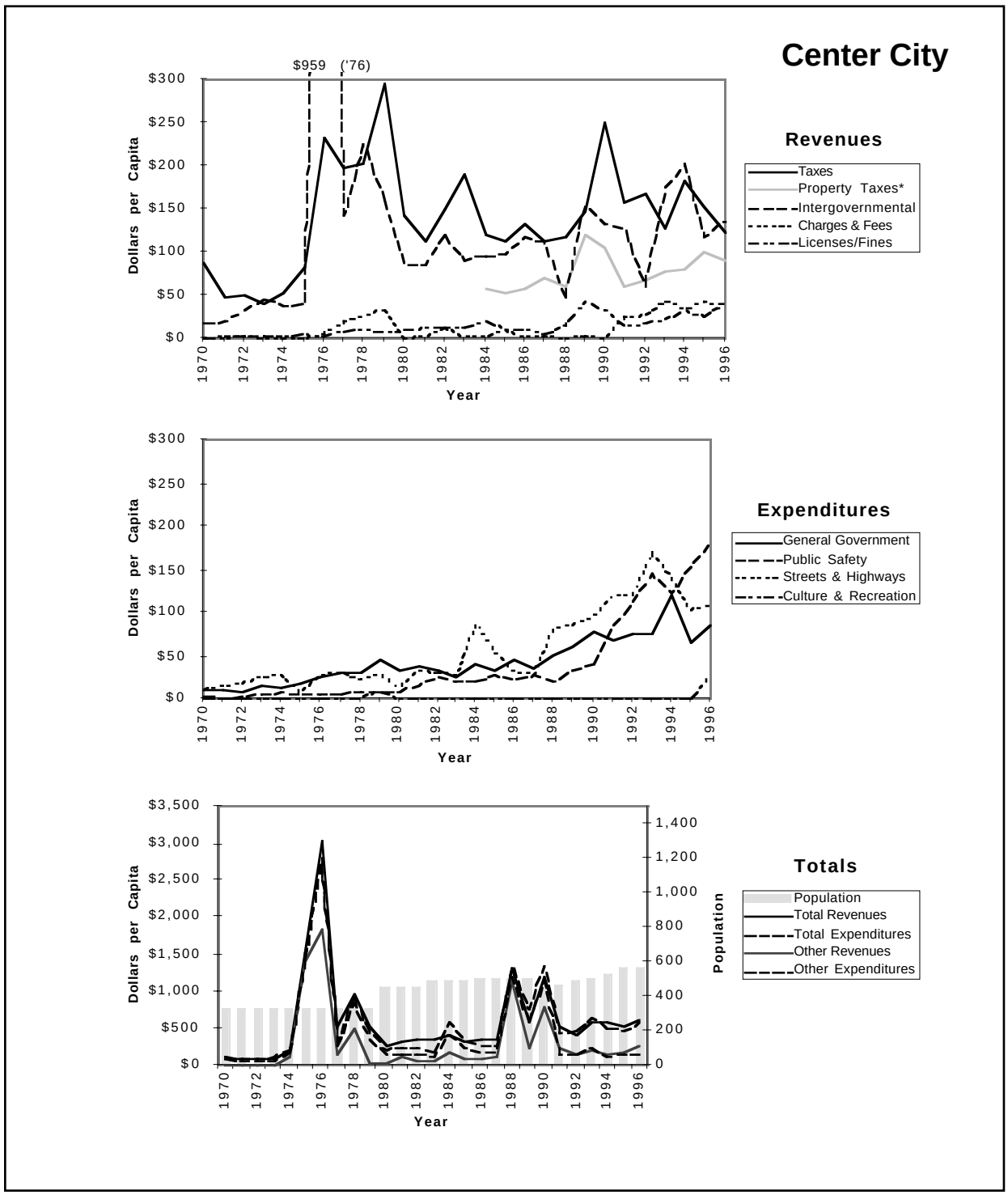


Figure 3.4. Major Local Government Revenues and Expenditures, Center City, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

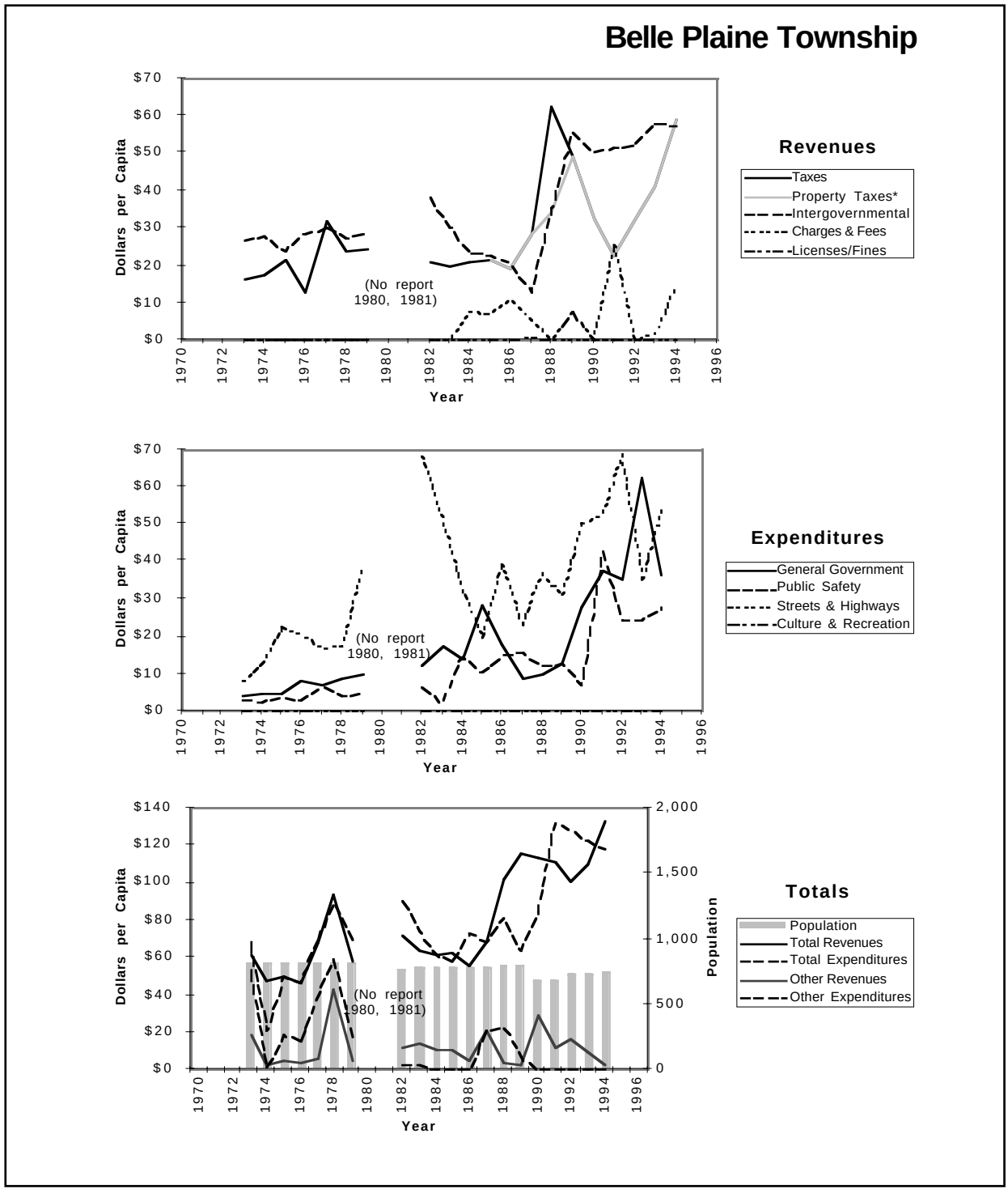


Figure 3.5. Major Local Government Revenues and Expenditures, Belle Plaine Township, MN, 1973-1994.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

Belle Plaine Township is located south on US169 near the southwest corner of Scott County. It had a population of just over 800 in the early 1970s and declined slightly in subsequent years. More than half of the housing units date from the pre-1940 period, and because only 55 units date from the period after 1970, its measured variance in age of housing is low. The steady upward trend in revenues and expenditures per capita in current dollars is obvious, from an annual average of $50 per capita in the early 1970s to $119 in the early 1990s–levels not much different from the townships described above (Figure 3.5). Adjusted for inflation however, the trends roughly track inflation, with total revenues and total expenditures per capita in the early 1990s approximately *two and a half times* the levels reported for the mid-1970s.

Minneapolis in Hennepin County is a special case because of its size, its age, its special governmental responsibilities, and its complexity, but it falls into the first group because of the average age of its housing stock. A majority of housing units date from the pre-1940 era, and most of the remainder were built before 1960, so the variance of housing ages is low. Average annual per-capita revenues and expenditures rose steadily from $345 in the early 1970s to $1,794 in the mid-1990s, more than a *five-fold increase* and much faster than the inflation rate (Figure 3.6). The Minneapolis rate of increase is about the same as that for Center City, but the amounts per capita are much higher for Minneapolis. Numbers and rates of increase are much lower for the three small townships, and well below inflation. Intergovernmental transfers provided the largest share of Minneapolis revenues, but taxes are close behind, with property taxes making up a majority but diminishing share of the tax revenues.

1940s Housing—Martell Town (WI), Sandstone, Winthrop, and St. Paul

Three of the four cities with median year of construction in the 1940s are relatively small towns located a good distance from the metro area. Any increases in population have been modest, which accounts for the early median year. The fourth city is St. Paul, which had enough undeveloped land after WWII to pull its median year to a decade later than Minneapolis.

Martell town is located on the northern border of Pierce County (WI), about six miles south of I-94 and about 40 miles east-southeast of St. Paul. Its housing stock of 298 units in 1990 was composed of just under half from the pre-1940 era, and the rest dating from the 1970s and later as easily accessible areas in Pierce County slowly entered the Twin Cities commuteshed. The result is a median year of housing construction of 1948, and a very high variance of housing ages reflecting the bi-modal character of the age distribution of housing. Fiscal data for Martell reveal the customary rising trend in revenues and expenditures, but the data must be used with care

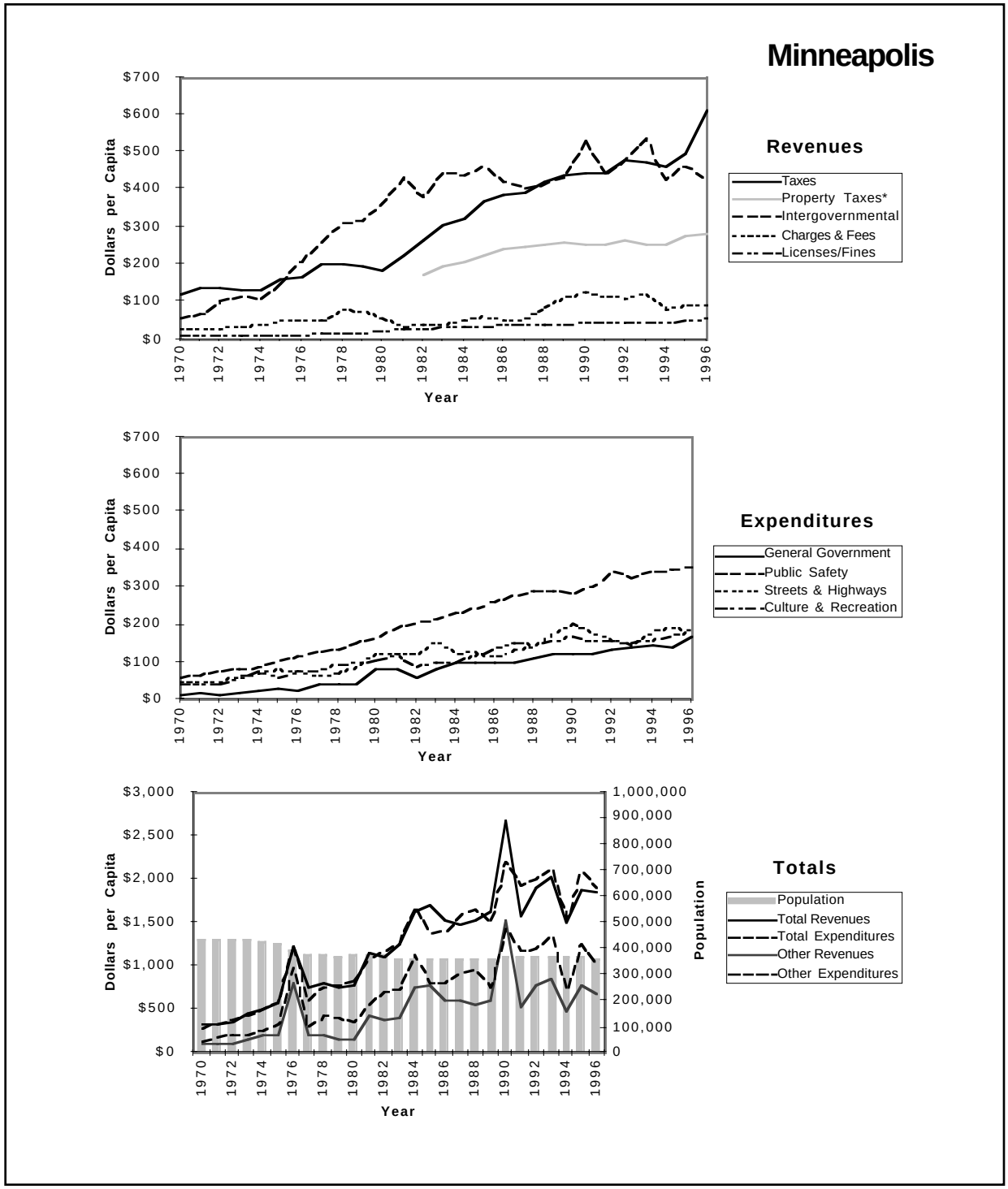


Figure 3.6. Major Local Government Revenues and Expenditures, Minneapolis, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

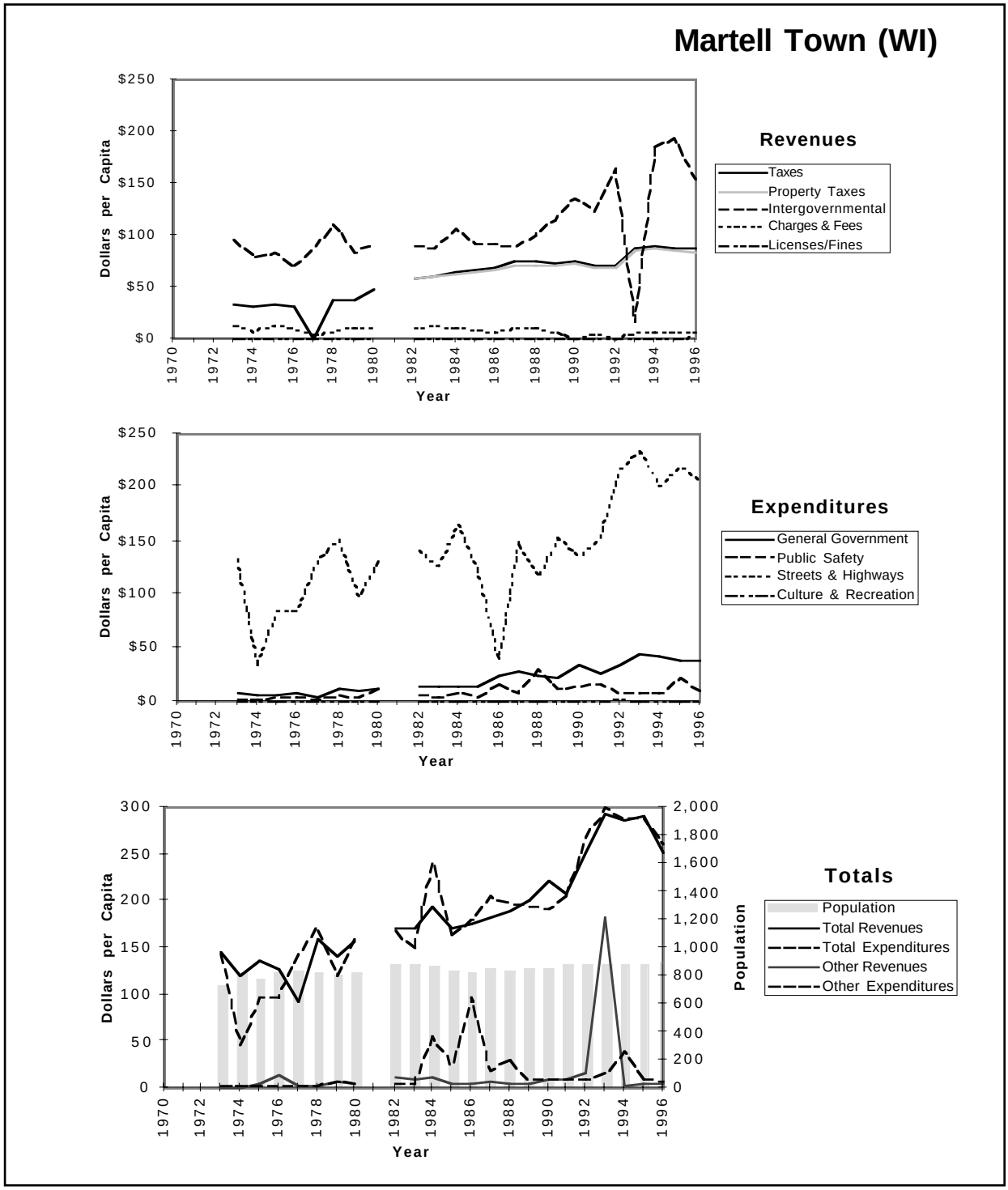


Figure 3.7. Major Local Government Revenues and Expenditures, Martell Town, WI, 1973-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Source: Wisconsin Department of Revenue. Calculations by the authors.

(Figure 3.7). There are differences between Minnesota and Wisconsin in methods of reporting various categories of expenditures and revenues, and there are additional differences among towns, villages and cities in Wisconsin due to accounting practices, organizational structures, service levels, populations and population densities, physical features, activities of neighboring municipalities, and labor costs. In addition, there were changes in reporting methods beginning in 1985 that make close comparisons between later and earlier periods impossible.

Martell had a population of 727 in 1973 (the first year for which we have data), and after fluctuating in the 1980s it reached 892 in 1996. Average annual per-capita revenues and expenditures for Martell town were $115 in the early 1970s, rising to $278 per capita by the mid-1990s, an *increase of almost two and a half times*, or well below the inflation rate for that period. Intergovernmental transfers were the major revenue source, with taxes second. Property taxes accounted for almost all the tax collections in Martell over the years. The main expenditure has been for streets and highways, which is typical for small towns in Wisconsin and townships in Minnesota.

Sandstone is a city of just over 2,000, located along I-35 in central Pine County about 90 miles north of St. Paul, near the northeastern edge of the 24-county study area. Although four out of ten housing units in the city date from before 1940, a spurt of new construction in the 1960s and 1970s pulled the median year of construction to 1945, but the variance in housing ages is relatively low. A federal prison is located at Sandstone, and its presence and operation may account for the unusual profile of revenues and expenditures for a city of this modest size (Figure 3.8). What is distinctive about Sandstone's revenue profile is the large and highly variable amounts of intergovernmental aid received by the city. In most years it comprises the largest single revenue source. Total revenues per capita were $82 in 1970 and rose to $912 in 1996, an *eleven-fold increase*, but with major variations above and below this amount in the 1990s. Expenditures per capita varied in the same way over the period.

Winthrop is a city of about 1,300 surrounded by agricultural activity, located about 75 miles southwest of Minneapolis near the center of Sibley County, near the edge of our 24-county study area. More than four of ten housing units date from the pre-1940 period, with steady additions between the 1940s and 1970s and few since then, so the variance in housing ages is low. Revenues per capita of each type rose during the study period, with intergovernmental transfers forming the largest single amount (Figure 3.9). Taxes were next in importance, with the property tax accounting for almost all of the taxes collected. Expenditures rose steadily during the study

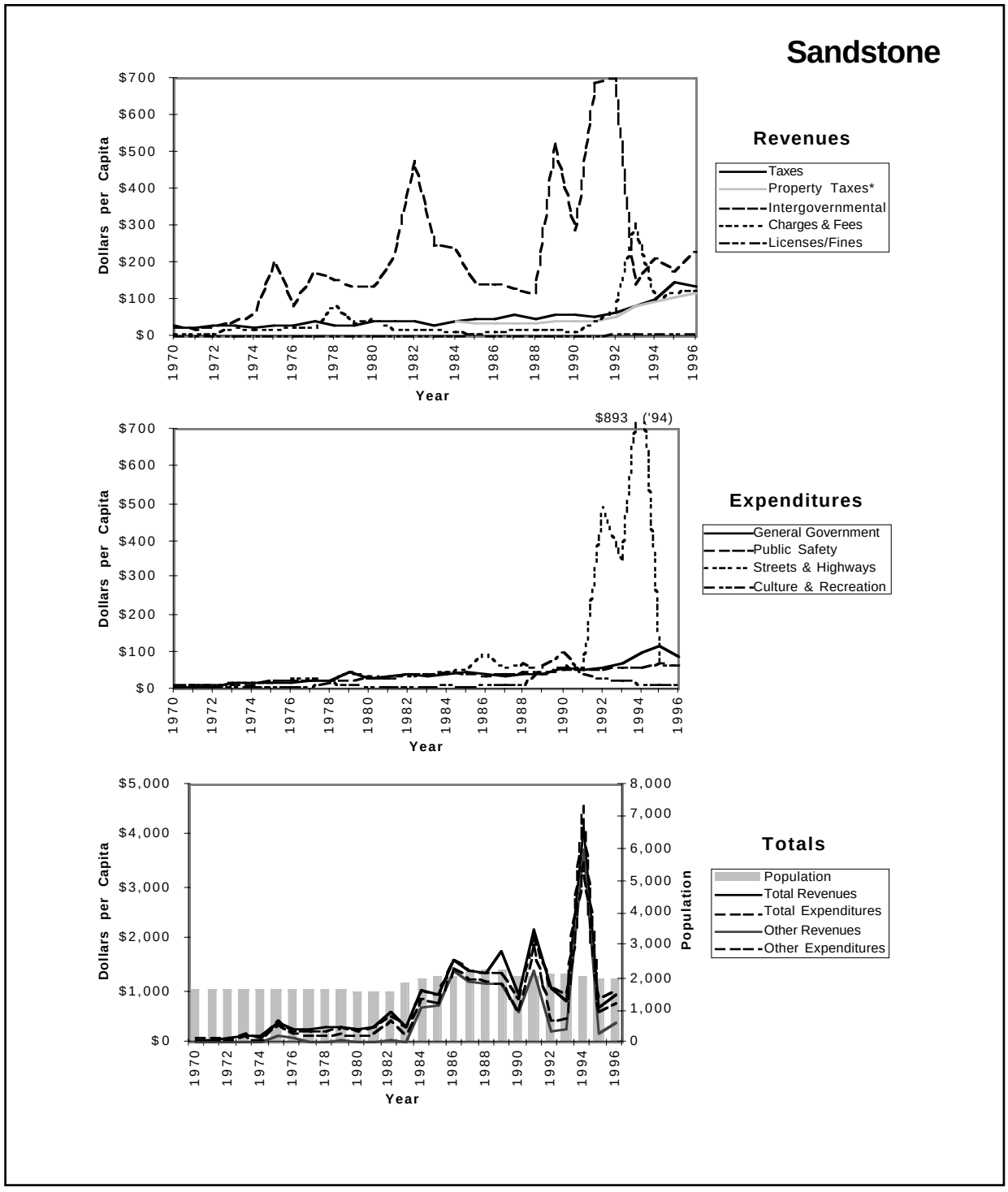


Figure 3.8. Major Local Government Revenues and Expenditures, Sandstone, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

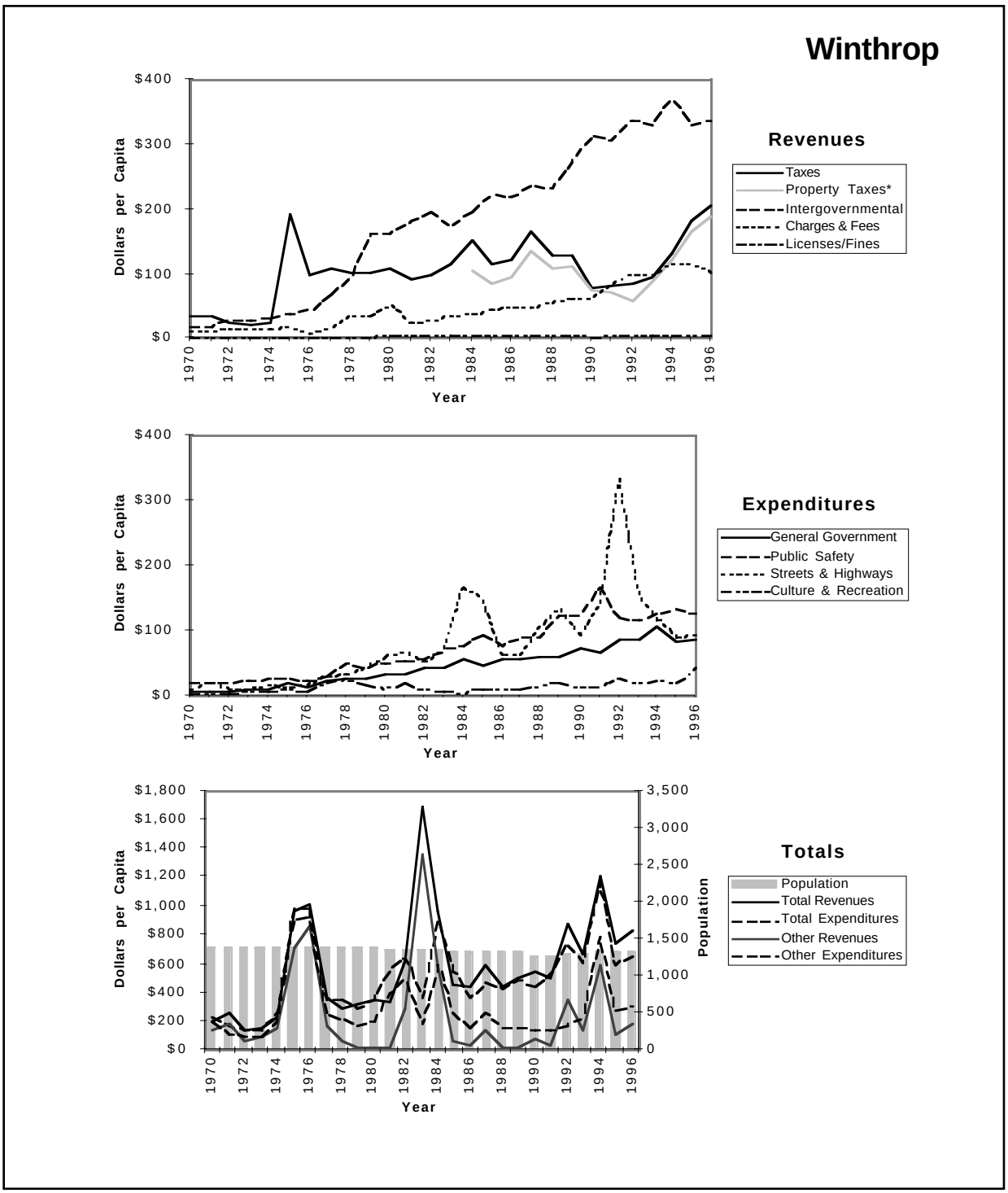


Figure 3.9. Major Local Government Revenues and Expenditures, Winthrop, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

period, with major spurts in spending on streets and highways in the mid-1980s, and again in the mid-1990s. Winthrop's population declined slowly between 1970 and 1990, but has been growing modestly since then. Over a period of almost three decades, per-capita revenues and expenditures for Winthrop have increased more than *four and a half times*, rates well ahead of the producer price indices.

St. Paul in Ramsey County contained a 1990 population of just over 272,000, but less than half of its housing dates from the pre-1940 period. There was enough immediate post-war construction on vacant land inside the city limits so that the median year of construction of housing in the city was 1944 in 1990, but variance in housing age is very low compared with other places of its vintage in our 24-county study area. St. Paul's annual per-capita revenues and expenditures averaged $351 in the early 1970s, a level similar to Minneapolis's, then *rose more than four-fold* to $1,516 by the mid-1990s–a rate of increase well ahead of the inflation rate as reflected in the producer price index, but below the more than five-fold rate of increase experienced in Minneapolis (Figure 3.10).

1950s Housing—Red Wing, Faribault, Le Sueur, Richfield

The four cities with median years of construction in the 1950s all happen to be located in the southern sector of our study area. Two are medium-sized towns, Red Wing and Faribault, both with high variance. Le Sueur is a smaller city to the southwest, and Richfield is the largest of the four, located directly south of Minneapolis in one of the first parts of the region to experience suburbanization.

Red Wing is a city located 50 miles southeast of St. Paul along US61 on the bank of the Mississippi River in Goodhue County, with a population that grew steadily from 10,441 in 1970 to almost 16,000 in 1996. Red Wing has over 6,000 housing units, but only about a third of them date from the pre-1940 era. As the city grew, significant amounts of new housing were added every decade since 1940, providing the city with a highly diversified housing stock which is reflected in the very high variance in housing ages. In 1990, the median year of housing construction was 1958. Annual local government revenues and expenditures per capita both were $284 in the early 1970s, then rose to $1,284 by the mid-1990s, *an increase of four and a half times* and a rate much faster than producer prices increases generally (Figure 3.11). Taxes have been by far the major revenue source, and property taxes make up almost all of the tax revenues, with intergovernmental revenues fluctuating at about half of tax levels. Among the expenditures, public safety and streets and highways currently lead the list, but all major categories have risen steadily as Red Wing has grown.

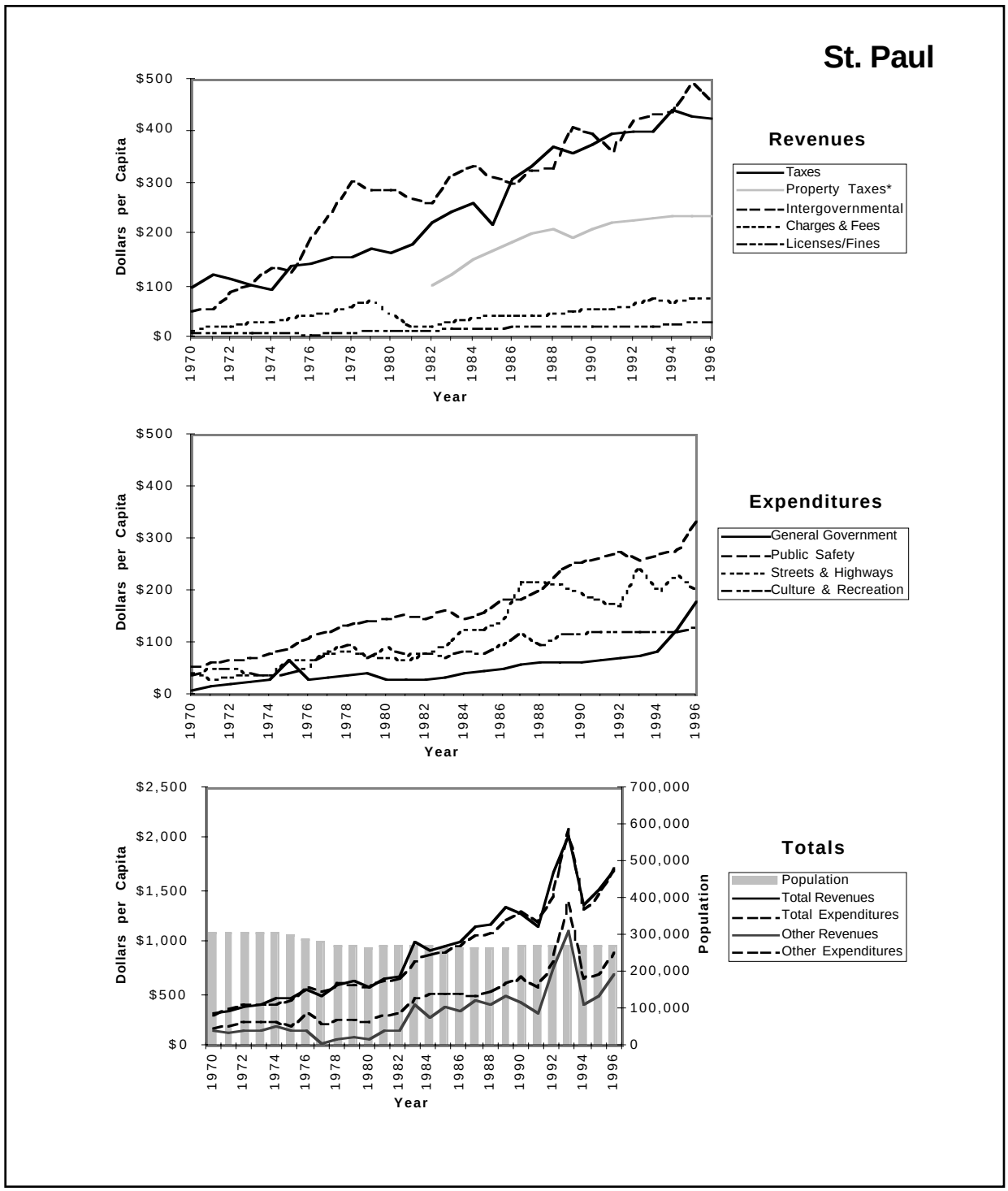


Figure 3.10. Major Local Government Revenues and Expenditures, St. Paul, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

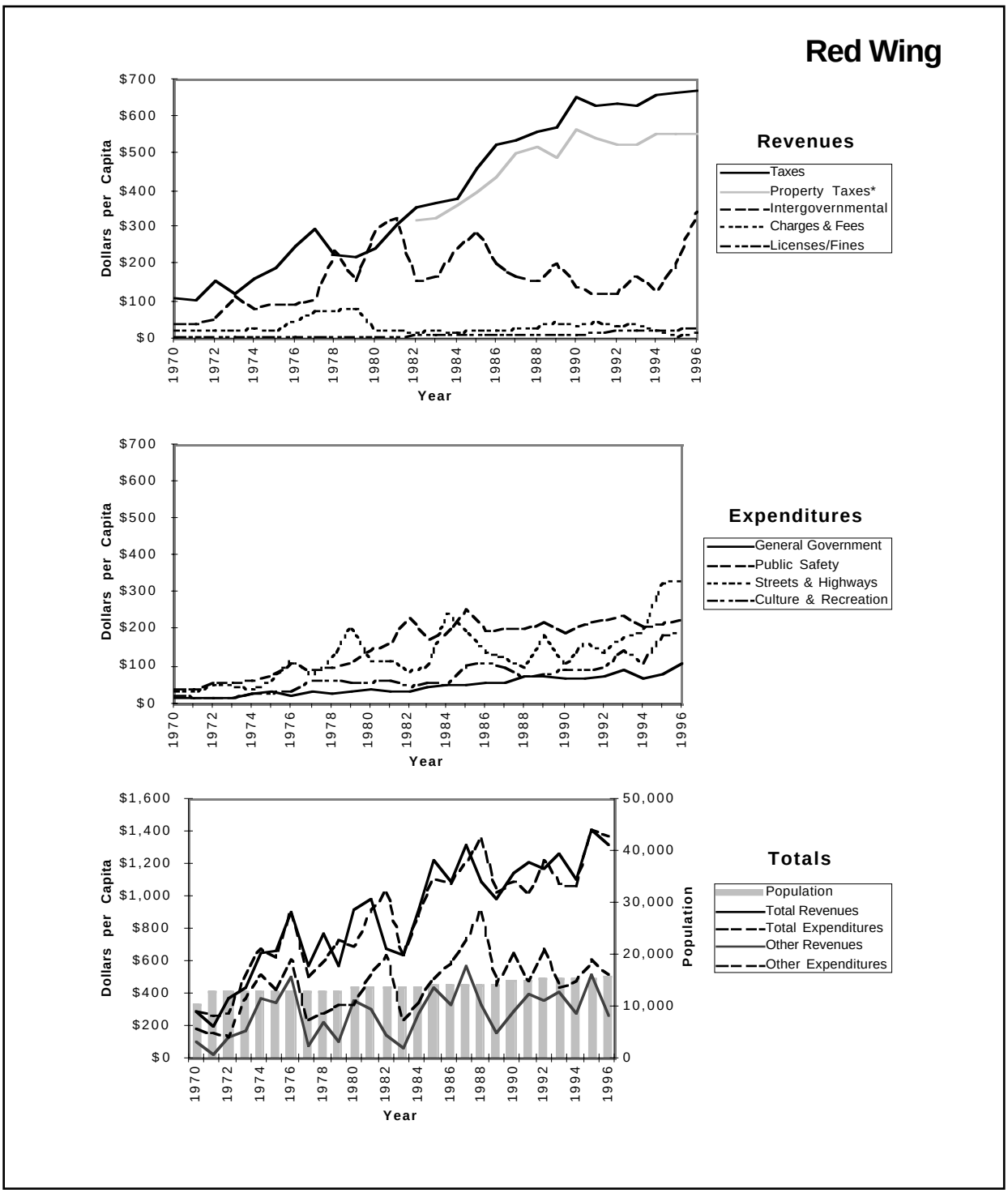


Figure 3.11. Major Local Government Revenues and Expenditures, Red Wing, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

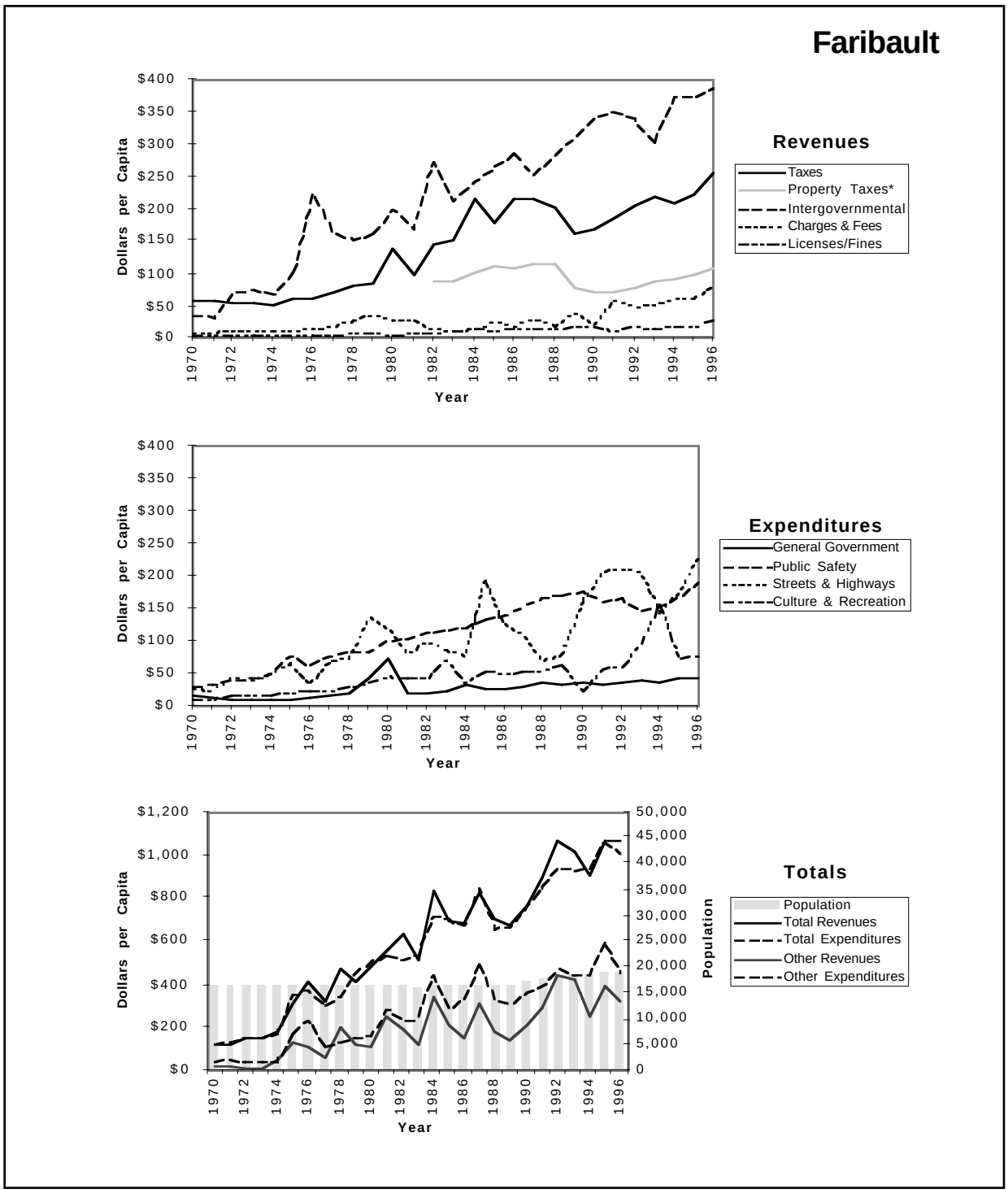


Figure 3.12. Major Local Government Revenues and Expenditures, Faribault, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

Faribault is a city located in Rice County about 60 miles south of the Twin Cities on I-35. About a third of its housing stock dates from the pre-1940 era, but housing has been added steadily over the years so that the variance in housing ages is above average. In 1990 the median year of housing construction was 1956. As population grew steadily from under 17,000 in 1970 to almost 19,000 in 1996, average annual per-capita revenues and expenditures of local government rose from $134 in the early 1970s to almost $1,009 in the mid-1990s, a *seven and a half-fold increase* (Figure 3.12). Unlike Red Wing, which is about the same size and about the same distance from the Twin Cities, intergovernmental revenues substantially exceed taxes for most of the study period. Taxes come next in importance, but property taxes comprise only about half the total taxes in recent years.

Le Sueur is a small city located in Le Sueur County along US169 about 60 miles southwest of Minneapolis. Its population has fluctuated around 3,800 for most of the past 30 years, but it appears to be growing slowly in recent years as the built-up Twin Cities area spreads toward the southwest. In the early 1970s, average annual per-capita revenues and expenditures of the local government were $223 (Figure 3.13). In the mid-1990s, per-capita revenues and expenditures were averaging $1,469, almost a *seven-fold increase*.

Richfield city is a first-ring suburb immediately south of Minneapolis in Hennepin County. Its population stood at over 47,000 in 1970, but dropped steadily to 34,700 as populations aged and household sizes declined. At the time of the 1990 census Richfield had only 695 of its 16,094 housing units of pre-1940 vintage, but 10,421 (or almost two-thirds of the total) were from the 1940s and 1950s. Richfield and a few other first-ring suburbs of Minneapolis and St. Paul have the distinction of filling up quickly with young families after World War II, which left the city with a relatively homogeneous housing stock in terms of age. The calculated variance in year of housing construction is very low. A housing stock that is built over a short period of time gets old all at once, and this abrupt aging can affect property tax revenues as well as city expenses.

Taxes are Richfield's major revenue source, with property taxes comprising about two-thirds of the tax total in recent years, but intergovernmental transfers are similar in amount in most years, with occasional spikes reflecting grants for specific purposes (Figure 3.14). In the first three years of the 1970s per-capita revenues and expenses averaged $204, with large families holding down figures. In the last three years of the study period, annual per-capita revenues and expenses averaged $936, or an increase of more than *four and a half times*, which was ahead of inflation during the period, but substantially below the experience of the other outlying cities in

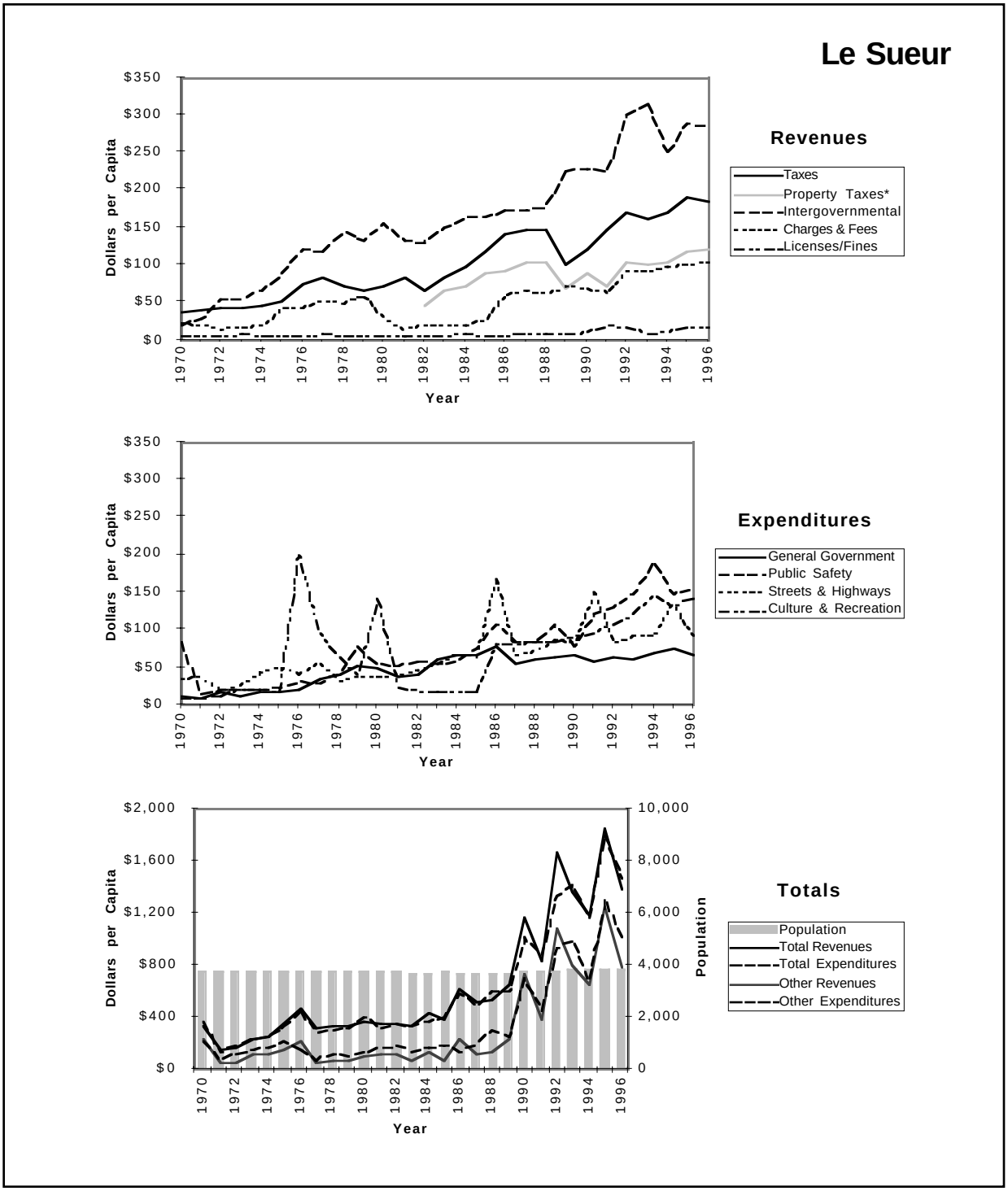


Figure 3.13. Major Local Government Revenues and Expenditures, Le Sueur, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

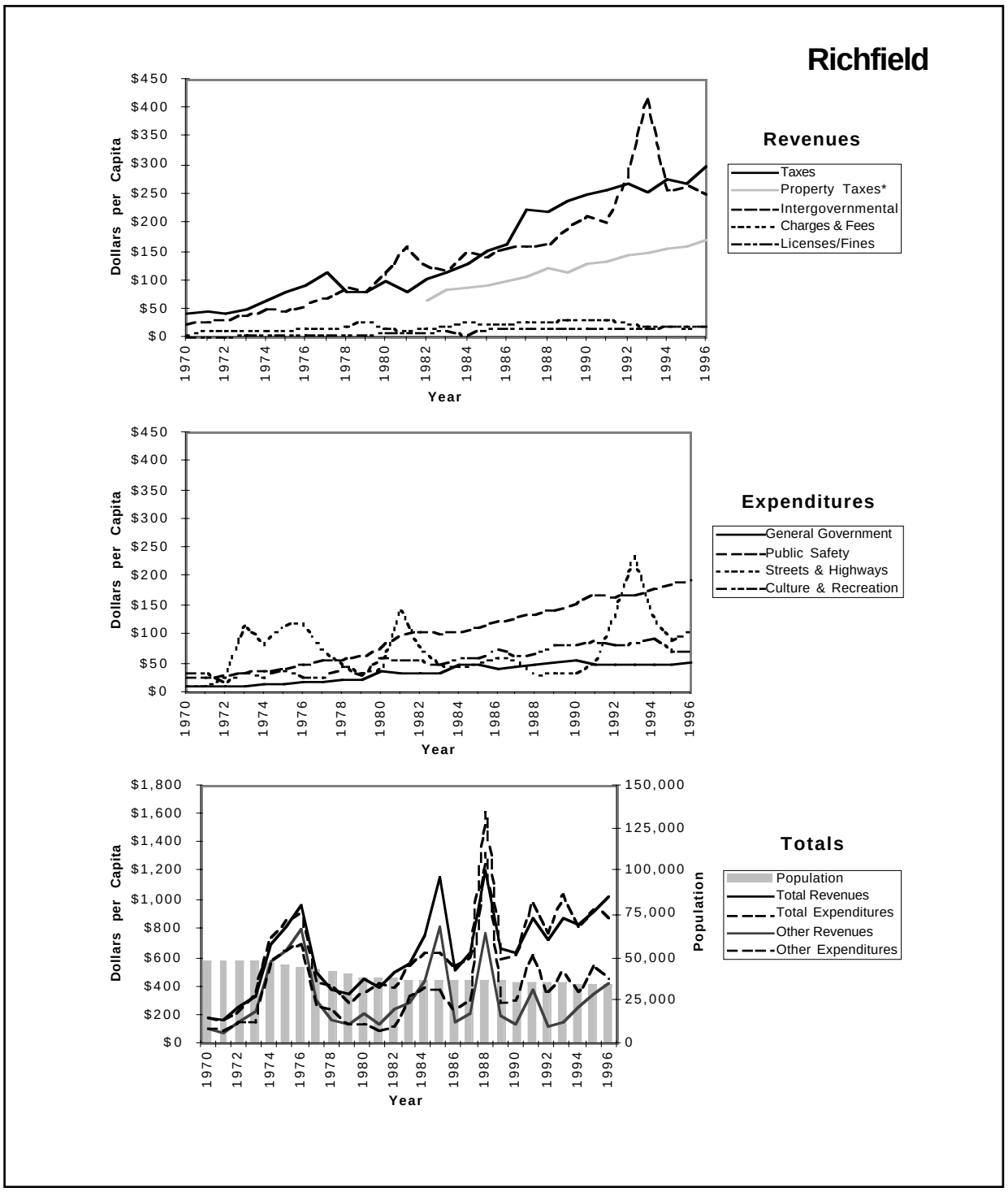


Figure 3.14. Major Local Government Revenues and Expenditures, Richfield, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

this group.

1960s Housing—Hudson (WI), Ogilvie, Siren (WI), Hutchinson, Anoka, Brooklyn Center
The six cities in this category are a mix of large and small, located at varying distances from Minneapolis and St. Paul. They are experiencing different rates of population change and different rates of increase in their revenues and expenditures, from two to eight times their 1970 figures by the mid-1990s.

Hudson city is located in St. Croix County (WI) about 20 miles east of St. Paul on I-94, just across the St. Croix River. Its population grew from 5,293 in 1973 to an estimated 7,285 in 1996. Hudson's population fluctuated in the 1980s, but there has been steady growth since the early 1990s. Hudson's housing stock of 2,634 units in 1990 contained significant proportions from each of the six vintages, from the pre-1940 era up to the 1980s and 1990s. This broad mixture produced a median year of construction of 1961 at census time, and an above-average variance of housing ages.

Average annual per-capita revenues and expenditures for Hudson were $233 in the early 1970s, rising to $1,828 per-capita by the mid-1990s, for an *increase of almost eight times*, which is well over twice the inflation rate for that period (Figure 3.15). Taxes were the major revenue source, with property taxes making up most of the tax revenues. Intergovernmental transfers were second in importance as a revenue source in the 1990s. Spending for streets and highways and for public safety were the main recent expenditure categories.

Ogilvie is a city in southwestern Kanabec County on S23, halfway between St. Cloud and Hinckley, about 75 miles north of Minneapolis on the outer edge of the Twin Cities commuteshed. It had a population of 508 in 1990, with 197 housing units. About four of ten housing units date from before 1940, but steady construction after 1940, especially in the 1970s, established the median at 1962 and created a highly heterogeneous stock in terms of age. Population rose slowly from a 1970 base of 384 and reached an estimated 529 by 1996. Local government finances are modest, with the dominant source of revenue coming from intergovernmental transfers (Figure 3.16). The biggest expense is general government, with occasional spikes in spending on public safety, perhaps for a new vehicle, and streets and highways. In the first three years of the 1970s, per-capita revenues and expenses averaged $124, and in the last three years of the study period they averaged only $465, an *increase of 3.75 times*, which just about tracked inflation during the period.

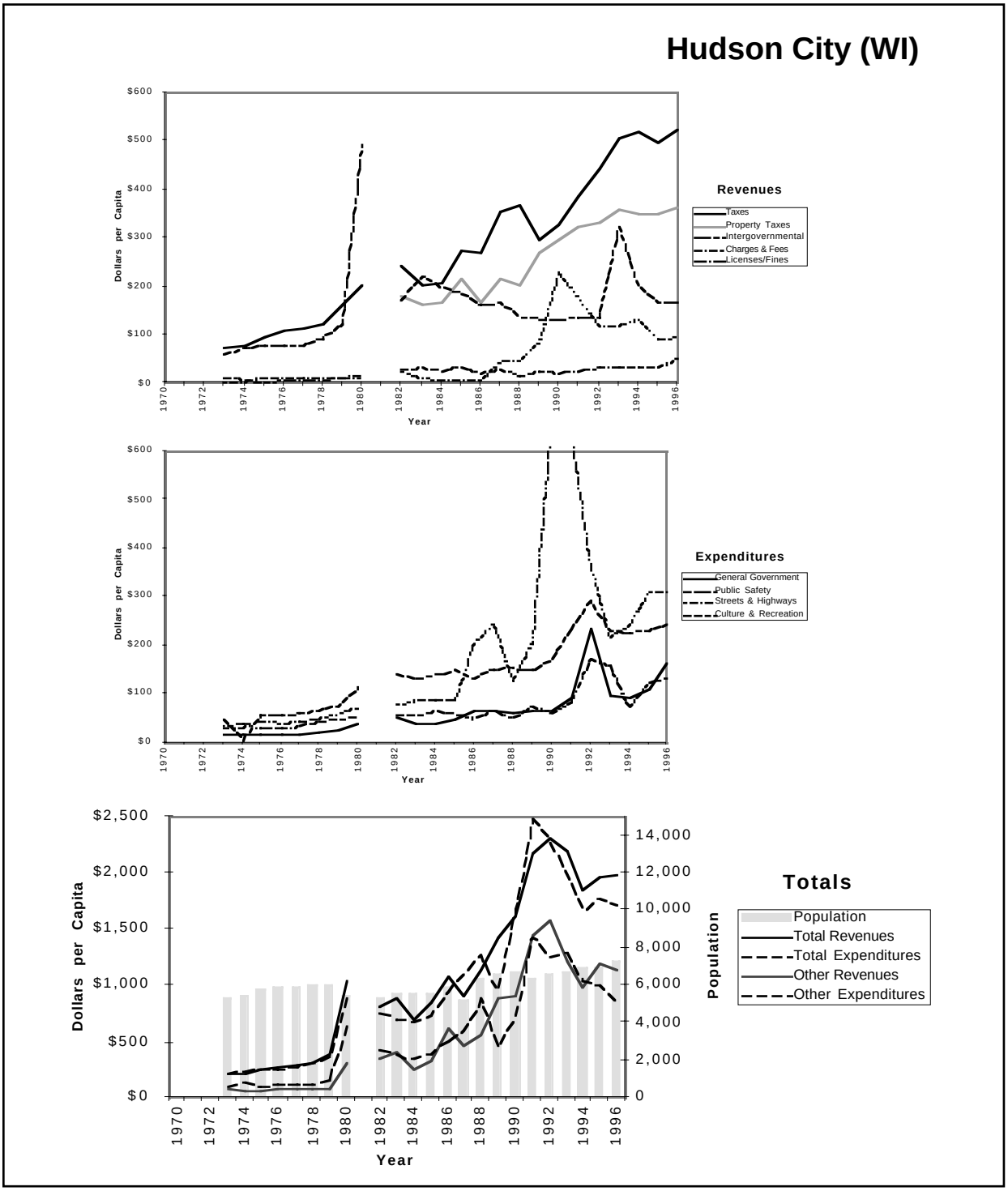


Figure 3.15. Major Local Government Revenues and Expenditures, Hudson City, WI, 1973-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Source: Wisconsin Department of Revenue. Calculations by the authors.

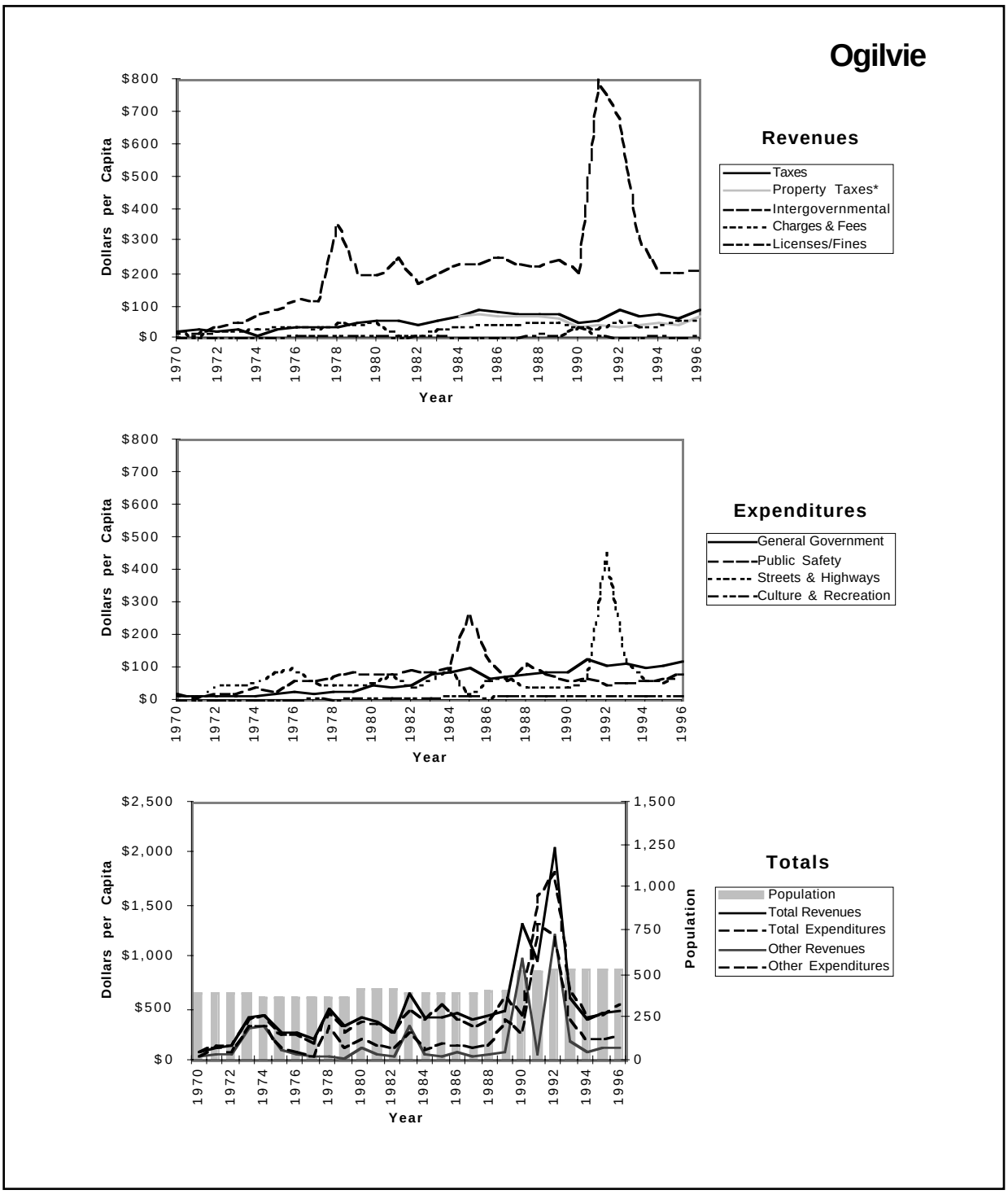


Figure 3.16. Major Local Government Revenues and Expenditures, Ogilvie, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

Siren village (WI), the county seat of Burnett County, is located about 85 miles northeast of the Twin Cities and is accessible to the Twin Cities by I-35 and other routes. Although it serves mainly as the commercial and local government center for surrounding agricultural and recreational areas, modest amounts of commuting from Burnett County to the Twin Cities were noted in 1990 census returns. Siren's population stood at 719 in 1973 and grew to an estimated 867 by 1996. The city's housing stock of 436 units contains shares from each vintage. About one in five units dates from the pre-1940 era, and major construction occurred in the 1970s and 1980s. Median year of housing construction was 1965 at census time, with an above-average variance in housing ages. In the mid-1970s, annual per-capita revenues and expenditures averaged $172, and in the mid-1990s they averaged $957, an *almost six-fold increase* (Figure 3.17). Intergovernmental transfers have been Siren's principal revenue source, with taxes second. Property taxes account for most of the tax revenues. Expenditure patterns fluctuate widely year to year, but streets and highways and public safety are the dominant categories.

Hutchinson city is located in McLeod County on S7 about 50 miles west of Minneapolis, near the edge of the Twin Cities commuteshed and the western boundary of our study area. Its population grew steadily from 8,142 in 1970 to an estimated 12,587 in 1996. The 4,764 housing units counted in 1990 had a median year of construction of 1969. With steady growth in population has come a corresponding expansion in the city's housing stock, and an above-average variance in housing age. Only about one in six units dates from the pre-1940 era, and more than a quarter of the total stock was built in the 1980s. Taxes and intergovernmental transfers have been roughly equal in importance in recent years, with property tax accounting for slightly more than half the total tax collections (Figure 3.18). Improvements in streets and highways typically have been the single largest expenditure category in recent years. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $304, and in the last three years of the study period they averaged $1,330, or an *increase of 4.4 times* over the study period, exceeding somewhat the overall rate of inflation as reflected in the producer price index.

Anoka, an historic lumber mill city, has in recent years become essentially a fourth-ring suburb of Minneapolis. It is located on the east bank of the Mississippi River northwest of the Twin Cities, at the intersection of US10 from St. Paul and US169 north from Minneapolis. It grew steadily from 13,295 in 1970 to an estimated 17,693 in 1996. Only one in eight of Anoka's housing units dates from before 1940. Every decade since the 1950s has brought between one

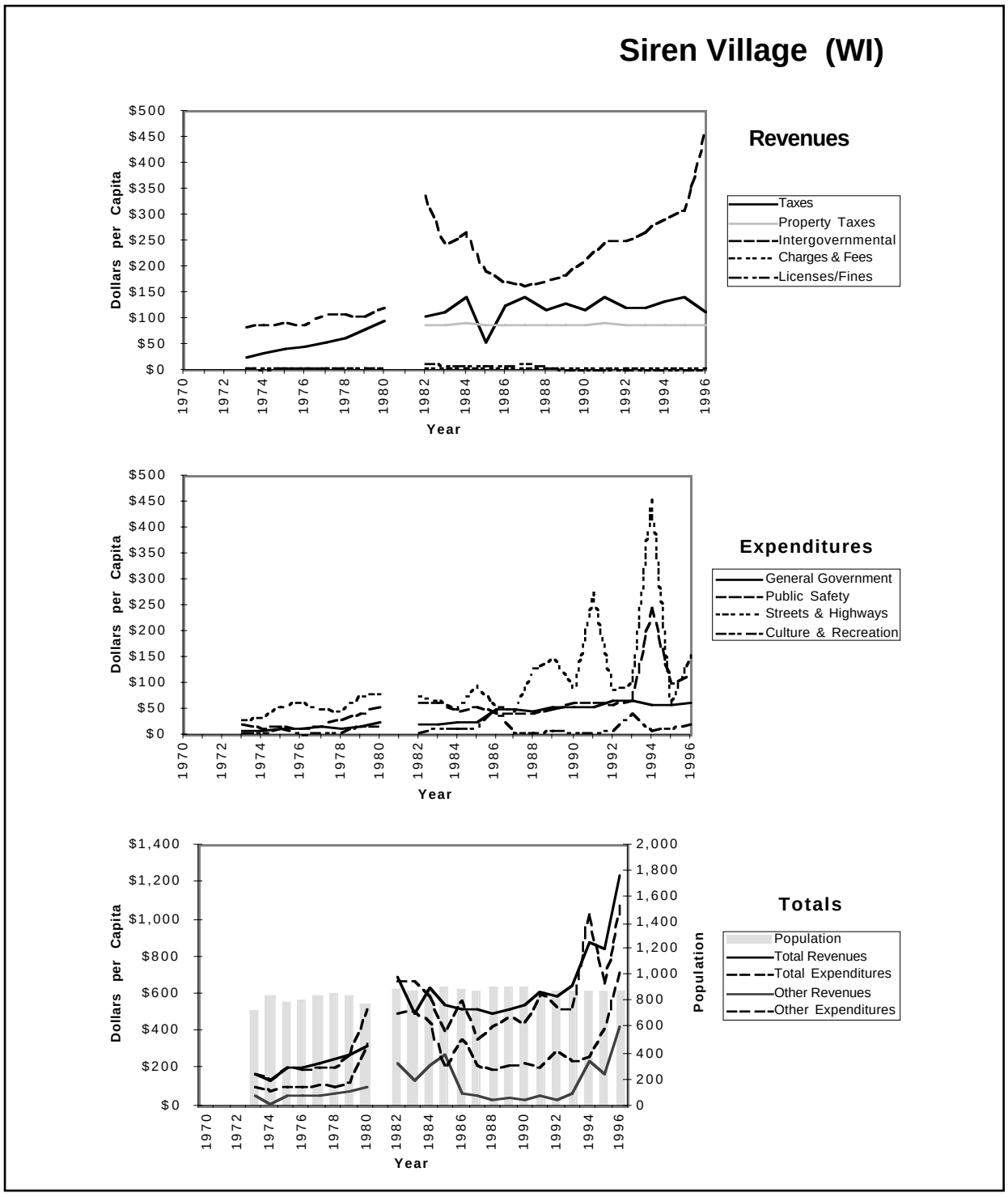


Figure 3.17. Major Local Government Revenues and Expenditures, Siren Village, WI, 1973-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Source: Wisconsin Department of Revenue. Calculations by the authors.

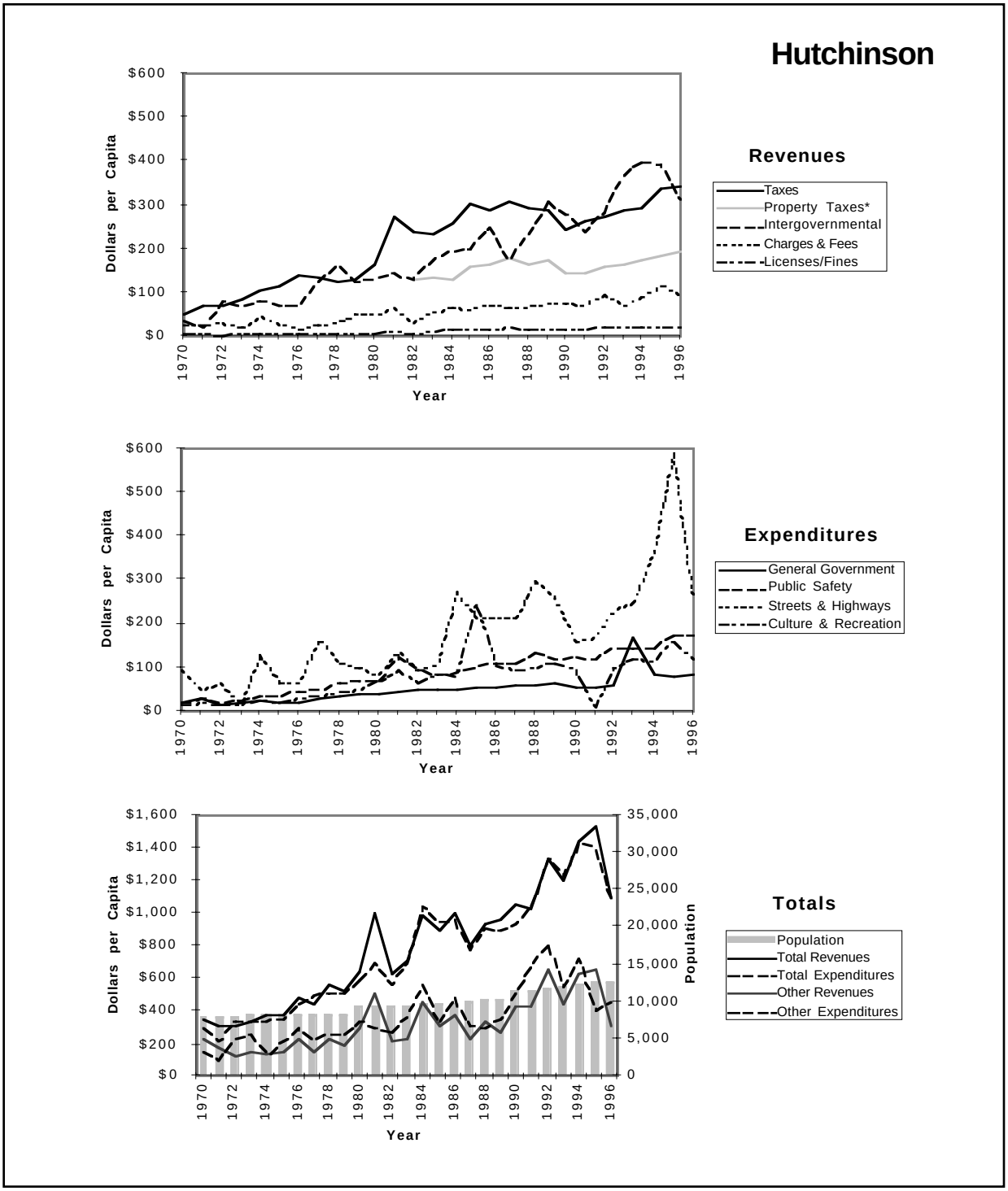


Figure 3.18. Major Local Government Revenues and Expenditures, Hutchinson, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

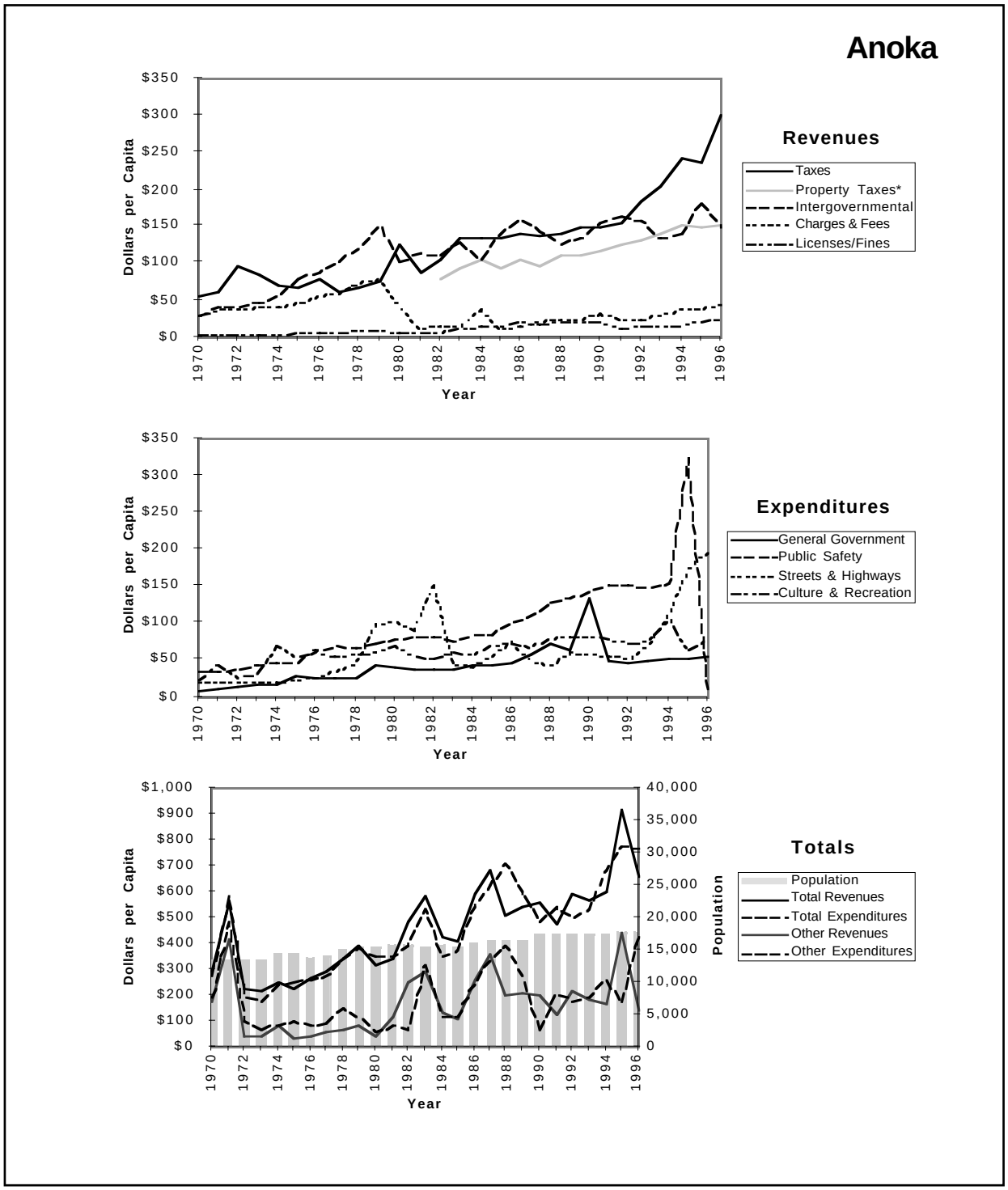


Figure 3.19. Major Local Government Revenues and Expenditures, Anoka, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota; Wisconsin Department of Revenue. Calculations by the authors.

and two thousand additional units. The median year of construction was 1969 in 1990, with slightly below-average variance in housing ages. Taxes and intergovernmental revenues were roughly equal in most years until the early 1990s; then taxes rose sharply, with property taxes accounting for about two-thirds to three-fourths of the total tax collections in most years after 1982 (Figure 3.19). In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $354, and in the last three years of the study period they averaged only $693, for an *increase of about two times* over the study period, falling well short of the overall rate of inflation as reflected in the producer price index. The steady growth of the population of young families contributes to the lowering of the per-capita revenue and expenditure figures, but total revenues and expenses continue to rise at a steady pace.

Brooklyn Center city is a first-ring suburb in Hennepin County at the northwest edge of Minneapolis. It had a population of 35,173 in 1970, which rose to a peak of over 37,000 in 1974, then began to drop, reaching an estimated 28,502 by 1996. Brooklyn Center was a farming community before World War II, and at census time in 1990 it contained only 329 or about 3 percent of its 11,713 housing units from that agricultural era. The city suburbanized rapidly after the war, with four of ten housing units built in the 1950s, and a somewhat larger fraction from the 1960s and 1970s. The result is a median year of construction of 1961, and a very low variance in housing ages. The largest share of city revenues comes from taxes, and in recent years about two-thirds of that total is property taxes. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $193, and in the last three years of the study period they averaged $780, or an *increase of about 4 times* over the study period, exceeding somewhat the overall rate of inflation as reflected in the producer price index (Figure 3.20).

1970s Housing—Osceola Town (WI), Big Lake, Cambridge, Chaska, Shoreview, Cottage Grove

Six cities in the sample have their median year of housing construction in the 1970s. With the exception of Osceola (WI), each is a relatively close-in suburb of the Twin Cities, and each had its major growth in recent decades. The six are presented from the greatest variance in housing ages (Osceola and Big Lake) to the least (Shoreview and Cottage Grove).

Osceola (WI) town is located in Polk County (WI) at the east end of one of the few St. Croix River crossings north of I-94 and Stillwater. Its population grew steadily from 865 in 1973 to an estimated 1,477 in 1996. Osceola's housing stock of 582 units in 1990 had one in four units

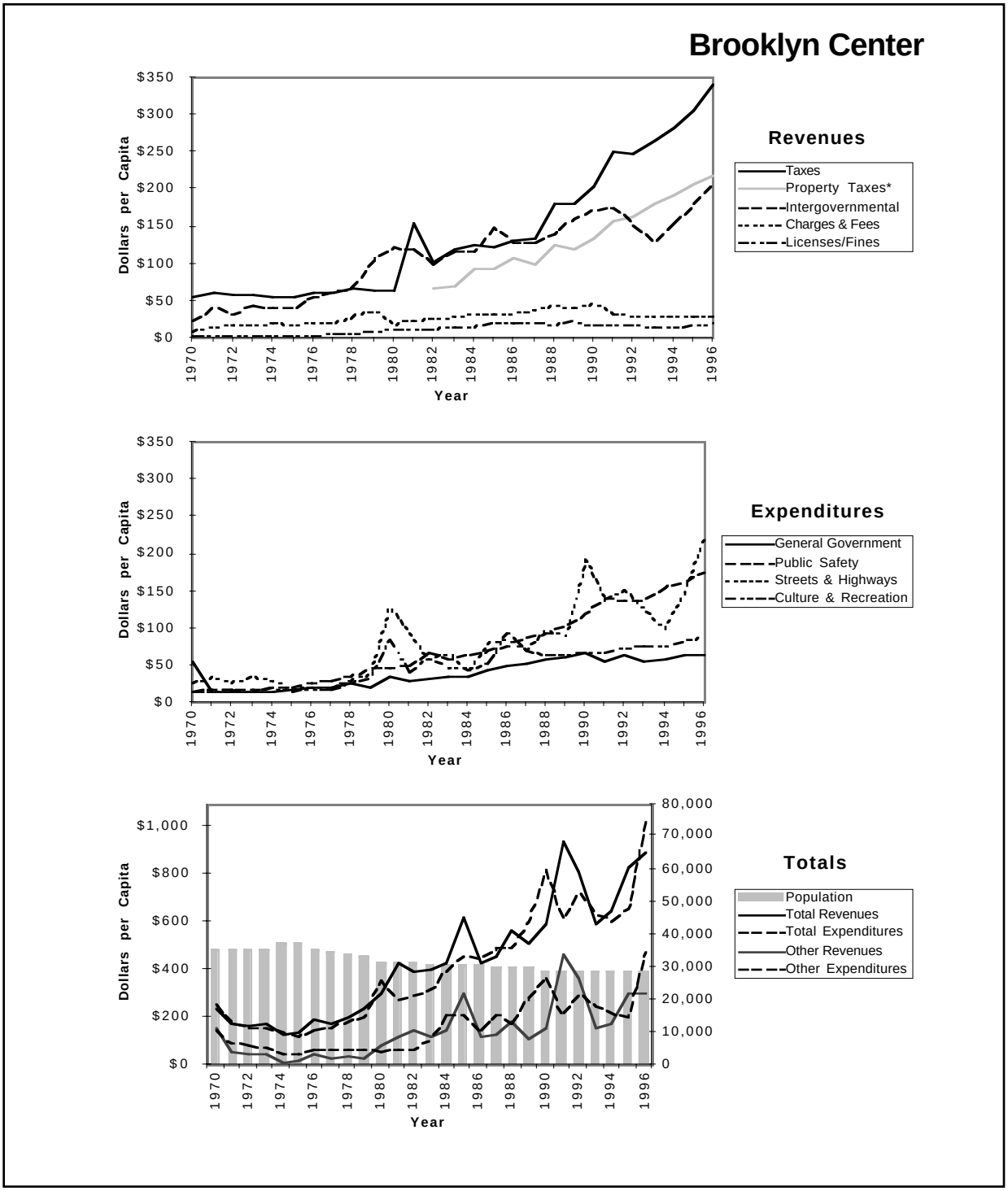


Figure 3.20. Major Local Government Revenues and Expenditures, Brooklyn Center, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

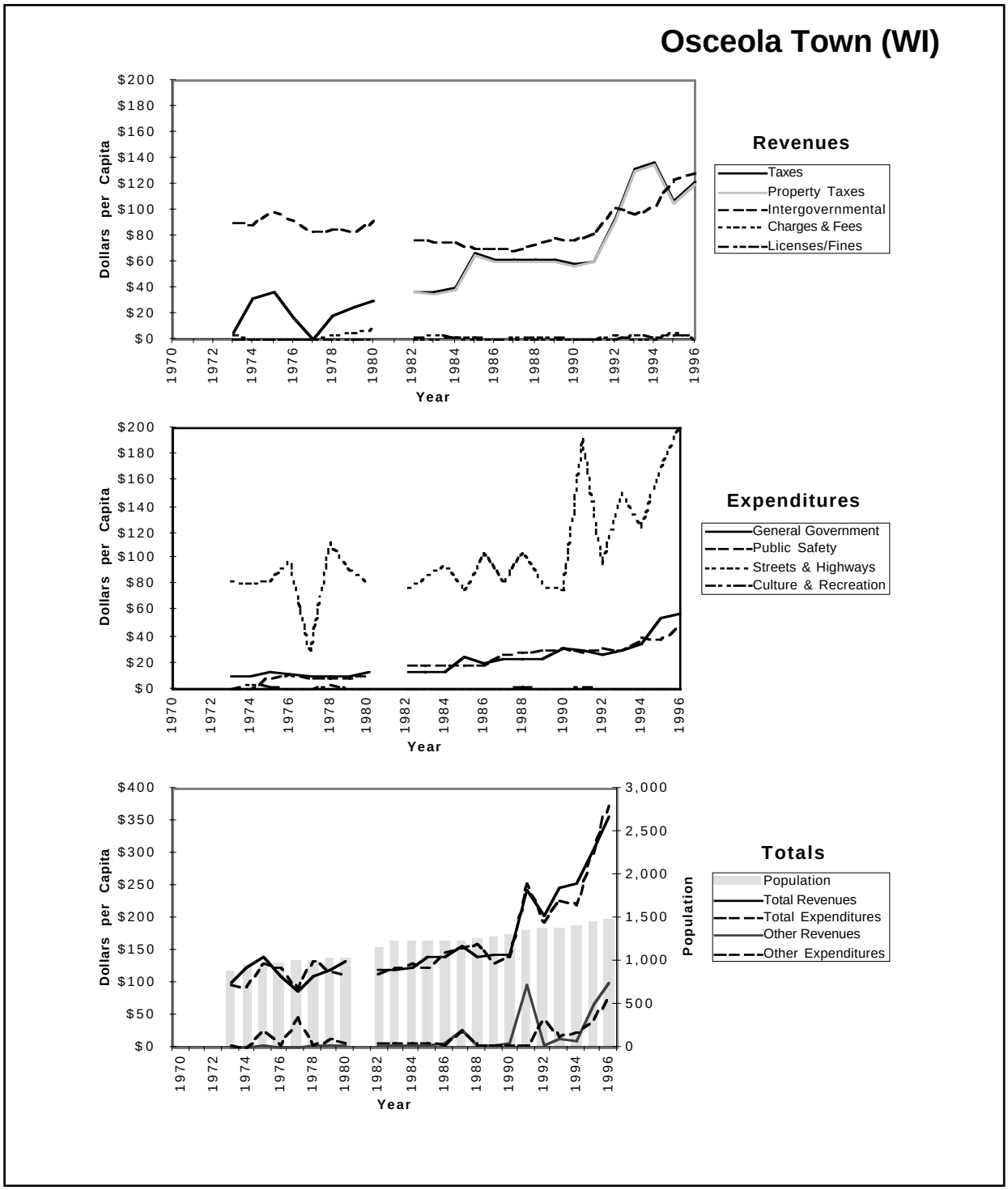


Figure 3.21. Major Local Government Revenues and Expenditures, Osceola Town, WI, 1973-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Source: Wisconsin Department of Revenue. Calculations by the authors.

dating from the pre-1940 era, but was augmented by significant increments after 1970, presumably a consequence of the opening of I-35 to the Twin Cities. The median year of construction was 1972 in 1990, with very high variance in housing ages. Along with population growth there has been an increase in government revenues and expenditures (Figure 3.21). In the middle 1970s, annual per-capita revenues and expenditures averaged $114, while in the mid-1990s the average was $303, a *nearly three-fold increase* or about the rate of inflation. Although available fiscal records are incomplete, taxes and intergovernmental revenues have been roughly equal in importance since the mid-1980s. Property taxes account for virtually all of the tax collections. The biggest expenditure class for the town is streets and highways, the pattern typical for small towns (WI) and townships (MN).

Big Lake city is located about 40 miles northwest of Minneapolis on US10 in southwestern Sherburne County. Its population has steadily increased from just over a thousand in 1970 to an estimated 4,022 in 1996. Median year of housing construction was 1974 in 1990, reflecting the steady expansion in the housing stock in recent decades. One in five housing units dates from the pre-1940 era, when Big Lake lay well beyond the commutesheds of the Twin Cities and St. Cloud. The cluster of old housing along with recent construction produces a large variance in average housing age. In the years before Big Lake attained suburban status, average per-capita revenues and expenses were typical of a small town. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged only $66, while in the last three years of the study period they averaged $715, or an *increase of more than ten times*, substantially exceeding the overall rate of inflation as reflected in the producer price index (Figure 3.22). In the early years, intergovernmental revenues comprised the largest source of local government revenues, but since the early 1980s, taxes have become the dominant revenue source, with property taxes accounting for just under half of total tax revenues.

Cambridge city, the county seat of Isanti County, is located about 60 miles north of Minneapolis on S65. Like Big Lake, it was a small town in the early post-war period, but slowly has been drawn into the metropolitan orbit. Its population of 2,720 in 1970 doubled to an estimated 5,376 in 1996. The small pre-war housing stock was augmented rapidly after the 1960s, bringing the median year of construction in 1990 to 1975, with above-average variance in housing ages. Local government finances changed with growth, paralleling the experience of Big Lake (Figure 3.23). In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $182, while in the last three years of the study period they averaged $1,683, or an *increase of more than nine times*, substantially exceeding the overall rate of inflation as reflected

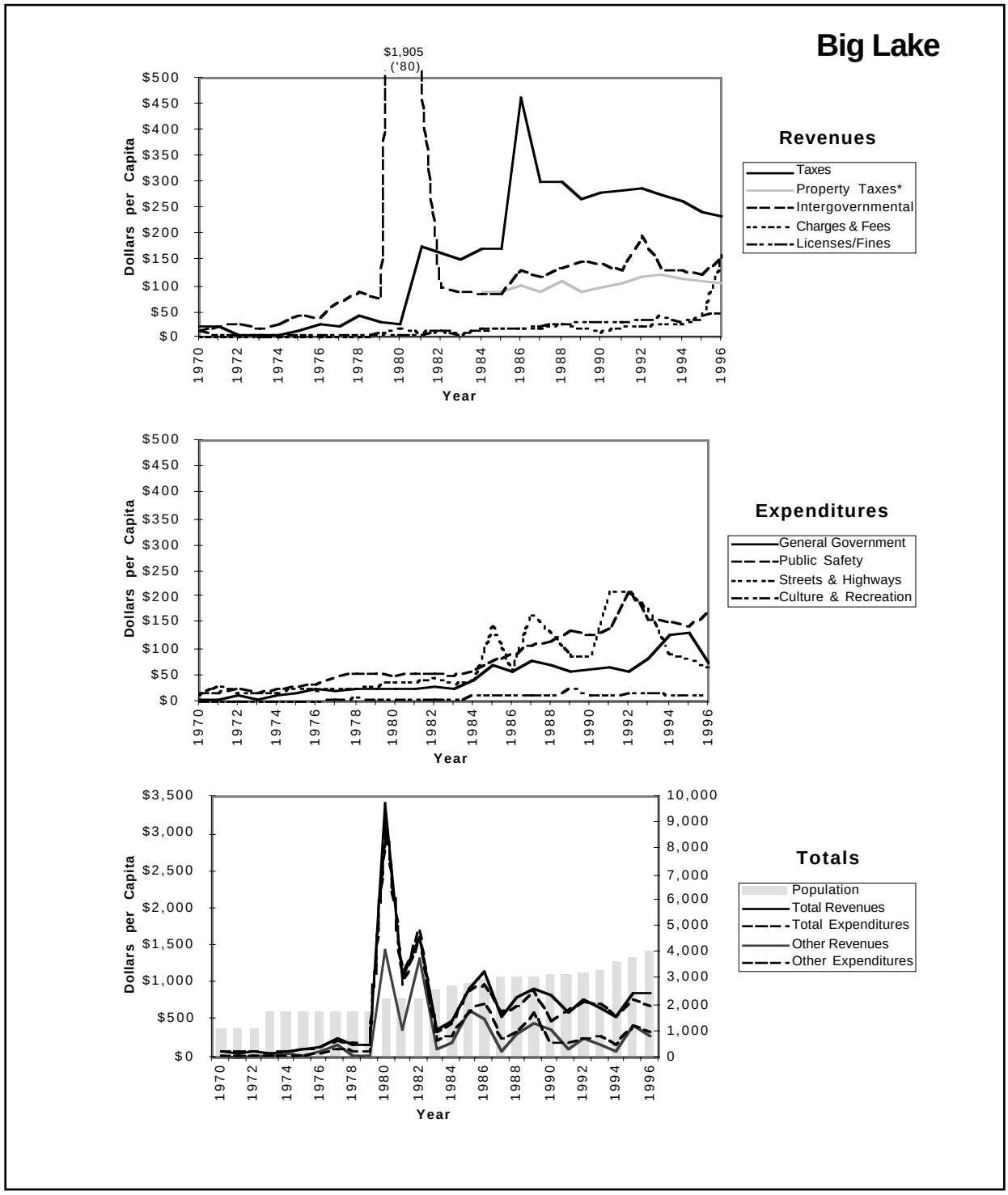


Figure 3.22. Major Local Government Revenues and Expenditures, Big Lake, MN, 1970-1996

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

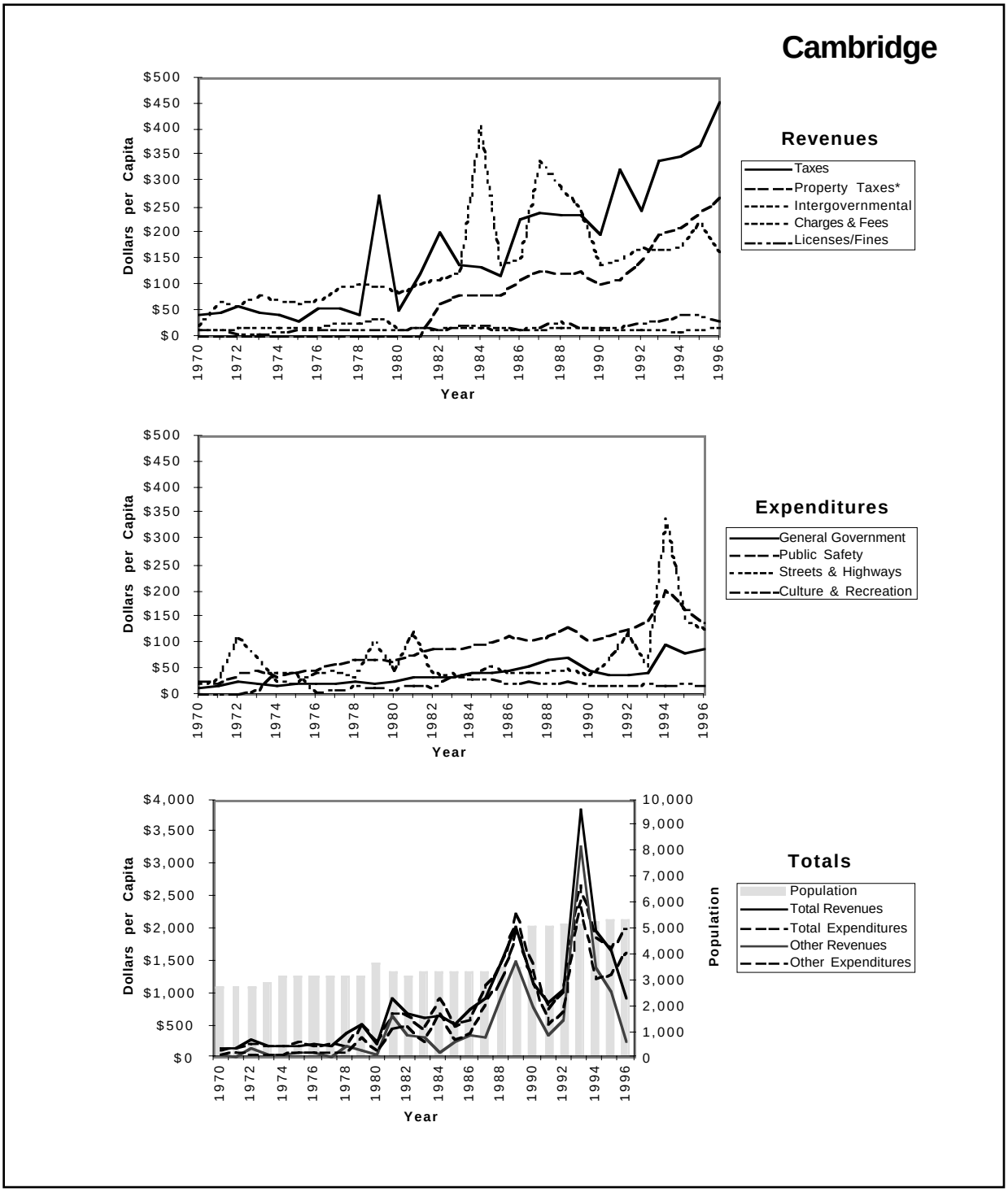


Figure 3.23. Major Local Government Revenues and Expenditures, Cambridge, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

in the producer price index. In the early years, intergovernmental revenues comprised the largest source of local government revenues, but since the late 1970s taxes have become the dominant revenue source, with property taxes accounting for almost two-thirds of total tax revenues.

Chaska city, the county seat of Carver County, is a fourth-ring suburb southwest of Minneapolis on US212. As the metropolitan area has grown, Chaska's population expanded more than three times over, from 4,352 in 1970 to an estimated 14,370 in 1996. Only about one in ten housing units dates from the pre-1940 era, with most of the stock built since 1970. The median year of construction in 1990 was 1976, and the variance in housing age was low. Chaska was twice the size of Cambridge and four times the size of Big Lake in the early 1970s, and local government finances were correspondingly higher on a per capita basis (Figure 3.24). In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $640, while in the last three years of the study period they averaged $2,837, or an *increase of almost four and a half times*, exceeding the overall rate of inflation as reflected in the producer price index. Since the early 1980s, taxes have risen sharply, and form the single largest revenue stream, although only about one tax dollar of seven comes from property taxes. Intergovernmental revenues form an unusually large share of total revenues in recent years.

Shoreview city in Ramsey County is a second-ring suburb north of St. Paul which grew rapidly beginning in the 1970s. It had under 200 housing units in the pre-1940 era, but almost 10,000 in 1990, with a median year of construction of 1976 and a very low variance in housing age. Population has grown steadily, from 10,995 in 1970 to an estimated 26,118 in 1996. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $200, while in the last three years of the study period they averaged $576, or about a *three-fold increase*, falling a bit short of the overall rate of inflation as reflected in the producer price index (Figure 3.25). Taxes have been the city's major revenue source throughout the study period, with property taxes accounting for three out of four tax dollars.

Cottage Grove city in Washington County is a third-ring suburb southeast of St. Paul linked with the central city by US10 & 61, which run together through the center of the city. Like Shoreview, it lay beyond the metropolitan orbit in the pre-1940 era, and had only 139 of 7,105 housing units from that period at census time in 1990. Major development began in the 1960s, and reached high rates of development in the 1970s and 1980s. The median year of construction as of 1990 was 1973, and variance in housing ages was very low. Population has increased every year since 1970, from 13,419 in that year to an estimated 29,031 in 1996. As growth continues,

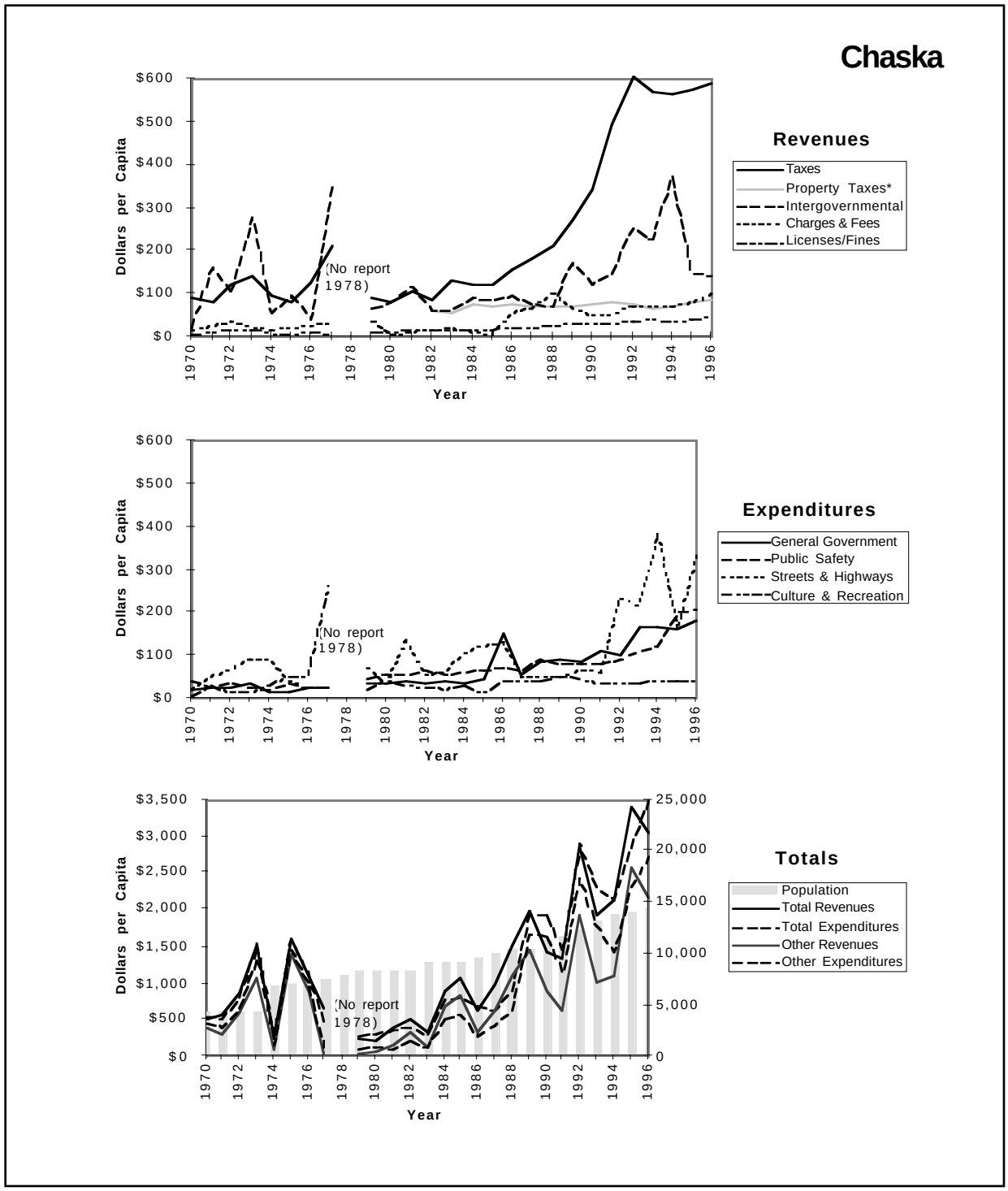


Figure 3.24. Major Local Government Revenues and Expenditures, Chaska, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

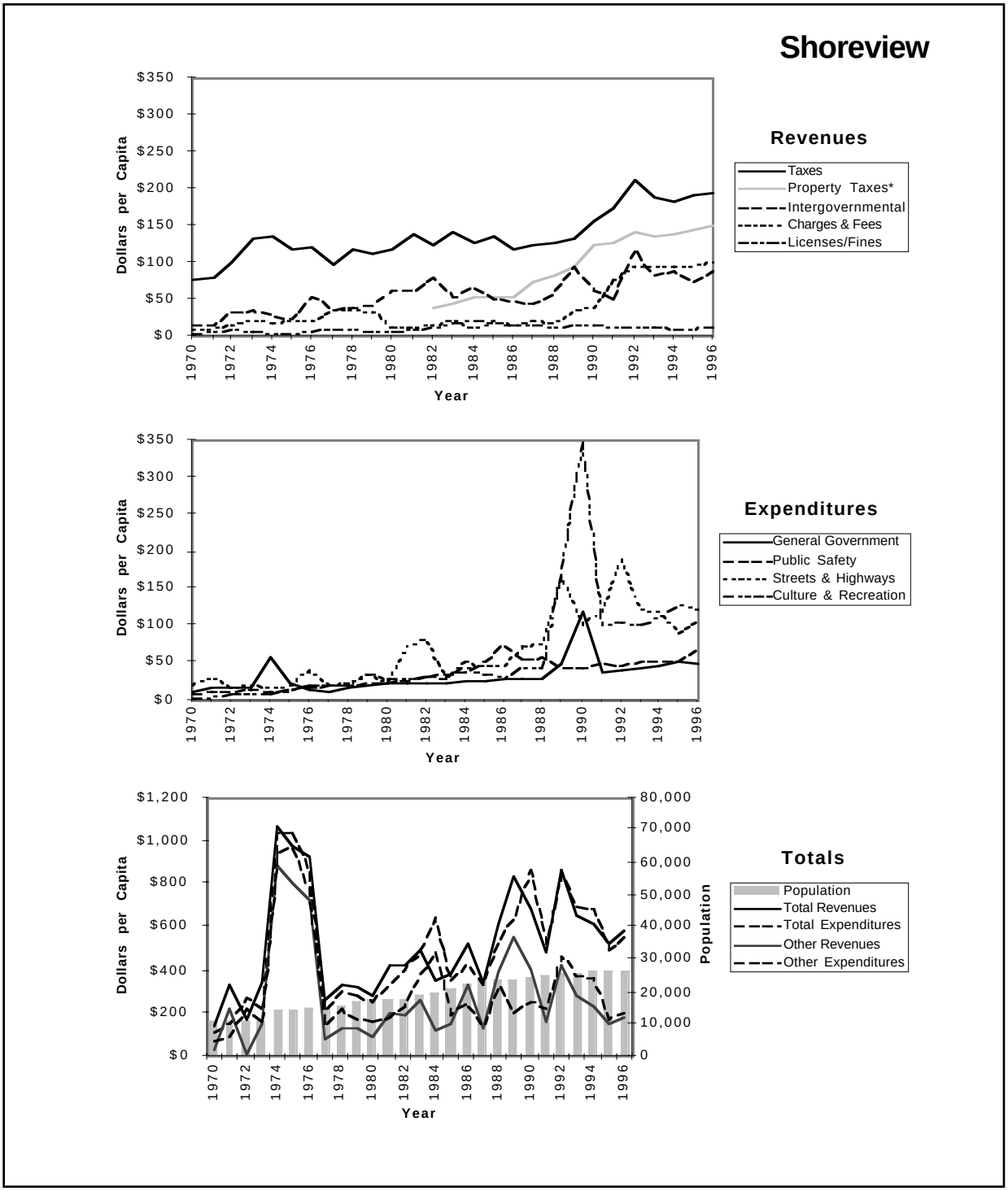


Figure 3.25. Major Local Government Revenues and Expenditures, Shoreview, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

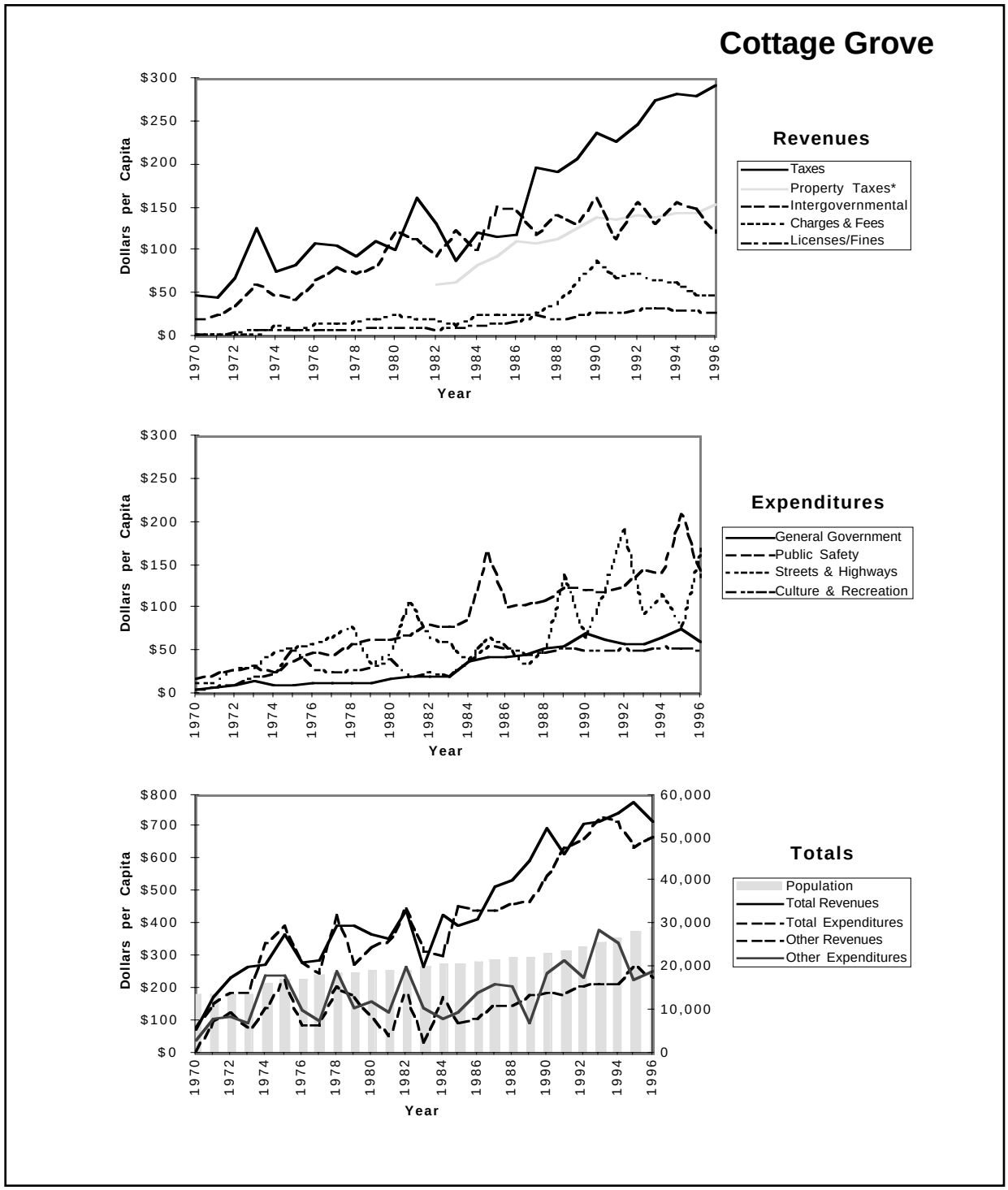


Figure 3.26. Major Local Government Revenues and Expenditures, Cottage Grove, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

local government finances expanded in amount and composition (Figure 3.26). Taxes have been the main local government revenue source, with property taxes accounting for well over half the tax total. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged $148, while in the last three years of the study period they averaged $709, or almost a *five-fold increase*, exceeding the overall rate of inflation as reflected in the producer price index.

1980s Housing—Albertville, Eagan, Maple Grove

These cities have the newest housing because they have grown fast during very recent times. They are all basically suburbs of the Twin Cities, although Albertville is located in the orbit of St. Cloud as well. As they have grown, their local governments have expanded activity at different rates calculated on a per capita basis. Albertville began the smallest, but expanded government the fastest. Eagan grew from a larger base in the early 1970s but per-capita local government revenues and expenditures grew relatively slowly. Maple Grove's record is between the other two.

Albertville city is located in Wright County along I-94 about 30 miles northwest of Minneapolis. Until the 1980s, it generally lay beyond the commuteshed of both the Twin Cities and St. Cloud, but after the completion of I-94, it began developing steadily. Fewer than ten percent of its housing units date from the pre-1940s. Most were constructed after 1980, so the median year of construction in 1990 was 1984, and the variance in ages was low. Population in 1970 was 451, but rapid growth began in 1980, bringing population in 1996 to an estimated 2,366. As this small, rapidly growing city replaced a quiet farm-service center, local government activity began expanding. In the first three years of the 1970s, per-capita revenues and expenses of local government averaged only $82, while in the last three years of the study period they averaged $800, or about a *ten-fold increase*, exceeding by a wide margin the rate of inflation as reflected in the producer price index (Figure 3.27). Taxes have been by far the city's major revenue source throughout the study period, except for one major spike in intergovernmental revenues in the profile in the late 1970s. Data records for Albertville are incomplete, but property taxes appear to be a growing share of all taxes, and in recent years seem to comprise the majority of tax revenues.

Eagan city in Dakota County is a second-ring suburb that grew rapidly after the completion of I-35E south of St. Paul and the rebuilding of the Cedar Avenue bridge (S77) across the Minnesota River south of Minneapolis. Population was 10,398 in 1972, but had climbed to an estimated

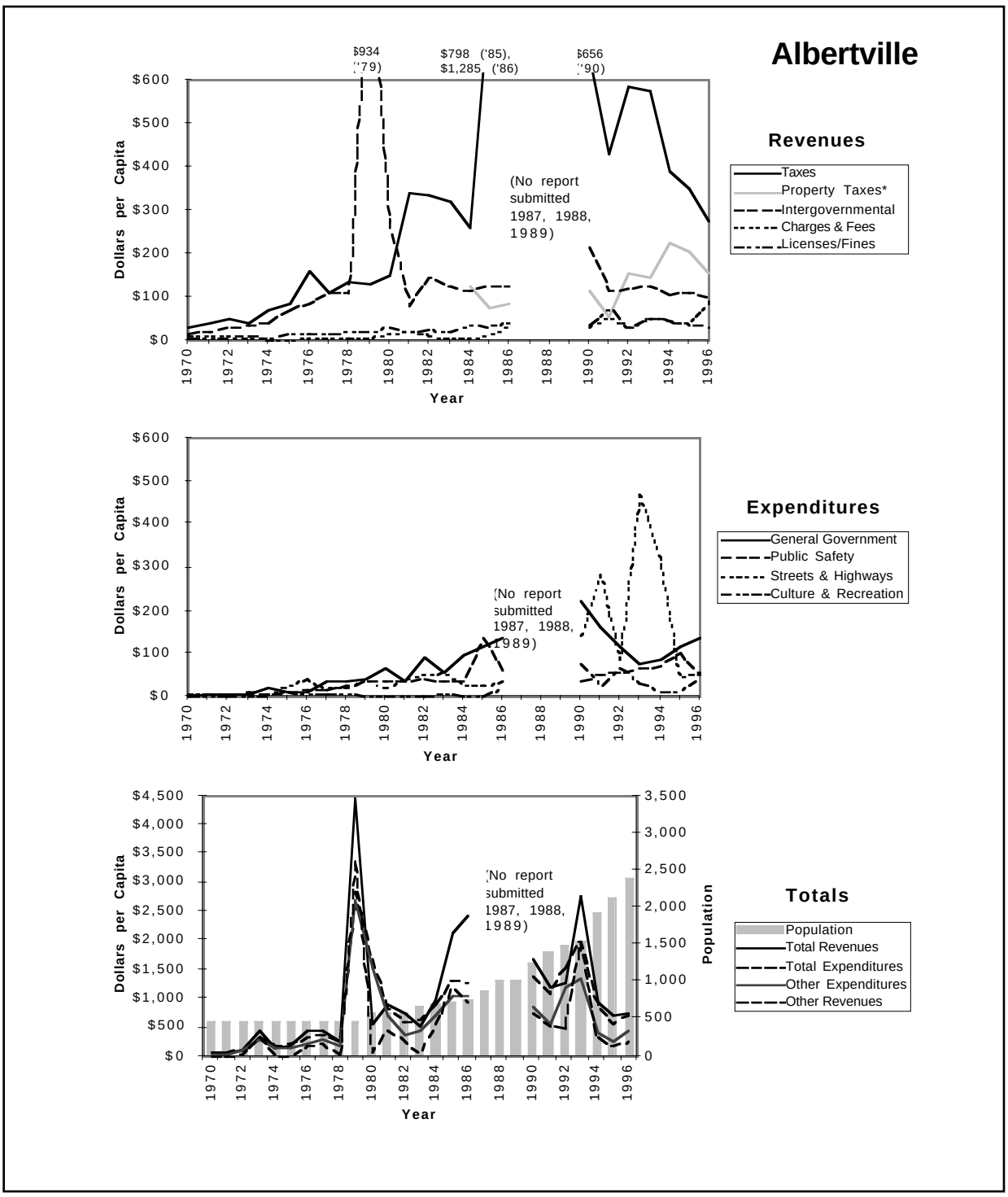


Figure 3.27. Major Local Government Revenues and Expenditures, Albertville, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

57,757 in 1996. For a time, Eagan was Minnesota's fastest-growing city. The age of the housing stock reflects Eagan's explosive growth. At census time in 1990, only 61 units of the city's total of 18,451 dated from before 1940. Median year of construction was 1983, so variance in ages was extremely low. In the 1972-74 period, annual per-capita revenues and expenses of local government averaged $529, while in the last three years of the study period they averaged $866, or *less than a two-fold increase*, falling well short of the overall rate of inflation as reflected in the producer price index (Figure 3.28). Taxes have been by far the city's major revenue source throughout the study period, with property taxes approaching two-thirds of the tax dollars in the last few years.

Maple Grove city in Hennepin County is a fourth-ring suburb of Minneapolis located northwest of the city where I-94 to St. Cloud intersects I-494/694. Like Eagan, it was a small agricultural area before 1940, grew slowly in the 1950s and 1960s, then grew explosively beginning in the 1970s as suburbanization spilled in and interstate highways provided easy access to many parts of the metropolitan area. Rapid growth began in the 1970s and has continued into the 1990s. Population was 6,275 in 1970 and had reached an estimated 45,000 by 1996. Median year of housing construction was 1981 in 1990, and variance in housing ages was extremely low. In the first three years of the 1970s, annual per-capita revenues and expenses of local government averaged $412, while in the last three years of the study period they averaged $1,267, or more than a *three-fold increase*, falling a bit short of the overall rate of inflation as reflected in the producer price index (Figure 3.29). In a pattern similar to Eagan's, taxes have been the city's major revenue source throughout the study period, but property taxes have accounted for fewer than half the tax dollars in recent years.

Summary

This chapter asked two questions: (1) What have been the impacts through time of population growth, and accompanying residential, commercial, industrial, and office development on the revenue and expenditure patterns of a sample of local units of government at different locations around the 24-county Twin Cities area? (2) How do those profiles differ depending on average age of housing in local areas, and on variability in the age of local housing stocks? To provide a partial answer to these questions we examined patterns of revenue and expenditure of 28 local governments in the 24-county Twin Cities study area during the period 1970 to 1996.

We can then plot the 28 places according to (1) their populations at the beginning and at the end of the study period, and (2) their average annual per-capita revenues and expenditures in the first

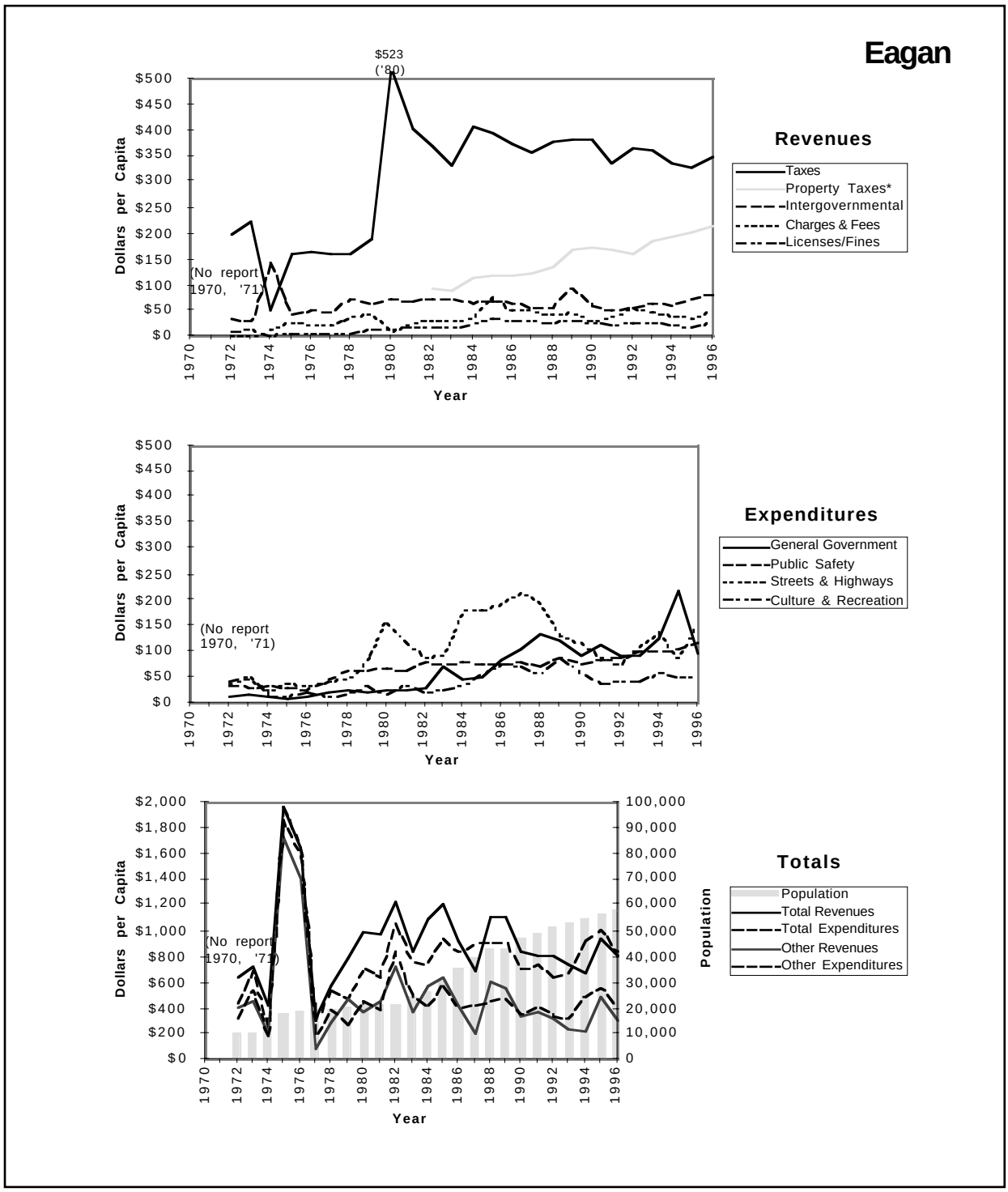


Figure 3.28. Major Local Government Revenues and Expenditures, Eagan, MN, 1972-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

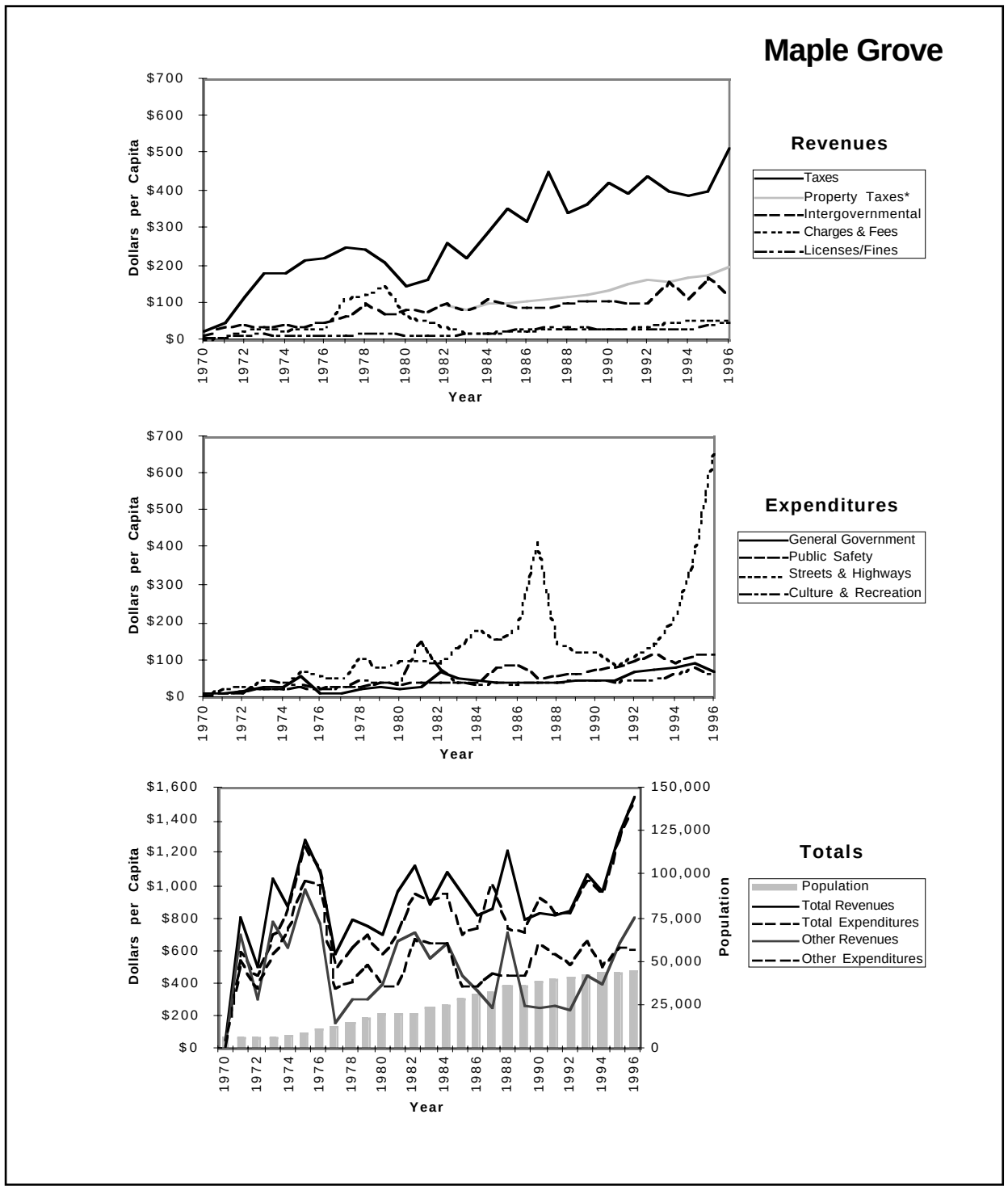


Figure 3.29. Major Local Government Revenues and Expenditures, Maple Grove, MN, 1970-1996.

*Property Taxes plotted separately (as a subset of Taxes) beginning in the first year data were available. In prior years Property Taxes were included in Taxes category.

Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota. Calculations by the authors.

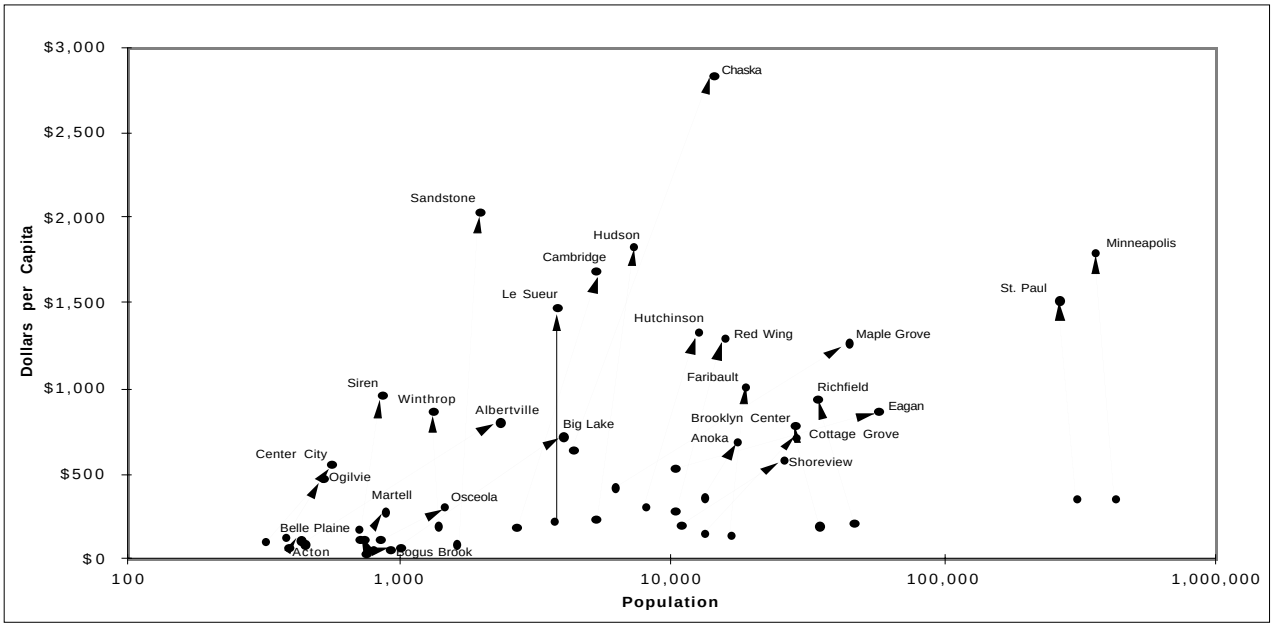


Figure 3.30. Change in Average Annual Per-Capita Revenues and Expenditures.
Data Sources: Department of the Public Examiner, State of Minnesota; Office of the State Auditor, State of Minnesota; Wisconsin Department of Revenue. Calculations by the authors.

three years of the study period and in the last three years of the study period (Figure 3.30). The direction and length of the arrows on this graph indicate the direction and amount of change in the population of a place, as well as the direction and amount of change in average annual per-capita revenues and expenditures in a place, from the beginning to the end of the study period. Because local government revenues and expenditures (and the method by which they are recorded in municipal accounting systems) can be quite variable over time, our three-year averages of annual per-capita revenues and expenditures reflect this variability (e.g., Sandstone's recent spike in revenues and expenditures causes its average value at the end of the period to be much larger than expected). The graph does not exclude such variations, as it is simply intended to portray how local government finance has changed over time, in comparison to population change over time.

With the exception of Minneapolis, the old-settled areas with a median year of housing construction before 1940 are clustered to the lower left corner of the graph. These outlying places have amounts and rates of change of average annual revenues and expenditures much lower than other places, and in two of the townships (Bogus Brook and Acton) average revenues and expenditures actually declined in constant dollars.

With the exception of St. Paul, places with median years of housing construction in the 1940s

also occur to the left of the graph, reflecting their relatively small populations. Sandstone's unique revenue and expenditure pattern in the last few years is reflected in the length of its arrow. Two of the places with median years of housing construction in the 1950s are growing steadily in population (Red Wing and Faribault), and their average annual revenues and expenditures have done the same, as has Le Sueur's. Richfield has also experienced an increase in annual revenues and expenditures that outpaces inflation, but its population has declined.

The directions and magnitudes of the arrows for places with median years of housing construction in the 1960s are quite varied, reflecting the mix of places in this group from large to small populations, varying distances from the core cities, and differing rates of increase in their revenues and expenditures. The situation on the graph for places with median years of housing construction in the 1970s is similar to that of places of the 1960s. To the right of the graph, Shoreview and Cottage Grove display their similar histories, with steady population growth and average annual revenues and expenditures that basically track inflation.

Finally, the three places with median years of housing construction in the 1980s (Albertville, Eagan, and Maple Grove) display a similar length and direction of arrow, even with varied base populations. All of these places experienced spurts in population growth during the suburbanization process, and their average annual revenues and expenditures have increased accordingly. However, because Albertville began as a quiet farm-service center with very low annual revenues and expenditures, its increase was the only one to exceed the rate of inflation, while Eagan and Maple Grove have managed to keep their rates of change below the overall rate of inflation.

Looking at the pattern of arrows on the graph, there appear to be five groups of places. These five classes can be presented by geographic location, as well as by the variability in the age of local housing stocks in the places that form these classes. In our sample of 28 places, those places with low variance in housing age (very homogeneous housing stocks) are the central cities and suburbs. The fourth ring suburbs (Anoka, Chaska, Albertville) and small exurban places tend to have below average variance, while the outlying regional centers (Faribault, Hutchinson, Siren, Cambridge) have above average variance. The places with the highest variance in housing age are mixed, ranging from Wisconsin towns and cities (Martell, Osceola, Hudson), to an outlying regional center (Red Wing), to a developing outer ring suburb (Big Lake) and a township (Bogus Brook).

1. Minneapolis and St. Paul. The central cities are larger by an order of magnitude than other

places in the sample, and with housing stocks that have very low variance, and that are among the oldest in the entire region. Both lost population between the early 1970s and mid-1990s while annual average revenues and expenditures per capita rose an average of 4.8 times, exceeding the general producer price index which advanced about 3.3 times in the same period.

2. Twin Cities Suburbs. Eight places with mid-1990s population between 17,000 (Anoka) and 58,000 (Eagan) form a second group. All are suburbs within the built-up area of the Twin Cities, and all have very low variance in their housing stocks (except for Anoka, with below average variance). Two places (Richfield, Brooklyn Center) lost population as the aging and decline of the central cities spread beyond central city borders. Annual average revenues and expenditures per capita for the eight places rose an average of 3.81 times during the study period.

3. Exurban Centers. Seven cities ranging in size from 2,000 (Sandstone) to 15,000 (Red Wing) had average revenues and expenditures well above most of the other places, and all were growing. Four of these outlying centers had above average to very high variance in housing age (Hutchinson, Red Wing, Hudson, Cambridge), while three had below average variance (Sandstone, Le Sueur, Chaska). The annual average revenues and expenditures per capita for the seven places rose an average of 8.67 times during the study period, but all started from very low bases, then expanded activity to accommodate growth.

4. Small Exurban Centers. The next set includes four places, all starting from low bases: two growing quickly (Albertville, Big Lake), one growing slowly (Siren), and one losing population (Winthrop). These four places cover the entire range of variability in housing age. All have average annual per-capita revenues and expenditures under $1,000, which rose an average of 7.7 times during the study period.

5. Small Places; Small Absolute Changes. The last seven places range in population in the mid-1990s from 439 (Acton) to 1,477 (Osceola). Although some of them grew at fast relative rates, the absolute growth was modest. Most of these places also have high variance in their housing stock. Per-capita annual average revenues and expenditures were correspondingly low, ranging from $48 (Bogus Brook) to a maximum of $546 (Center City). For the seven places in the group, annual average revenues and expenditures per capita rose an average of only 2.9 times, or below the general rate of inflation even though all started from very low bases.

To summarize, it is hard to generalize from the patterns that were observed in the 28 places over the study period from 1970 to the mid-1990s. The central cities, in a size class by themselves

and with special problems to contend with, display one distinct pattern of revenues and expenditures related to size and growth. Places in the other four sets seem to contain more internal differences than similarities. By selecting our sample from many different locations and housing age composition, we built variation into the sample, and that variation emerges at every point in our statistical analysis. Additionally, our study examined only cash flows of local government and ignored the depreciation of existing infrastructure, as well as any off-budget revenues and expenses such as those of community development agencies, housing authorities, and port authorities.

Conclusions

Only a fraction of the events that unfold within the jurisdiction of an MCD's government fall under its direct control. The two most important functions of these governmental units arise from their power to tax, and from their power to regulate land uses within their jurisdictions. They raise taxes to build and improve local public infrastructure, and to support various local public services. They regulate land use to segregate land uses, to restrict various types of land uses, and sometimes to slow the pace of local land development. Regulatory tools normally are used to achieve various land use goals, while local tax instruments are used mainly to raise revenues. But land use policy and local taxation interact in complicated ways, some intended, some unintended, and most of them poorly understood. A short review of recent literature pointed out the complexity of the interactions among local population growth, economic expansion, development pressure, development activity, land use controls, and the revenue and expenditure patterns of local governments located within the orbit of an expanding metropolitan region.

The increasing popularity of development impact fees, exactions, and special assessments to pay for improvements on or adjacent to newly improved properties reflects a growing awareness that if a greater share of the external costs of new development were passed on to the buyers and users of new residential and commercial-industrial properties and to the land owners converting their property to urban uses, then development would proceed with greater efficiency and greater equity. Meanwhile, state and local governments around the country have been imposing limits on tax hikes, governments have issued mandates against increasing spending without provisions for accompanying revenues, and elected officials seem increasingly reluctant to raise taxes.

A later report in this series will explore ways that local units of government around the country and in the Twin Cities region obtain the revenues and pay the costs of development. Another report will examine how the development process affects real estate prices of new and existing housing.

There are several central elements selected for examination in our analysis of the relationship between transportation and urban growth in the greater Twin Cities region.

- Within the *transportation system*, there is a hierarchy of roads ranging from those of interstate status to the city streets of small towns and the gravel roads maintained by township boards, and each year the system must be maintained, with portions upgraded to handle the impacts of growth.
- Within the category of *land use patterns* and *new land development* there are classes of land and types of development (residential, industrial, commercial, office, etc.) that must be distinguished and measured.
- Within the category of *government*, there is the federal government, the states, the counties, the local units of government, special districts (e.g., school districts), and the metropolitan government (i.e., the Metropolitan Council), with each government taxing and spending as they carry out their responsibilities.
- There are households of differing resources (income, wealth, knowledge, access to information, etc.) for whom the expanding metropolitan region is home. Dependent on how the region manages its affairs, the efficiency, prosperity and equity of the region and its households can be enhanced.

In this chapter, we were interested to learn whether per-capita revenue and expenditure patterns for a sample of local governments varied in any systematic way depending on (1) average age and variation in age of their housing stock, or (2) their population size and rate of population change. Housing age and age variability were hypothesized as reflecting local development history, with the expectation that an older average housing age would generally be associated with higher residential and population densities, and younger ages with lower densities.

We also expected that MCDs with minimal variability in housing ages would be either (1) places remote from the Twin Cities, relatively untouched by recent population change and development, and therefore displaying relatively stable fiscal profiles, or (2) recently developing suburbs of the Twin Cities with most of their housing coming from recent years and experiencing rapid

adjustments in their profiles of revenues and expenditures.

We focused attention on a sample of local governments in the region and illustrated how revenue and expenditure patterns changed through time as they were touched by Twin Cities-area development processes of the past several decades. This analysis by itself cannot answer the question whether development "pays for itself." That is the subject for a later study in this series. The data presented in this chapter seem to suggest that because there are lower governmental costs in small outlying areas, developers might be better off working out there. This observation neglects the aggregate impacts of development in small places over time. Total costs of development today in an outlying rural township will not be accurately reflected in this year's township budget, but they definitely will show up in state, county, school district, and metropolitan budgets in the years ahead. All the parts of the system are connected—over space, and through time.

There is also the suggestion from the 28 fiscal profiles that the bigger and faster the growth of a local unit of government, the more easily it can keep pace with inflation. Again this observation is too narrow because there is no attention to the ways that other governments are affected by growth in a specific community. Those ways can be changes in revenues and expenditures of those governments, as well as changes in the capital value of existing assets (housing, offices, stores, shopping centers, etc.) in other jurisdictions.

Finally, geographical setting has been and undoubtedly will continue to be important in the Twin Cities development process. Rolling hills and lakes such as have been available to the northwest, west, and southwest of the Twin Cities offer amenities for upscale development that poorly drained and flat areas such as many parts of the northern Anoka Sand Plain cannot match. As explained in an earlier chapter, the large populations in south Minneapolis and western St. Paul gave early impetus to suburban development into areas toward which those large, post-war populations moved.

Growth produces benefits as well as costs, yet questions persist whether new local government revenues will cover new and continuing costs. Even if the budgets balance, additional uncertainty remains regarding the relationships over space and time between who pays and who benefits. We have a sense that development costs and benefits are distributed among different locations and different interests, but it remains unclear who pays? Who benefits? And what are the long-term consequences of the development process across the metropolitan region when costs and benefits fail to match up in time and place?

Chapter 3

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Appendix 3-A: Selected Population and Housing Characteristics, 28 Sample Minor Civil Divisions.

MCD	County	Land Area (Square Miles)	Population	Population Density (Pop/SqMi)	Median Year of Housing Construction
Bogus Brook township	Mille Lacs	36.2	886	24	1939
Acton township	Meeker	33.3	444	13	1939
Center City city	Chisago	0.3	443	1,460	1939
Belle Plaine township	Scott	39.2	675	17	1939
Minneapolis city	Hennepin	54.9	368,383	6,706	1939
Martell town	Pierce (WI)	35.8	870	24	1948
Sandstone city	Pine	4.3	2,057	482	1945
Winthrop city	Sibley	0.8	1,291	1,556	1948
St. Paul city	Ramsey	52.8	272,235	5,157	1944
Red Wing city	Goodhue	34.9	15,103	433	1958
Faribault city	Rice	11.6	17,085	1,477	1956
Le Sueur city	Le Sueur	3.6	3,720	1,026	1959
Richfield city	Hennepin	6.9	35,710	5,190	1956
Hudson city	St. Croix (WI)	4.0	6,378	1,606	1961
Ogilvie city	Kanabec	1.2	508	414	1962
Siren village	Burnett (WI)	1.0	844	839	1965
Hutchinson city	McLeod	5.4	11,523	2,134	1969
Anoka city	Anoka	6.6	17,192	2,601	1969
Brooklyn Center city	Hennepin	7.9	28,887	3,636	1961
Osceola town	Polk (WI)	35.6	1,337	38	1972
Big Lake city	Sherburne	2.1	3,057	1,430	1974
Cambridge city	Isanti	3.8	5,094	1,347	1975
Chaska city	Carver	13.7	11,339	828	1976
Shoreview city	Ramsey	11.2	24,587	2,197	1976
Cottage Grove city	Washington	34.0	22,935	675	1973
Albertville city	Wright	3.1	1,252	403	1984
Eagan city	Dakota	32.2	47,409	1,470	1983
Maple Grove city	Hennepin	32.8	38,736	1,179	1981

Data Source: U.S. Bureau of the Census, 1990 Census of Population and Housing, STF-3A. Calculations by the authors.

Appendix 3-A (continued)

MCD	Total Housing Units	Housing Units 1989-3/90	Housing Units 1985-88	Housing Units 1980-84	Housing Units 1980-90	Housing Units 1970-79
Bogus Brook township	299	4	20	22	46	63
Acton township	204	0	6	22	28	41
Center City city	186	10	0	12	22	14
Belle Plaine township	211	0	2	13	15	25
Minneapolis city	172,666	1,032	3,682	5,751	10,465	16,242
Martell town	298	2	18	23	43	69
Sandstone city	538	2	13	11	26	119
Winthrop city	599	0	6	24	30	100
St. Paul city	117,583	513	3,328	4,349	8,190	13,651
Red Wing city	6,182	194	588	314	1,096	1,142
Faribault city	6,618	124	246	449	819	1,257
Le Sueur city	1,522	17	28	104	149	402
Richfield city	16,094	15	357	437	809	1,341
Hudson city	2,634	43	387	230	660	350
Ogilvie city	197	2	10	16	28	53
Siren village	436	6	12	44	62	138
Hutchinson city	4,764	87	725	555	1,367	926
Anoka city	6,799	298	915	277	1,490	1,744
Brooklyn Center city	11,713	11	373	629	1,013	2,032
Osceola town	582	22	58	56	136	182
Big Lake city	1,318	65	228	189	482	296
Cambridge city	1,950	71	304	332	707	530
Chaska city	4,476	271	834	429	1,534	1,667
Shoreview city	9,280	131	1,600	1,475	3,206	3,306
Cottage Grove city	7,105	434	791	587	1,812	2,540
Albertville city	423	54	146	59	259	81
Eagan city	18,450	1,036	6,688	3,726	11,450	4,589
Maple Grove city	12,968	715	3,538	2,707	6,960	4,726

Appendix 3-A (continued)

MCD	Housing Units 1960-69	Housing Units 1950-59	Housing Units 1940-49	Housing Units 1939 or before
Bogus Brook township	13	10	0	167
Acton township	13	15	2	105
Center City city	18	4	6	122
Belle Plaine township	19	23	12	117
Minneapolis city	18,055	19,251	16,837	91,816
Martell town	21	14	8	143
Sandstone city	52	27	89	225
Winthrop city	65	90	63	251
St. Paul city	14,170	15,905	10,573	55,094
Red Wing city	693	845	288	2,118
Faribault city	921	745	569	2,307
Le Sueur city	176	264	159	372
Richfield city	2,828	7,042	3,379	695
Hudson city	336	329	219	740
Ogilvie city	21	5	11	79
Siren village	35	56	49	96
Hutchinson city	705	659	285	822
Anoka city	1,298	858	531	878
Brooklyn Center city	2,999	4,729	611	329
Osceola town	57	36	22	149
Big Lake city	142	32	106	260
Cambridge city	194	134	69	316
Chaska city	480	242	63	490
Shoreview city	1,159	1,227	210	172
Cottage Grove city	1,579	991	44	139
Albertville city	31	8	10	34
Eagan city	1,825	485	40	61
Maple Grove city	901	162	55	164

APPENDIX 3-B: DATA NOTES

1) In 1973 Acton Township submitted an incomplete or unclassified report. Thus figures are based on estimated receipts and disbursements from Minnesota Department of Revenue.

2) In 1989 Minnesota's formula for calculating taxable valuation changed. As a result of this changed formula, caution should be used when comparing property tax revenues in years 1988 and prior with those in years 1989 and later.

3) Revenue and expenditure figures include the operations of public service enterprises.

4) Caution should be used when comparing data for Wisconsin municipalities in years 1986 and prior with those for years 1987 and later, as county enterprise fund data no longer are included in the later period.

5) Data for the city of Eagan do not appear until 1972, the first year it reported as a city.

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Wisconsin: Wisconsin Department of Administration, estimates.

Chapter 4
SCHOOL DISTRICTS, SCHOOL FINANCE, AND MUNICIPAL GOVERNMENTS

INTRODUCTION

School districts are one system among the many overlapping jurisdictions that make our political/administrative landscape so complex. In Chapter 3 the variety in budgets and local circumstances among municipal governments or minor civil divisions became clear. In this chapter we examine the enrollment and expenditure patterns of five school districts between 1970 and 1997, and explain some of the trends within the context of development within our 24-county study area. We also explore some of the linkages between municipal finance and educational finance at the local level, and the relevance of those linkages to metropolitan development.

Why study school districts?

- School expenditures are the largest single category of aggregate spending at the state and local level in Minnesota, so patterns of development affect spending in major ways.

- The circumstances within which school districts operate depend in part upon land development patterns, state and local public finance, and the transportation system that both *leads* and *responds to* the patterns of development that evolve.

Both school districts (SDs) and municipalities (MCDs) rely heavily upon local property taxes to support services within their boundaries, and that is why their spending and revenue-raising practices–and the responses that they trigger–are important to metropolitan development patterns. Local tax base is a direct reflection of land development and property value within a jurisdiction's boundaries, and that pattern of land use is determined to some degree by the place's situation within the larger metropolitan area, including its access to transportation. The value of property also depends in part on land use patterns outside of a jurisdiction's boundaries, and over which it has little control, because the metropolitan area may be thought of in some respects as one land market, with several submarkets within it. The desirability of a given location *relative to others within the metropolitan area* plays a part in land use decisions of every kind.

All of these elements come together to influence financial decision-making within administrative

areas. Service delivery is inseparably bound up with both financial and political concerns, which are reflected most directly in the willingness (or lack thereof) of property owners to accept a given level of taxation.

Municipal governments and school districts are, in essence, competing with each other for property tax revenues. Municipalities can influence growth and development levels to some extent, through zoning laws and tax policies, and the use of financing tools. School boards have no such influence, except through indirect political means. Conversely, school districts can be reconfigured more easily than municipalities in the face of changing circumstances. Growing MCDs sometimes annex their smaller neighbors, but a group of cities seldom if ever consolidates into one. The leadership of both jurisdictions must find a balance between support for schools and support for other local services. When they cannot, one or the other suffers.

School District Boundaries

The logic that underlies current school district boundaries may seem elusive at first glance (Figure 4.1). Outside of the central cities they often correspond with no other administrative boundary, and overlap and split municipalities in ways that immediately suggest inter-jurisdictional chaos. There is, in fact, a logic to the system, but it resides in the history of school district development.

Origins

The Constitution of the State of Minnesota mandates that state government "establish a general and uniform system of public schools . . . secure a thorough and efficient system of public schools throughout the State" [1]. In 1849, the first laws for school district reorganization in Minnesota's territory were enacted. The township was the smallest local unit of government at the time that could supply enough pupils to make a school feasible. Every township with five or more families in residence became a district, but townships could be divided into two or more school districts if population warranted, usually restricted in size to the distance a pupil reasonably could walk to and from each day. As population grew, most townships were subdivided into smaller districts.

By 1887, the state had over 5,000 small school districts. Legislation for district enlargement was thus far inadequate. Some larger cities were able to obtain legislative charters to create special

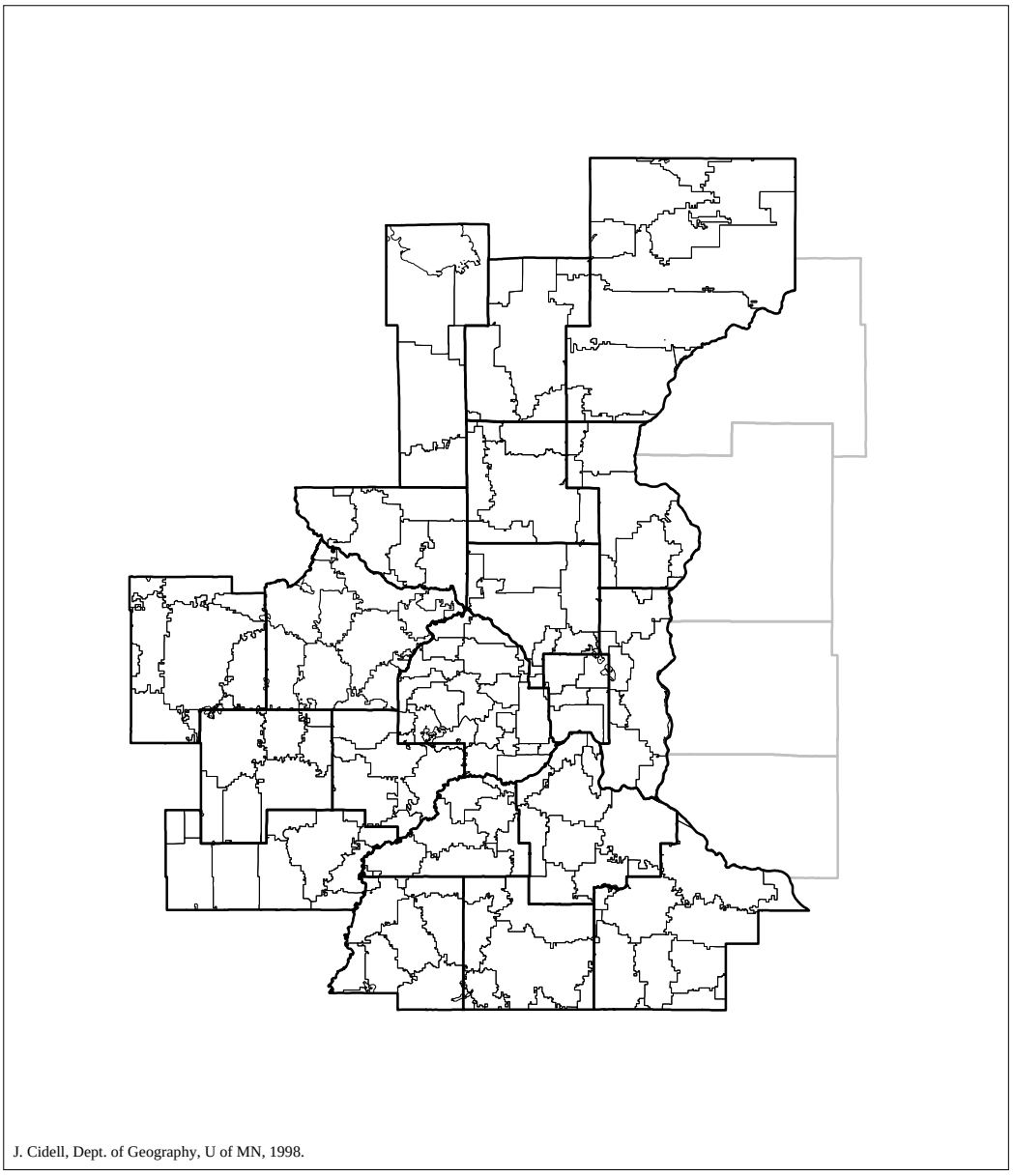


Figure 4.1. School Districts, 20-County Area, Minnesota.
Note: In this chapter we considered only Minnesota school districts.

districts of their own, as did St. Paul, for example, in 1857. Others soon followed. By 1865 the demand for this sort of coordination became so widespread that new legislation provided for independent districts in towns and villages as well.

Consolidations Begin

Agricultural improvements and urbanization during the late 19th century eventually created a pattern of uneven property development across the state. Population change was unpredictable, many rural schools became inadequate in size, and smaller districts with rapid population growth soon developed a mismatch between demands on schools and local tax resources to provide them.

In 1901, the first consolidation law established 12-grade districts, usually comprised of a village center and surrounding countryside [2]. The act provided no incentives for consolidation, and the increased size of a new district often introduced a requirement to provide transportation for pupils, which often offset much of the savings realized through closing inefficient schools. District size still was constrained by the "reasonable distance" principle, even if horse or wagon transport were available. Only nine new consolidated school districts were formed under this law.

The state's interest in consolidation was to achieve maximum efficiency and quality in the school system. In 1911 a new law was passed that provided some financial incentives for consolidation, by granting general state aid to consolidated districts [3]. In 1915 this direct state aid was replaced with funds specifically for school buildings and transportation [4]. As districts lost population, they closed schools and contracted for services with neighboring districts, or consolidated. In 1935 general state aid to education was broadened, but the building fund was repealed, leaving transportation funding as the only specific aid to education from the state.

By 1939, when federal aid that had been granted to school districts under the WPA ended, there were 434 consolidated districts in Minnesota, most in the sparsely settled northern part of the state [5]. The withdrawal of federal funds slowed the rate of consolidation, as most new districts required new facilities. World War II slowed activity further by creating teacher shortages and a general conservatism toward expansion during the war years.

The Post-War Consolidation Boom

Many of the state's schools emerged from the war neglected and outmoded, and district resources rapidly were outpaced by population growth. Many rural schools had closed, and urban schools were overwhelmed by new enrollments. State government faced the dual challenges of equalizing educational opportunity across a variegated landscape of rich and poor districts, and of rationalizing the delivery of school services for greatest efficiency–mainly by reconfiguring

district lines. The major savings realized by consolidation accrue mainly from the reduction in administrative redundancy and cost, and the more efficient use of buildings.

As a remedy new, broadly permissive legislation in 1947 provided revised methods for enlarging districts: c*onsolidation, dissolution*, and *reorganization* [6]. The legislation produced results rapidly. Sixty-three Minnesota counties undertook reorganization plans. The first seven years under the law saw the number of districts in the state drop by 38 percent, to 4,722 [7].

In 1978, academic pairing legislation was created, allowing and encouraging districts to share staff, programs, and students. Few districts participated in the 1980s. In 1989, c*ooperation* and *combination* legislation created the means for districts to ease gradually into permanent reorganization, from academic pairing or cooperative agreements [8]. Between 1989 and 1993, 33 cooperation/combination agreements were forged, involving 80 school districts.

Dissolution and attachment is another option for reorganization [9]. In this process one district is dissolved and attached to another. Local property owners may petition the auditor of their county for a vote to dissolve the district. If dissolution occurs, the district's teaching staff can be reassigned to other districts, although options exist in the law for early retirement. Provisions also are included for severance levies and operational debt levies, to supplement state aid in funding the costs of consolidation.

Finally, *detachment* and *annexation* allow citizens to initiate the detachment of a parcel of land on the border of a district [10]. This process requires the approval of all affected school boards and county boards.

By 1994, the prospect of permanent reorganization had become more acceptable. In order to facilitate the movement further, districts wanted simpler state aid formulas, fewer local levies, and shorter reorganization timelines. The law on consolidations was amended, so that $300 of state aid per pupil went to consolidating districts over a two-year period [11]. (Combination/ cooperation had offered $600 per pupil in state and local levies over 4 years.) Combination/ cooperation was phased out beginning in fiscal year 1995. Since 1994, there have been 20 consolidations in the state, involving 40 districts.

School District Consolidation Today

School district reorganization continues to be regulated by state law, but is initiated locally, often triggered by deteriorating financial or demographic circumstances. The Minnesota Department of Children, Families and Learning notifies districts when they begin to exhibit any of the following conditions:

- economic or population growth is less than the state or regional average;
- enrollment or school-age population declines;
- increasing numbers of students enroll in special programs outside of the district;
- grades 7-12 have fewer than 400 students, or grades K-6 have fewer than 140;
- there is no upturn in population growth or economic growth, and none is foreseen;
- educational program quality/quantity declines, or staffing levels and staff/student ratios become unfavorable;
- student achievement levels decline;
- districts experiencing these changes are not involved in cooperative agreements or partnerships;
- such districts seem unable to enter into such agreements or partnerships;
- parental and community involvement and support are in decline;
- school facilities are old, too small, or the cost of upgrading them would be more than 40-50 percent of the cost of new construction;
- maintenance costs are high, and the district cannot pass the bond referenda necessary to support the facilities.

Over the course of the past century, school district reorganizations have changed school management and finance dramatically. From a peak of over 8,000 districts in 1918-19, the number of districts has dropped steadily, while the number of pupils served by each district has increased exponentially, particularly during the 1960s as the demographic changes of the Baby Boom years pushed districts to rationalize their delivery of services (Table 4.1). Between 1990 and 1998, 71 reorganization agreements were undertaken in Minnesota, involving 160 school districts. Consolidation has played a greater role outside of the metropolitan area than within it.

Table 4.1. Number of School Districts and Pupils Per District, 1900 to 1997

Year	Number of Districts	Number of Pupils	Average Number of Pupils per District
1899-1900	6,896	399,207	58
1918-19	8,087	485,684	60
1939-40	7,685	514,886	67
1959-60	2,581	684,998	265
1969-70	446	934,032	2,094
1979-80	437	771,678	1,766
1989-90	432	733,338	1,698
1994-95	382	812,852	2,127
1995-96	365	827,588	2,267
1996-97	358	840,377	2,347

Source: Minnesota Taxpayers Association. 1997. Understanding Education Finance 1996-97, p. 5.

Cities and School Districts

Through consolidation, a single school district may come to serve several municipalities. If a district has a rapidly growing school-age population that outpaces local tax base growth, it may be in that district's interest to consolidate with others. New housing often is the first type of development to appear on the metropolitan fringe, and it may not provide enough tax base to support needed new schools. An MCD can act to attract commercial, industrial, and office development to improve its tax base and relieve the burden on homeowners, but school boards have no such authority.

There are, in fact, spheres of service delivery in which local governments and school districts do intersect–school board elections and bond referenda, school tax levies and collections, audits, and building code enforcement, to name a few. Although there is a time-honored and well founded practice of keeping school districts autonomous from municipalities (except in large cities), some cost efficiencies might be accomplished with greater coordination of service delivery between them.

Central city districts such as Minneapolis, St. Paul, and some first-ring suburbs often face several kinds of additional costs. Outward expansion of the metropolitan area also may lead to population decline for these central cities, as it has in Minneapolis-St. Paul. There are certain economies of scale to school districts because of certain fixed costs (physical plant, etc.), so that the fewer pupils there are, the more expensive it can be to provide basic education for each one.

As a city's enrollment declines, fewer teachers are needed, and those with less seniority are the first to be laid off. This leaves in place a staff of longer-term, often better-trained teachers who command higher salaries and benefits, thus driving up per-pupil instructional salary costs. Younger teachers may find jobs most easily in fast-growth areas at the metropolitan fringe, so salary expenses will be lower. Expanding districts with newer facilities also may face lower maintenance costs than those with aging and inefficient buildings.

In addition, population out-migration and declining birth rates have negative consequences for the property tax base (assessed valuation) of a city, leaving it more likely to provide only the minimum level of services–both municipal and educational–compared with high-valuation cities, in which the same tax *rate* will yield higher revenues. Out-migration reflects low demand for a city's land parcels; lack of demand lowers price and valuation of property; a lowered valuation produces fewer dollars at a given tax rate. In large districts serving several MCDs with a variety of growth rates and socioeconomic levels, attempts to raise local district revenues through bond referenda can become contentious political battles. An aging inner-ring suburb with a declining school-age population and recently closed schools may resist passage of a bond issue to help build new schools in the same district's outer reaches, where fast growth has migrated.

As the Twin Cities metropolitan region has grown, economic, social, and racial sorting within housing and labor markets has occurred, for complex reasons. The result is a disproportionate number of poor and minority pupils within some cities in the metropolitan core. In 1997 categorical state aid changed, from support of children receiving Aid to Families with Dependent Children, to aid for children qualified to receive free or reduced-cost lunch at school. This aid follows the student to his or her district. Income levels are used as a predictor of below-grade reading levels, requiring remediation and special support programs.

Transportation and School Districts

The portion of school district finance that is used to transport pupils to and from school generally is small in relation to other expenditures, although the per-pupil amount varies along with the geography of the district (Figure 4.2).

Districts are reimbursed by the state for the costs of transporting pupils to and from school each day (one round trip):

- for elementary pupils who live more than one mile from school,

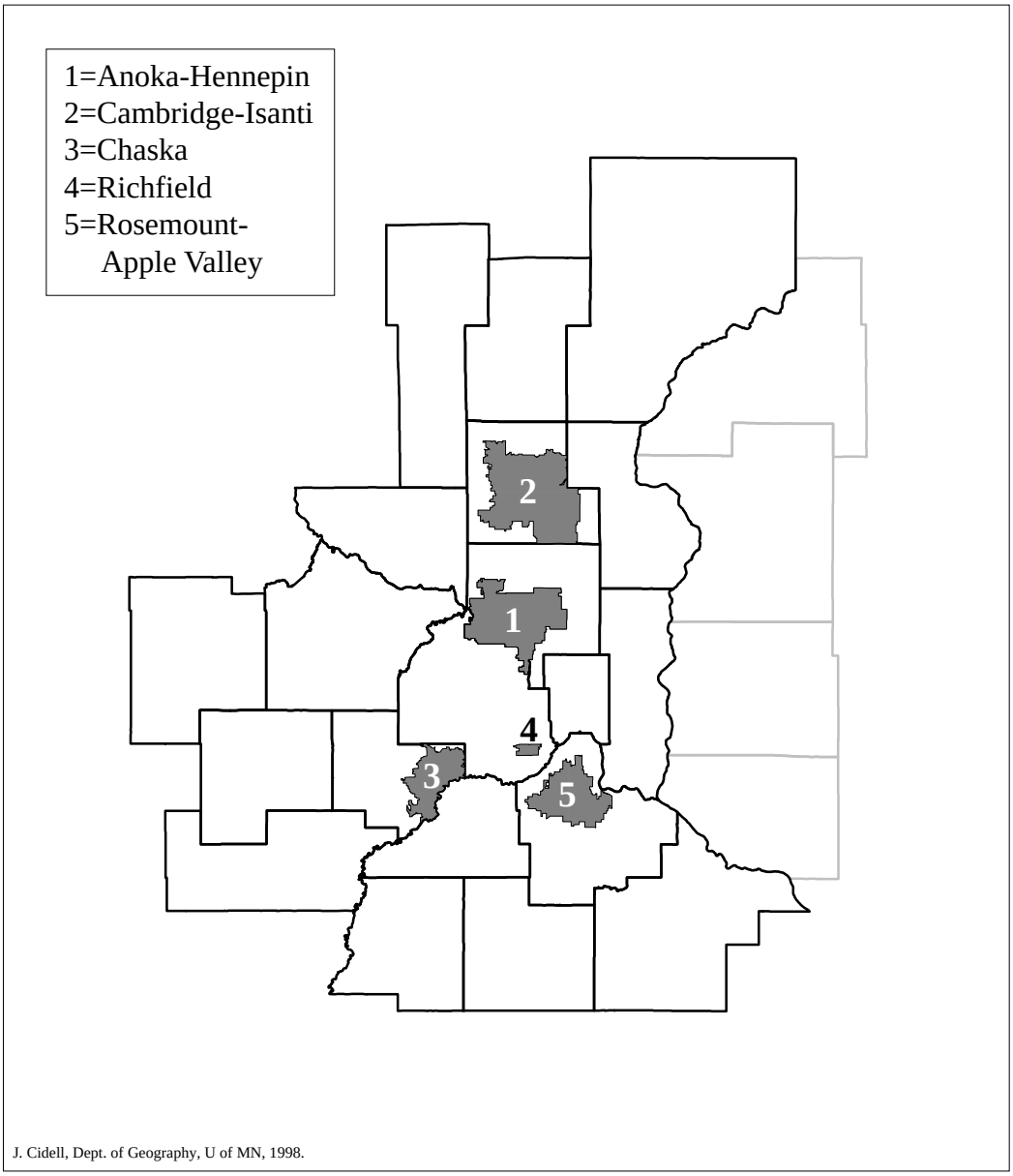


Figure 4.2. Five Sample School Districts.

- for secondary pupils who live more than two miles away, and
- for pupils whose walking path would require them to encounter traffic, drug or crime hazards–for elementary pupils living less than one mile from school, and for secondary pupils living 1-2 miles away.

Most of the costs of busing children have to do with the distance between their homes and the school facilities, and how a district provides transportation–with its own vehicles, or by contracting out. There are several additional categories of non-regular transportation services, including transport of disabled pupils; and of non-public pupils who use some public school services. Some additional transportation costs have been imposed by desegregation legislation; these also are reimbursed by the state [12]. Districts may impose local levies to pay for transportation services not reimbursed by state aids; for example, to bus secondary pupils who live less than two miles from school.

Metropolitan area district costs for regular transportation are likely to be higher than elsewhere, because of required lower speeds, more frequent stops, and the higher likelihood that all grades will be bused, due to traffic hazards and the extent of desegregation orders.

In every case, the wisdom of consolidation depends upon the tradeoff of the benefits of pooled resources against the costs–not only in money, but in time, cohesiveness, and participation–of the new configuration. Increased transportation finance costs traditionally may not have been an important consideration in consolidation decisions, because these are reimbursed by state aids. Thus, the cost increases may not be evident on local property tax bills, but may be embedded in state income tax payments.

In addition, transportation costs often are transferred to households and so do not appear on school district budgets, as parents chauffeur kids to classes and to the plethora of extracurricular activities that larger districts can afford to offer. In some cases, parental involvement may decline with distance. Finally, time costs are significant for both parents and children. Distance and congestion increase school-related travel time, and more time on the road increases the risk of mishap.

While transportation costs are not the largest item in a school district's budget, they do represent opportunity costs for time, safety, and community involvement, as well as directly to budgets.

School Finance in Minnesota

The State of Minnesota has granted certain kinds of aid to local school districts since 1863, starting with support for transportation and special and vocational education. Over the past century state support has expanded to ensure a minimal level of per-pupil expenditure throughout the state, and to equalize to some extent per-pupil spending levels across districts. To 1930, the state provided about 20 percent of school district revenues. By 1960 the state's portion had increased to 60 percent. We review below some of the major developments in school finance.

Post-War Increases in State Support

After World War II new legislation in 1947 drastically changed the financial basis of K-12 education in the state, by providing both *basic support* and *equalization* through four categories of aid:

1) *transportation*–for busing pupils to and from school;
2) *basic*–a fixed sum per "pupil unit" in average daily attendance;
3) *equalization*–to compensate for average assessed valuation per resident pupil unit below a minimum, with a maximum cap; and
4) *income tax*–a fixed dollar amount per child from income tax revenues; intended mainly to help pay off bonded indebtedness incurred from capital projects [13].

In 1946-47 the state provided $21.4 million in aid to K-12 education; by 1953-54 the figure had risen to about $73.7 million (covering just under 40 percent of the total cost). Most of this rise reflected rising costs for basic educational services, rather than expanded programs. Further legislation 1957 legislation strengthened and unified state funding into the *foundation aid program*, guaranteeing a minimum level of support for every student in the state. As costs continued to rise, however, districts' reliance on local property tax revenues rose, at differing levels. Concern over rising property taxes led to a new set of legislative reforms in 1971, at the beginning of our study period.

The "Minnesota Miracle." The reforms passed by the 1971 legislature were meant both to further equalize aid among districts, and to relieve local property tax burdens. As a result of this legislation the state's share of K-12 education funding rose dramatically, eventually settling back to its current level of about 62 percent (Table 4.2).

Table 4.2. Trends in State Share of K-12 Funding, 1970-1995

Year	State Aids and Taxes (thousands)	Percent State Aid
1930-31	35,304	29.5
1965-66	647,385	44.4
1968-69*	875,771	51.7
1981-82	2,115,700	71.7
1988-89	3,266,390	61.9
1989-90	3,513,266	60.3
1990-91	3,768,193	63.5
1991-92	4,052,040	59.8
1992-93	4,263,355	56.4
1993-94	4,525,324	63.5
1994-95	4,901,405	61.2

*1930-31 and 1960s numbers include federal revenues. Data for 1989-90 and later are from an unpublished table from House Ways & Means committee staff, 1/96.
Source: Minnesota Taxpayers Association. 1997. Understanding Education Finance 1996-97.

Current Structure of School Finance

Today school districts receive revenue from three major sources:

(1) State education finance appropriations

a. *General aids*: this is the largest share of (1), averaging about 40 percent of total district revenue, and is meant to provide basic support and to equalize differences in property wealth among districts.

b. *Categorical aids*: these funds are more targeted, to equalize costs that vary widely among districts, and to fund special programs. These aids provide about 10 percent of total district revenues.

(2) State-paid property tax credits: the state contributes funds to reduce local property tax burdens. For example, in 1997 legislation established an Education Homestead Credit, to begin in 1998-99, which is a means to provide property tax relief from school funding levies. The credit will be equal to 32 percent of the general education homestead property tax, with a maximum of $225 [14]. Thus, the state has taken on a larger burden of educational funding in a way that recognizes differing tax capacities among districts, and that is obvious to voter households.

(3) Property tax levies: locally collected levies. The largest share supports general education; this also is a major source of capital funds for school building. The state mandates a

fixed tax rate for general education revenues for all school districts (36.9 percent of adjusted net tax capacity (ANTC) in 1998-99) [15].

Additional Sources of Revenue. Federal funds are typically targeted toward specific minority and disadvantaged student populations, groups that constitute a proportion of Minnesota's enrollment smaller than the national average. Federal aid contributes about five percent of total district revenue. Other local aids–from gifts, tuition, rent, fees, etc.–comprise about ten percent of district revenue.

How Revenue Levels Are Established

Each year, the legislature determines the minimum dollar amount that must be spent per pupil unit in the state [16]. This is the *formula allowance*. In 1998-99 the basic per-pupil formula allowance is $3,530 (Table 4.3). The legislature also designates the percentage rate at which the adjusted net tax capacity (ANTC) of property will be taxed for the general education fund (36.9 percent (or .369) in 1998-99). This is the *local tax capacity rate*. The formula allowance times the number of pupil units in a district determines the dollar amount that each district is expected to raise through local property taxes. Thus, an average district might have the following school funding profile [17]:

Number of pupil units			=	1,000
General Education Formula Allowance			=	$3,530 per pupil unit
Adjusted Net Tax Capacity (ANTC)			=	$3,500,000
Local Tax Capacity Rate for 1998-99			=	36.9% (.369)
Rate	x	ANTC	=	Local Effort
.369	x	$3,500,000	=	$1,291,500

The local tax capacity rate is then multiplied by the adjusted net tax capacity (ANTC) of the property within a school district (as determined by the local assessor). The sum is the district's *local effort* or *general education levy*, the portion of a district's funding that is based on the property wealth of the district. Local effort on average pays for about 35 percent of K-12 education costs.

In most districts, local effort revenues fall short of formula allowance revenues–that is, districts do not raise the minimum sum mandated by the formula. *State aid* makes up the difference

Table 4.3. Basic Revenue and General Education Levy Rate

School Year	Formula Allowance	Tax Rate
1979-80	1,182	27
1980-81	1,265	23
1981-82	1,333	24
1982-83	1,346*	22.5
1983-84	1,475	24
1984-85	1,475	24
1985-86	1,585	23.5
1986-87	1,690	23.2
1987-88	1,720	22.7
1988-89	2,755	35.9
1989-90	2,838(a)	29.3
1990-91	2,953	26.3
1991-92	3,050	26.4
1992-93	3,050	27.9
1993-94	3,050	30.7
1994-95	3,150	34.9
1995-96	3,205(a)	34.2
1996-97	3,505(c)	40.8
1997-98	3,581	37.4
1998-99	3,530(d)	36.9

Data source: Minnesota House of Representatives. 1997. Financing Education in Minnesota 1996-97, and 1998-99. A Report by the House Fiscal Analysis Staff. St. Paul, MN: House of Representatives.

Notes:
*Tax rates were drawn from different sources. Some reported figures carried to one decimal place; others did not.
(a) The formula allowance for 1989-90 was originally set at $38 lower than this number. The formula for 1995-96 was originally set $55 lower. The amount added to the formula in each of those years is all state aid and is not used to determine the equalizing factor.
(b) For 1989-90, the tax rate is applied to gross tax capacity. For 1990-91 and after, it is applied to adjusted net tax capacity (ANTC).
(c) The formula and tax rate for 1996-97 reflect the "roll-in" of a major portion of transportation funding and training experience funding into the general education formula. The formula increase of $300 ($3,205 to $3,505) reflects that roll-in. The tax rate reflects the roll-in and also includes the property tax portion of the operating capital funding.
(d) The formula allowance for 1998-99 reflects the "roll-out" of training and experience funding from the general education formula. The decrease of $51 ($3,581 to $3,530) is the net result of the $130 reduction for the roll-out of training and experience and a $79 increase in the formula.
*Set at $1,346; appropriation only $1,313.

between local effort and the formula allowance. General education state aid contributes an amount equal to the difference between what a district can raise by taxing at the general education levy rate, and the total of number of the district's pupil units times the formula allowance. In our average district, the formula calculation would be:

Total Formula Allowance Revenue	-	Local Effort	=	State Aid
(formula allowance x pupil units)	-	(ANTC x Tax Capacity Rate)	=	State Aid
$3,530 x 1,000	-	$3,500,000 x .369	=	State Aid
$3,530,000	-	$1,291,500	=	$2,238,500

State Aid per Pupil Unit	=	$2,238.50 (64%)
Local Revenue Per Pupil Unit	=	$1,291.50 (36%)

Referenda. School districts are permitted to raise more revenue from local property taxes than the minimum required in the formula allowance. There are forty to fifty different levy categories that districts may assess; two of these must be approved by district voters: to augment the general education operating fund, and for building construction. The state equalizes the first $315 per pupil unit of referendum revenue (to be raised to $350 in 1999-2000). Smaller districts tend to rely on local levies for operating funds more than do larger districts. In 1998-99, 283 districts have referendum levies totaling $261 million.

Off-Formula Districts. A few districts have enough property wealth to raise more than the formula allowance sum at the general education tax capacity rate. If the revenue that a district raises by taxing its ANTC at the local tax capacity rate is more than (formula allowance x pupil units), the district will receive no general education state aid. The amount raised at this rate that is in excess of (formula allowance x pupil units) must be used to replace state categorical aids and other credits. If a levy at the required tax capacity rate would raise revenues exceeding (formula allowance x pupil units), the district will be allowed to use a lower local tax capacity rate than that set by the legislature. This provision is called *levy equity*.

Finances of Minnesota Schools Today

In 1998 there are over 836,000 students enrolled in Minnesota's public schools, equaling ninety-eight percent of the K-12-aged population in the state. There are 353 public, operating school districts; of those, 198 have fewer than 1,000 students. Eighty of the nearly 1,600 school buildings are over 80 years old.

Since 1981, per-pupil expenditures have grown by about 15 percent, from an average of $5,660 to just under $6,500 today [18]. (These figures are expressed in real (inflation-adjusted) dollars.) Highest spending growth has occurred for exceptional education (up 96 percent) and community education (up 90 percent), while spending on vocational education has dropped by 65 percent. Staffing levels for special education have grown 129 percent (teachers), 74 percent (administrators) and 73 percent (other support staff), while vocational education staff has dropped by 55 percent. While salary levels have increased about 14 percent, the expansion of fringe benefits has required spending growth of nearly 60 percent over the last 15 years. Total elementary-secondary revenues in the state for fiscal year 1998-99 totaled $5,911,600,000.

Variations Across Districts

Per-pupil spending varies widely across districts for a variety of reasons:

- Districts have varying referendum levy revenues. While state funding formula is equalized, referendum levies are only partially equalized. Local officials and voters decide on referenda, so political conditions across districts affect revenues from this source.
- The size of a district's enrollment matters. Fewer students mean less state aid to support the basic cost of teachers, administrators, services, and instructional technology. While some costs vary with the number of pupils served, others are more fixed. A district's physical plant has a much longer life span than any enrollment trend; a building constructed for 500 students still has to be maintained even after enrollments drop to 300.
- The number of pupils from low-income families, reflected in AFDC and free or reduced-cost lunches, affects the amount of special state aid for additional programs for these pupils. Additional aid is granted as the proportion of these pupils rises compared to total enrollment, with a maximum. Most districts received this category of aid in 1996-97, for a total of $133 million.
- Projected future enrollment affects current spending. If a district anticipates enrollment growth it might incur debt with the expectation that state aids will increase in the future.
- Teachers in districts with declining enrollments often have more seniority and training, and thus above-average salaries, compared with other districts. The state provides special aid to supplement pay and benefits for more highly trained and experienced staff.

• Sparsely-populated regions receive categorical state aids to offset the additional costs of operating small and isolated schools. Per-pupil aid is given for elementary grades with 20 or fewer pupils, and living 19 miles or more from the nearest elementary school, and for secondary grades with enrollment of fewer than 400 that serve a large geographic area, and where pupils live a substantial distance from another secondary school. In 1996-97, $9.5 million was disbursed to 65 districts.

• Transportation sparsity revenue is granted to districts with low pupil densities (independent of area size). In 1996-97 this aid ranged from $0-400 per pupil for a total of $45 million, granted to 330 districts.

• Districts that are part of interdistrict cooperation agreements may have lower costs for some categories of spending, as they share staff, programs, and other services.

The length of the school year in a district will affect operating costs; fewer days sum to fewer dollars.

• Transportation costs vary. Metropolitan-area districts have higher per-mile costs; lower-density districts have longer distances over which to transport pupils. Districts that own their own buses have lower costs than districts that contract to private service providers.

Local Property Tax and Schools

The most frequently advocated reform in K-12 education is to reduce its heavy reliance on property taxes for revenue. The primary argument for this reform is one of *equity*, both for pupils and for taxpaying households and municipalities. There are several aspects of the current funding system that create unequal conditions for support of education in different locales:

• Local property wealth varies widely across the state; levies are easier to impose and raise more revenue in high-wealth districts than in poorer ones. The more expansive the metropolitan area becomes, the more uneven the property tax base will be.

• District revenues are affected by the proportion of property that is *residential*. Owner-occupied housing is taxed at a rate different from that imposed upon rental property, or on industrial, office, and other commercial property. When these other property types are present in a school district in large proportion, they can help to relieve homeowners of the tax burden to support schools. Conversely, an excessive tax burden on commercial and industrial property might lead business owners to locate elsewhere.

• Property tax is indifferent to household income. It may be a better reflection of "permanent income" than are salaries and wages, but it also may mask great differences between

asset and income levels, and place an exceptional burden on some low-income households–most notably, retirees whose homes have appreciated in value over time.

• Tax rates affect property values, by changing the demand for and desirability of a parcel. If a district or city has high tax rates without compensatory services or other value, mobile populations may locate elsewhere and property values will slip.

• Dependence upon local property tax leaves long-range district financial planning at the whim of local demographic change and economic trends that affect the location and land use decisions of property-tax-paying activities and development. Although the state provides revenue stability through state aids, local ability to raise revenues for capital projects or general education enhancements can shift dramatically within the course of a decade or less.

• School finance reforms that neutralize local tax capacity differences can reduce property values (in effect) in districts with high incomes and high property values.

• There is an institutionalized belief in American education that some children are more difficult and more costly to educate than others. Research has shown for decades, for example, that pupils residing in low-income families tend to have lower reading levels than middle-income pupils. As metropolitan dynamics concentrate poor families in certain areas, and as a concomitant the tax base in those areas often is in decline, further inequality in education is introduced. Some state aids are targeted to low-income pupils, but they are insufficient to fully remediate *all* of the additional costs of conducting education in a district with high poverty rates.

The most frequently suggested alternative funding method is an increased reliance on state sales and income taxes. Although sales tax can be regressive, both of these are seen to be more progressive than property taxes. However, both of these taxes tend to fluctuate even more than do property taxes, and would make school financing less stable than it currently is. Moreover, sales and income taxes are “one step removed” from household budgets, and taxpayers might not be as vigilant in their scrutiny of government expenditures from these funding sources as they are of those from sources of which they have a direct accounting–at least in the case of homeowners.

The Minnesota Education Association has advocated another alternative–a broadened sales tax with a lower rate as an enhanced source of K-12 financing. They also favor taxing all property classes at the same rate, and introducing a business activity tax that would shift some of the education tax burden out of the state. A broadened sales tax, however, may be more regressive than a more limited one, and taxing all property at the same rate likely would lower business property tax but raise residential property tax. In addition, a business activity tax might have a dampening effect on economic activity within the state.

Our Case Studies

This part of our examination of Twin Cities regional dynamics is framed by the assertion that K-12 funding claims a major portion of local budgets and local tax capacity, and thus is an important influence on the behavior of local governments toward population growth, economic development, and demand for publicly-funded infrastructure as they try to expand local tax base.

As in earlier chapters, we selected a sample of districts as case studies to illustrate the connections among MCDs, school districts, and metropolitan growth patterns:

- As development proceeds within MCDs, school districts must respond to the demand for services that growth generates.
- The settlement system of the state and the metropolitan area is in constant flux, and school districts are constantly adjusting the geographical organization of school services in order to meet the educational needs of a population of kids that is changing in *number*, in *location*, and in *types of special needs*:
  - Rural population decline stimulates state pressures for consolidation of small districts, despite the fact that financial and educational advantages of consolidation are not always clear, and enlargement of districts inevitably expands demand for pupil transportation.
  - Outward migration of urban population into low-density suburban and exurban settings brings the need for capital expenditures for new schools, and for transportation of pupils to and from schools over longer distances.
  - Declining inner-suburban school populations means the under-utilization of existing capital facilities that pupils often can reach on foot or with bus rides of only modest length.
  - Older city schools increasingly serve low-income, immigrant, and special-needs pupils with aging capital facilities, within districts that at the same time are supported by a tax base of aging structures, many of which are losing market value.
  - Specialization of school offerings at diverse locations means that although population densities are the highest in the metropolitan area, almost all pupils are bused to school, either for safety reasons or to provide them with access to the specialized programs needed by an increasingly diverse school population.
- School districts are required by the legislature to pay for as much of their educational bills as they can from local property taxes, with the state supplying from its general revenue sources the balance school districts need to achieve mandatory threshold spending levels per pupil.

• The property taxes that can be collected by a school district depend upon the amount, type, and market value of the taxable property within its boundaries, but the school district has almost no influence over the amount, type, or market value of taxable property value within its jurisdiction.

Five Sample School Districts

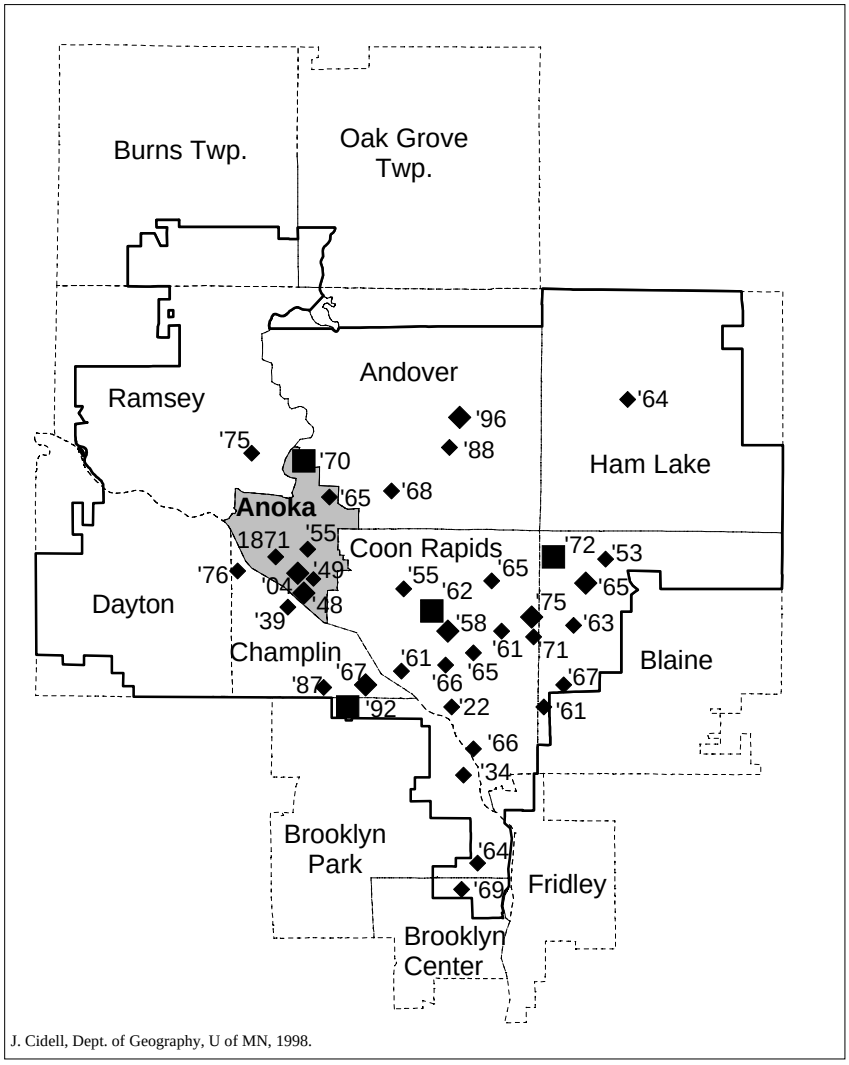
We selected five school districts to examine within our 24-county study area, paying attention to size, geographic spread, coincidence with municipal boundaries, and recent development rates (Figure 4.2). Four of these–except Cambridge-Isanti–are within the traditional seven-county metropolitan core. All but one (Richfield) encompass several municipalities of different development ages and densities.

Our sample districts are varied in character–old and new, core and edge, large and small in population. Within each of them is one of the 28 MCDs examined in Chapter 3 (except Eagan, which is divided between two districts). We first portray the revenue sources and expenditures of five school districts from 1970 to 1997, and then explain some of the variations among them.

CASE #1: ANOKA-HENNEPIN SCHOOL DISTRICT, #11 (ANOKA COUNTY)

Anoka-Hennepin Consolidated School District (CSD) lies 20 miles north of Minneapolis, straddling the Mississippi River (Figure 4.3). It is the state's third-largest school district, with a 1997-98 enrollment of 48,467 and a 1990 population of 192,619, up 24 percent over the decade. The district currently operates twenty-seven elementary, six middle, and four senior high schools, along with a number of specialized education centers.

This CSD has incorporated several sparsely-settled township-based independent districts over time, achieving its current boundary in 1959. The area exhibits perhaps the most scattered pattern of settlements within our sample, including the cities of Ramsey, Andover, Coon Rapids, Ham Lake, Dayton, Champlin Park, and our sample city, Anoka. The district is characterized by high growth and low incomes, with an increasing minority population (Tables 4.4, 4.5). The average age of resident is 29.9, the youngest in the seven-county metropolitan area; the per-capita income is the lowest in the region at $14,554. The proportion of college graduates is lowest (15.5 percent), as are median housing values. Minority school populations have doubled in the last decade (from 3.5 to 7 percent) [19].



Legend

- Elementary School
- Junior High or Middle School
- High School

Locations are approximate.

Figure 4.3. City of Anoka Within Anoka-Hennepin School District (#11).

Table 4.4. Population of Constituent Municipalities, 1950-1990. Five Sample School Districts

Anoka-Hennepin School District

MCD	1950	1960	1970	1980	1990
Andover	757	1,402	3,830	9,387	15,216
Anoka	7,396	10,562	13,489	15,634	17,192
Blaine	3,604	7,565	20,635	28,558	38,975
Brooklyn Center[1]	4,284	24,356	35,173	31,230	28,887
Brooklyn Park[2]	--	10,197	26,230	43,332	56,381
Burns Twp	806	966	1,129	1,976	2,401
Champlin	1,400	2,093	2,275	9,006	16,849
Coon Rapids[2]	--	14,391	30,505	35,826	52,978
Dayton	1,046	1,202	2,631	4,070	4,443
Fridley	6,075	15,173	29,233	30,228	28,335
Ham Lake	793	1,423	3,327	7,832	8,924
Oak Grove Twp	624	826	1,674	3,926	5,441
Ramsey	670	1,179	2,536	10,093	12,408

Cambridge School District

MCD	1950	1960	1970	1980	1990
Athens Twp	468	455	849	1,793	2,062
Bradford Twp.	507	539	912	2,370	2,637
Cambridge	1,790	2,728	3,467	3,170	5,094
Cambridge Twp	2,076	2,167	1,427	2,452	1,988
Dalbo Twp	675	524	595	665	616
Isanti	422	521	679	858	1,228
Isanti Twp	755	1,172	1,647	2,204	1,800
Maple Ridge Twp	678	531	655	722	658
North Branch Twp	739	693	960	1,507	1,486
Oxford Twp	214	251	342	554	638
Spencer Brook Twp	429	499	666	1,146	1,203
Springvale Twp	610	580	817	1,046	1,113
Stanchfield Twp	861	811	951	1,077	1,060
Stanford Twp	563	714	922	1,592	1,822
Wyanett Twp	639	617	927	1,429	1,377

Chaska School District

MCD	1950	1960	1970	1980	1990
Carver	548	467	669	642	744
Chanhassen	1,977	3,411	4,839	6,359	11,732
Chaska	2,008	2,501	4,352	8,346	11,339
Chaska Twp	185	3,167	119	205	174
Dahlgren Twp	916	920	1,147	1,225	1,296
Laketown Twp	966	1,036	1,750	2,424	2,232
San Francisco Twp	400	436	509	650	773
Victoria	302	425	850	1,425	2,354

Richfield School District

MCD	1950	1960	1970	1980	1990
Edina	9,744	28,501	44,046	46,073	46,070
Ft Snelling	2,584	898	624	223	97
Richfield	17,502	42,523	47,231	37,851	35,710

[1]Annexed a large portion of Brooklyn Twp after 1950.

[2]Incorporated after 1950.

U.S. Department of Commerce, Bureau of the Census. Census of Population, General Characteristics, 1970-Table 10; 1980-Table 44; 1990-Table 76; Characteristics of the Population, 1960-Table7; 1950-Table 6.

Table 4.5. Population and Housing Characteristics, 1980 and 1990

	Population		Percent of Total Population Ages 3-19		Percent of Occupied Housing Units Owned	
District	1980	1990	1980	1990	1980	1990
Anoka-Hennepin	120,204	163,920	26	28	82	82
Cambridge-Isanti	15,857	18,084	24	27	81	81
Chaska	15,939	23,040	37	25	74	75
Richfield	40,977	39,612	10	15	64	65
Rosemount-Apple Valley	45,340	94,029	36	28	86	81

Sources: Minnesota State Planning Agency, Land Management Information Center; and National Center for Education Statistics.

Between 1957 and 1967 Anoka-Hennepin grew in population from 6,999 to 23,196 pupils–an increase of 232 percent. By 1968 the district operated 20 elementary, 3 junior high, and 2 senior high schools, and one vocational-technical institution.

As with many districts of its size, Anoka-Hennepin is organized internally into school “clusters”, centered on Anoka, Blaine, Champlin Park, and Coon Rapids. Clusters are multi-school internal networks used to share information, resources, and strategies inside the district, and they are one way to offset the negative effects of a very large district.

Anoka-Hennepin’s clustering of schools in the southern third of the district is striking. The pattern reflects the original townships which were filled in after WWII with suburban expansion of baby-boomer households. It also is clear that school construction in the district slowed after the 1970s, as growth has proceeded outward but at a much reduced rate.

The district has experienced modest but steady growth in enrollments since the mid-1980s (Figure 4.4). Regular instruction has been a shrinking proportion of total operating expenses since 1980. A substantial share of the Anoka-Hennepin’s education revenue has come from state aid (Figure 4.5).

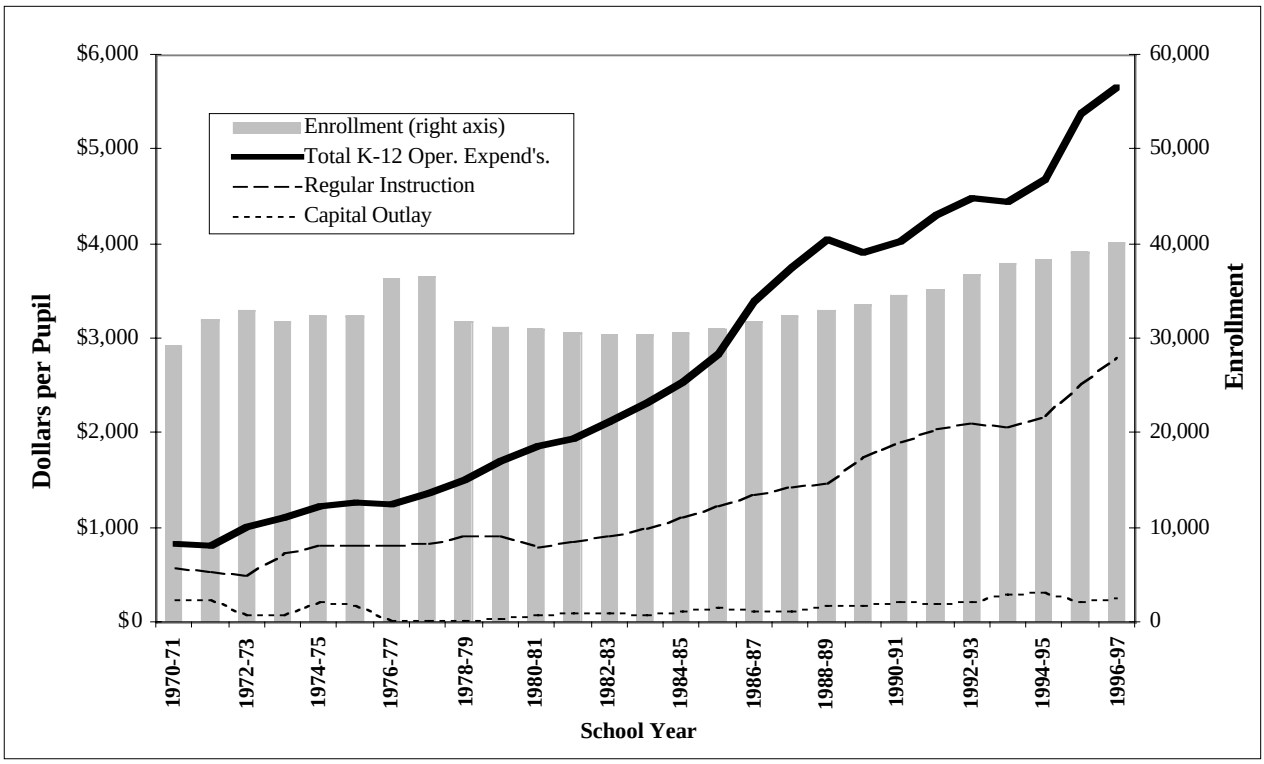


Figure 4.4. Enrollment and Major Expenditures, Anoka-Hennepin School District, 1970-71 to 1996-97.

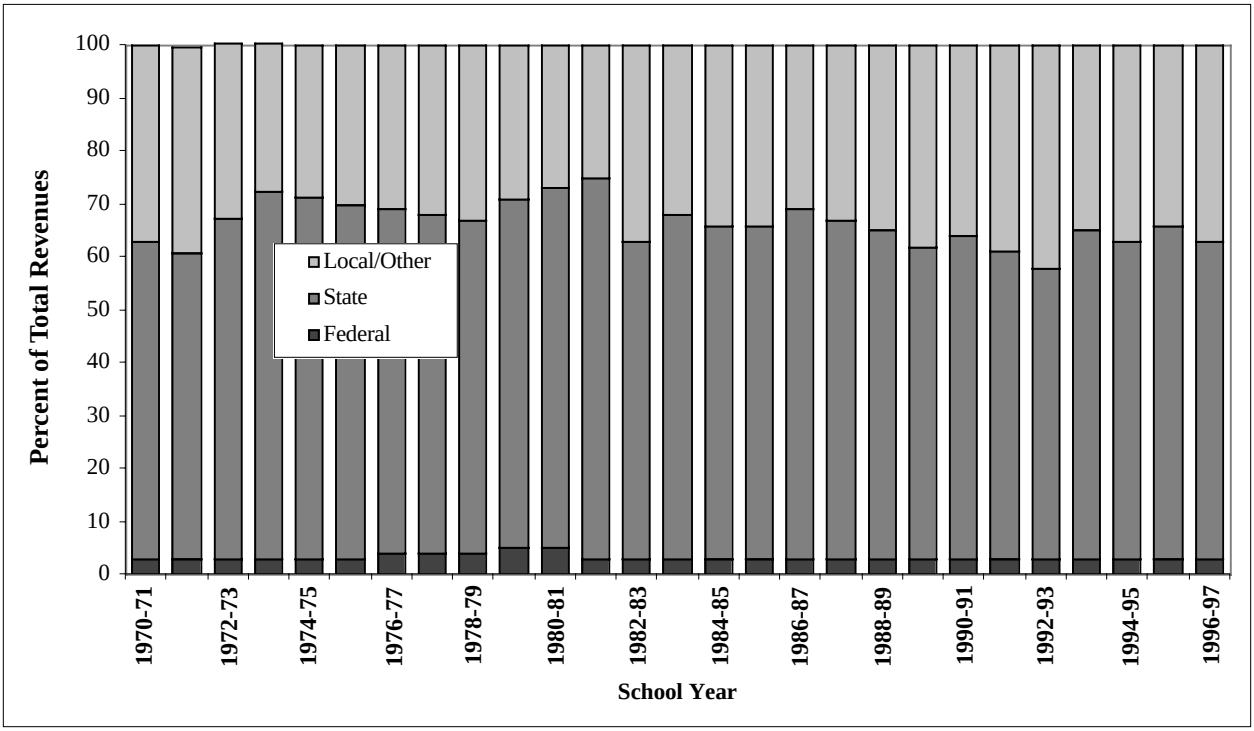


Figure 4.5. Sources of Revenue, Anoka-Hennepin School District, 1970-71 to 1996-97.

CASE #2: CAMBRIDGE-ISANTI SCHOOL DISTRICT, #911 (ISANTI COUNTY)

This district contains our sample MCD of Cambridge, and is the only one of our five sample districts that lies outside of the traditional 7-county metropolitan core. District enrollments in 1996-97 were 4,596, and 1990 population was 18,084 (Tables 4.4, 4.5). Schools within the district currently include two elementary, two middle, and one senior high school (Figure 4.6).

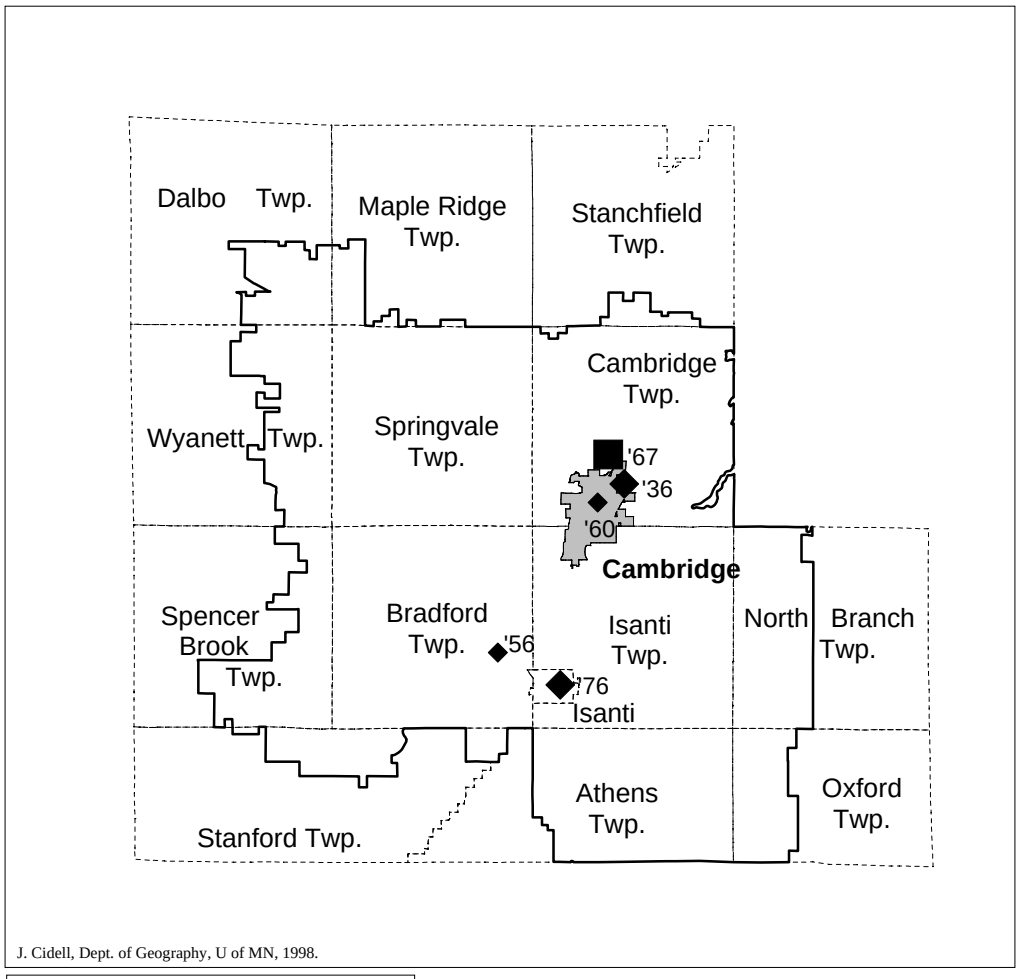


Figure 4.6. City of Cambridge Within Cambridge-Isanti School District (#911).

Population centers in the district include Cambridge, Isanti, and Braham. This non-metro district serves a sparsely-settled area of townships, centered on the cities of Cambridge and Isanti.

Regular instruction has become smaller proportion of total operating costs since the mid-1980s (Figure 4.7). Enrollments have been stable after a slight slump in the mid-1980s. The district's spending does not greatly exceed the per-pupil formula allowance. Tax capacity is the lowest of the five sample districts, reflecting the sparsity of both residential and other forms of development in the area (Figure 4.8). Like Anoka-Hennepin, Cambridge-Isanti receives a large share of its revenue from state aid (Figure 4.9). Per-pupil transportation costs fall in the middle to lower range among the five, perhaps reflecting the clustering of most of the district's population around Cambridge and Isanti (Figure 4.10).

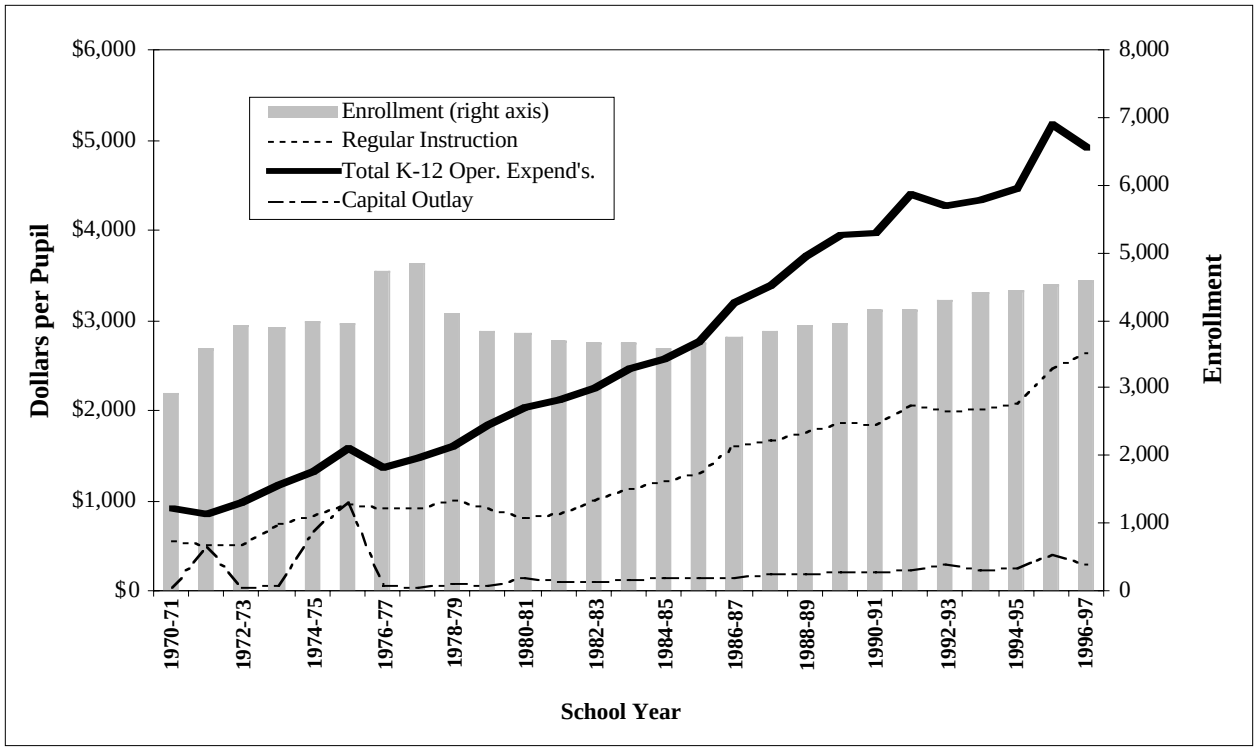


Figure 4.7. Enrollments and Major Expenditures, Cambridge-Isanti School District, 1970-71 to 1996-97.

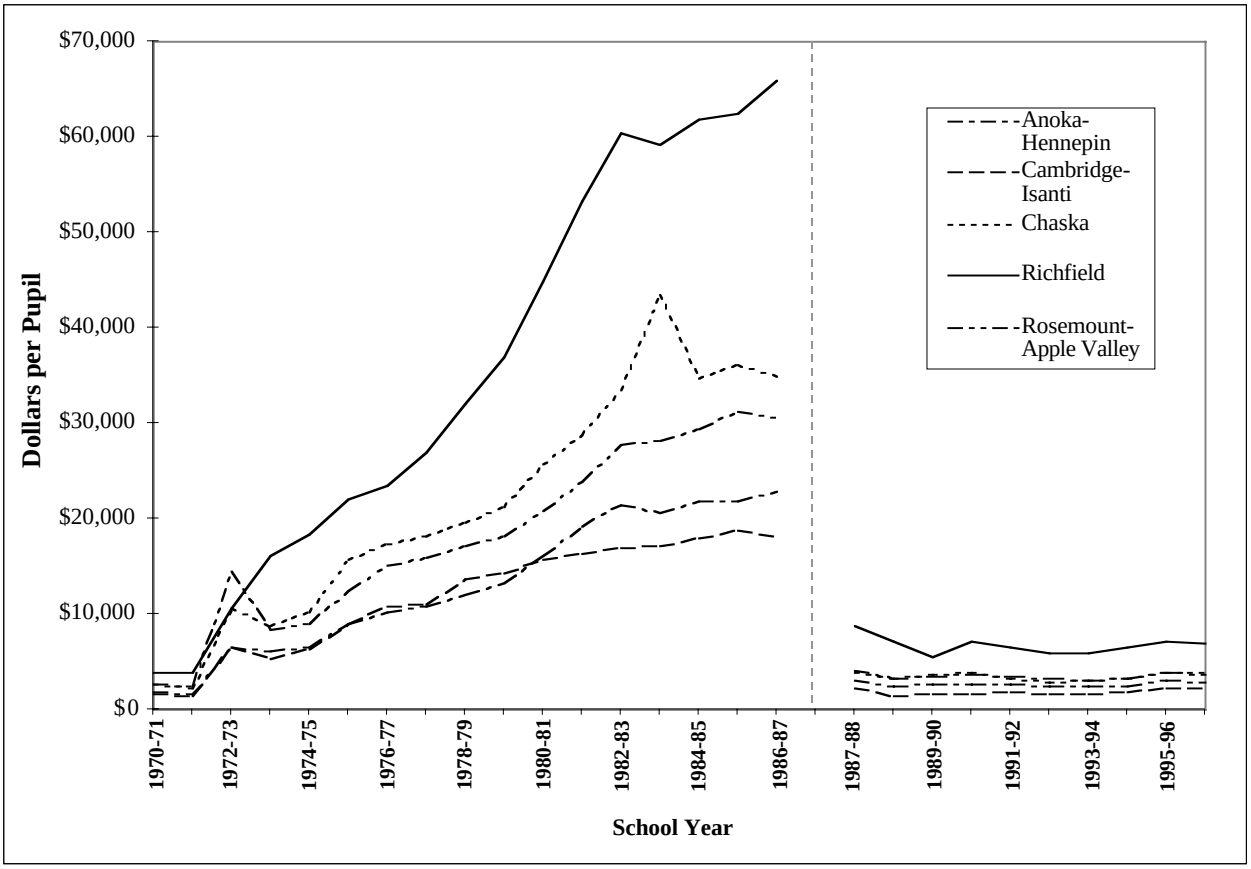


Figure 4.8. Tax Capacity Measures, Five Sample Districts, 1970-71 to 1996-97.
Data Sources: MN Department of Children, Families, and Learning; Office of the MN State Auditor.

Note: Measures reported by the Department of Children, Families, and Learning to reflect district wealth (ability to raise revenue through local property taxes) have changed over the study period, and are reported here for inter-district comparisons only. These data are not comparable across time periods as the measures changed. 1970-71 and 1971-72: Adjusted assessed valuation per pupil-unit; 1972-73 to 1985-86: EARC value* per pupil-unit; 1987-88: Adjusted gross tax capacity; 1988-89 to 1996-97: Adjusted net tax capacity (ANTC).**

*EARC Value is the adjusted assessed valuation published by the Equalization Aid Review Committee; it is adjusted to be comparable across districts.
**ANTC is the property value used for assessing most school taxes. It is determined by equalizing differences in tax capacities by property type in different counties, and reflects the application of the classification rates to the market value of property.

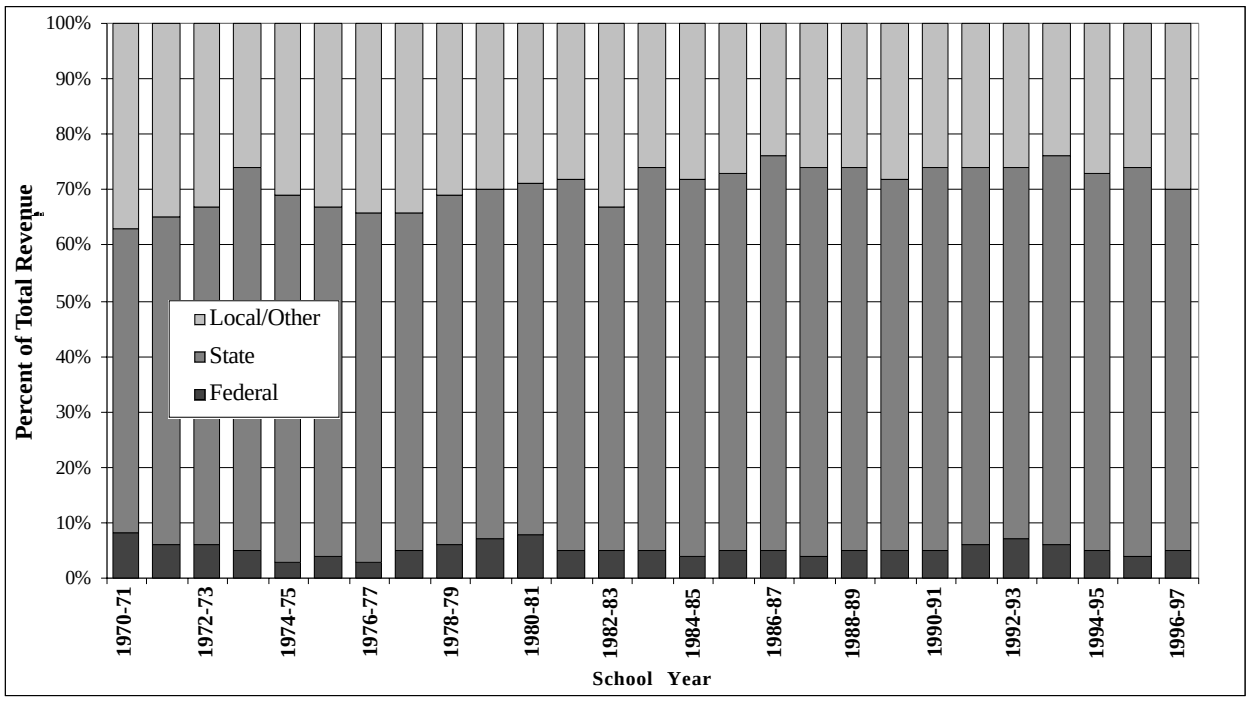


Figure 4.9. Revenue Sources, Cambridge-Isanti School District, 1970-71 to 1996-97.

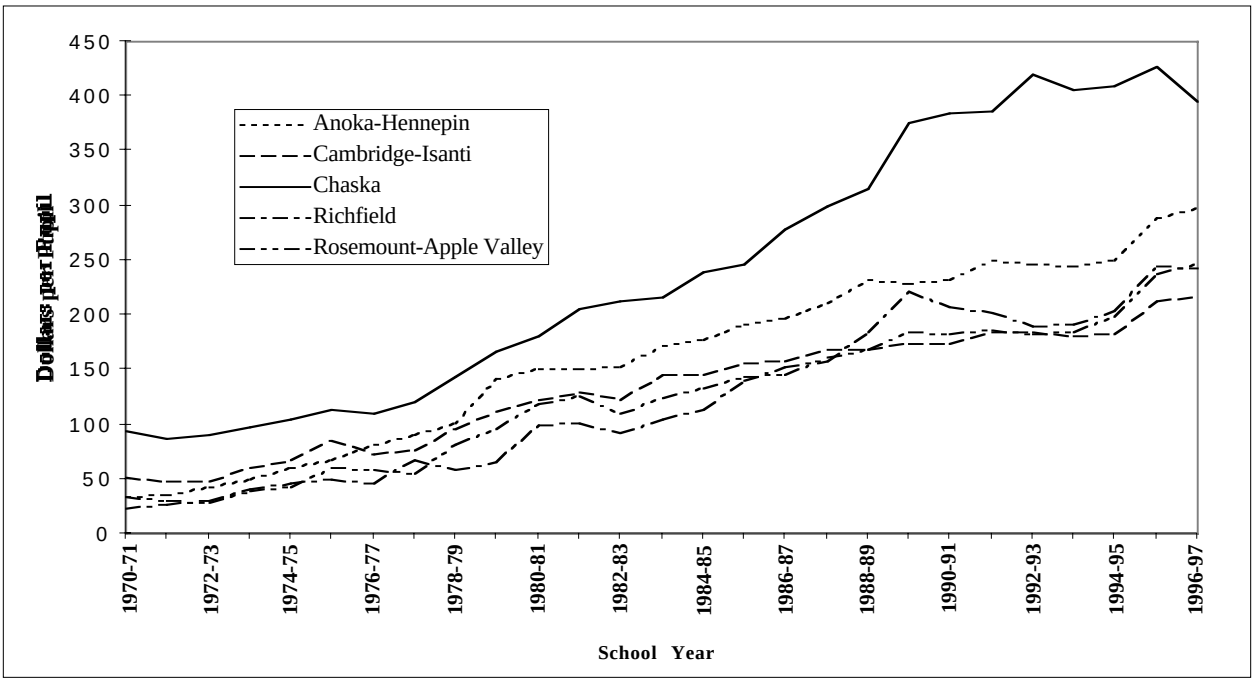


Figure 4.10. Transportation Costs Per Pupil, 1970-71 to 1996-97, Five Sample School Districts.

CASE #3: CHASKA SCHOOL DISTRICT, #112 (CARVER COUNTY)

The Chaska CSD is situated 30 miles southwest of Minneapolis, south of Lake Minnetonka in eastern Carver County. Chaska is one of our sample MCDs; the district also serves the municipalities of Chanhassen, Victoria, and Carver. It is a large, consolidated district, with some fast-growth centers but also containing much low-density residential area. 1996-97 enrollment

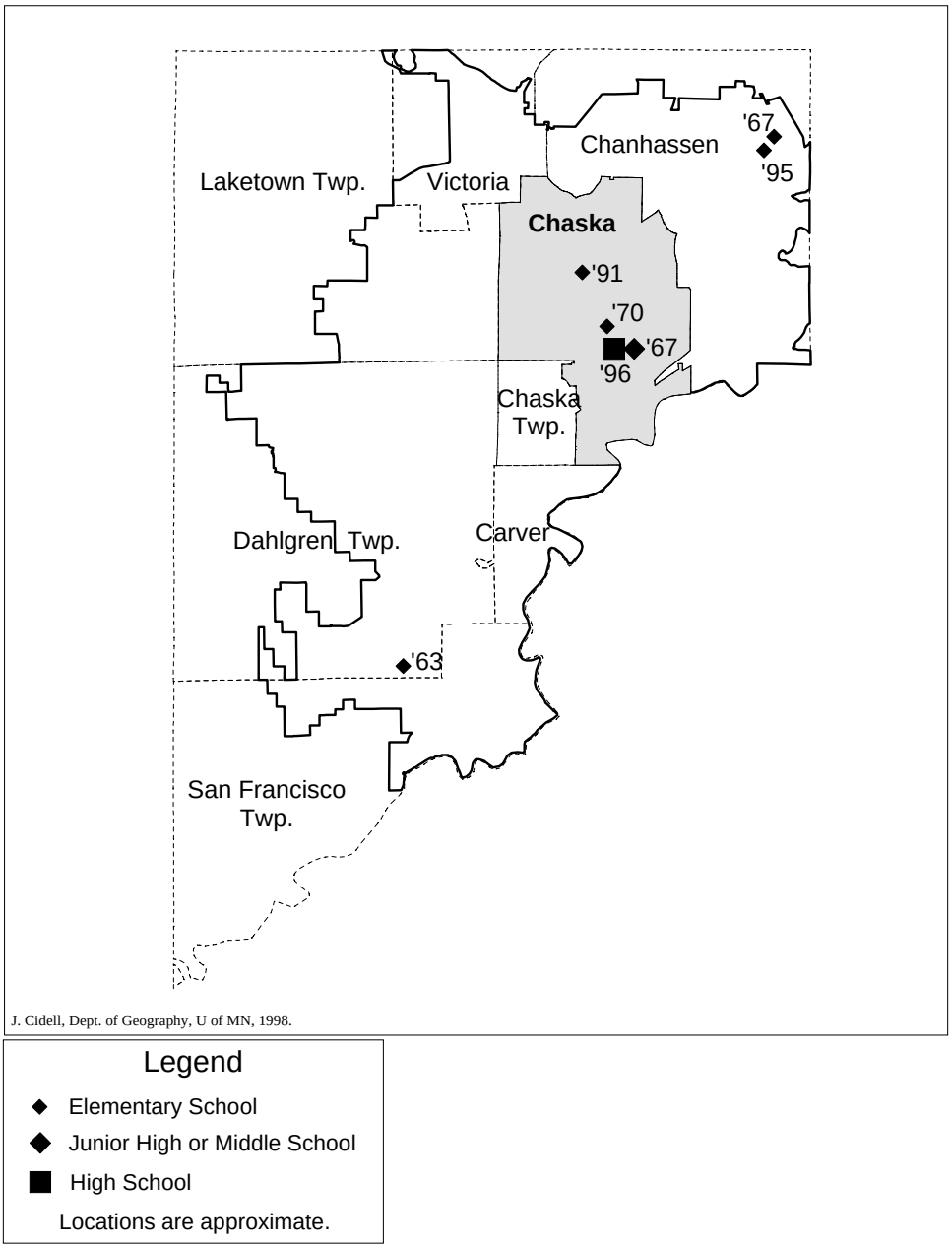


Figure 4.11. City of Chaska Within Chaska School District (#112).

was 5,923, and 1990 population was 23,040 (Tables 4.4, 4.5). The district currently operates four elementary, one middle, and one senior high school, two early childhood centers and a special education center (Figure 4.11).

The constituent jurisdictions within the district have enjoyed an unusual level of cooperation over the past decade. The area's Community Leaders Group, composed of elected officials, district officers, city and county managers and others, is an informal coalition that meets monthly to share information and coordinate economic development and land use planning. The group has drawn on outside expertise to assist with growth forecasting, for example, and tries to coordinate actions such as bond levies so that they are staggered rather than simultaneous, to ease the tax burden on property owners.

Most of the district's facilities are located within the city of Chaska, the area of highest-density development within the district. The area still is experiencing high growth rates of school-aged children, and residential development now is pushing out into the sparsely settled townships of eastern Carver County.

Regular instruction has been a smaller proportion of total operating expenses since 1980 (Figure

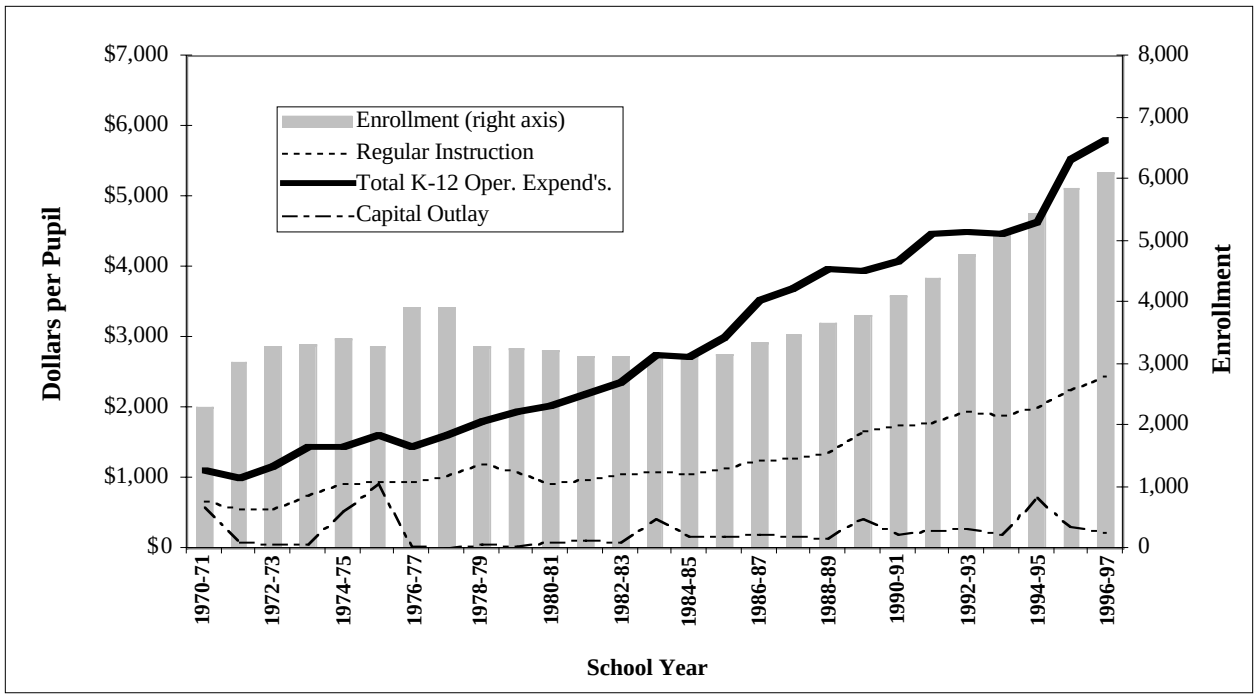


Figure 4.12. Enrollments and Major Expenditures, Chaska School District, 1970-71 to 1996-97.

4.12). Enrollments have been climbing steadily since the mid-1980s. The district's tax capacity is second only to that of Richfield among the five (Figure 4.8). Chaska's transportation costs consistently have been highest in the group, reflecting the size of the district and the extreme clustering of school facilities (Figure 4.10). Chaska funds a larger share of its K-12 education through local sources than any of the other districts except Richfield (Figure 4.13).

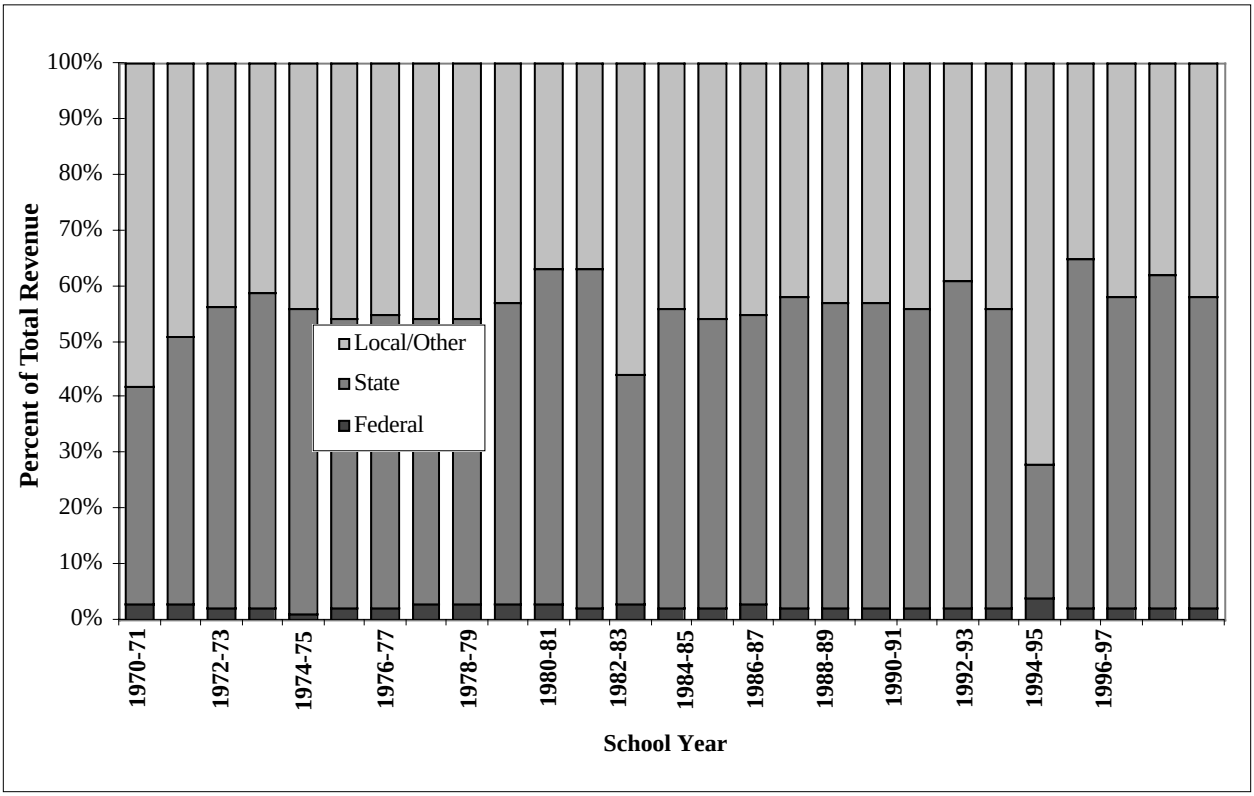


Figure 4.13. Revenue Sources, Chaska School District, 1970-71 to 1996-97.

CASE #4: RICHFIELD SCHOOL DISTRICT, #280 (HENNEPIN COUNTY)

Among the five in our sample, the Richfield school district comes closest to coinciding with the boundaries of its primary municipality, the City of Richfield, directly south of Minneapolis. Its age and size probably account for that; the city always has had a sufficient number of pupils to warrant its own district. The district had a 1990 population of 39,615, and enrollments of 4,319 in 1996-97 (Tables 4.4, 4.5). It currently operates one high school, one junior high, and four

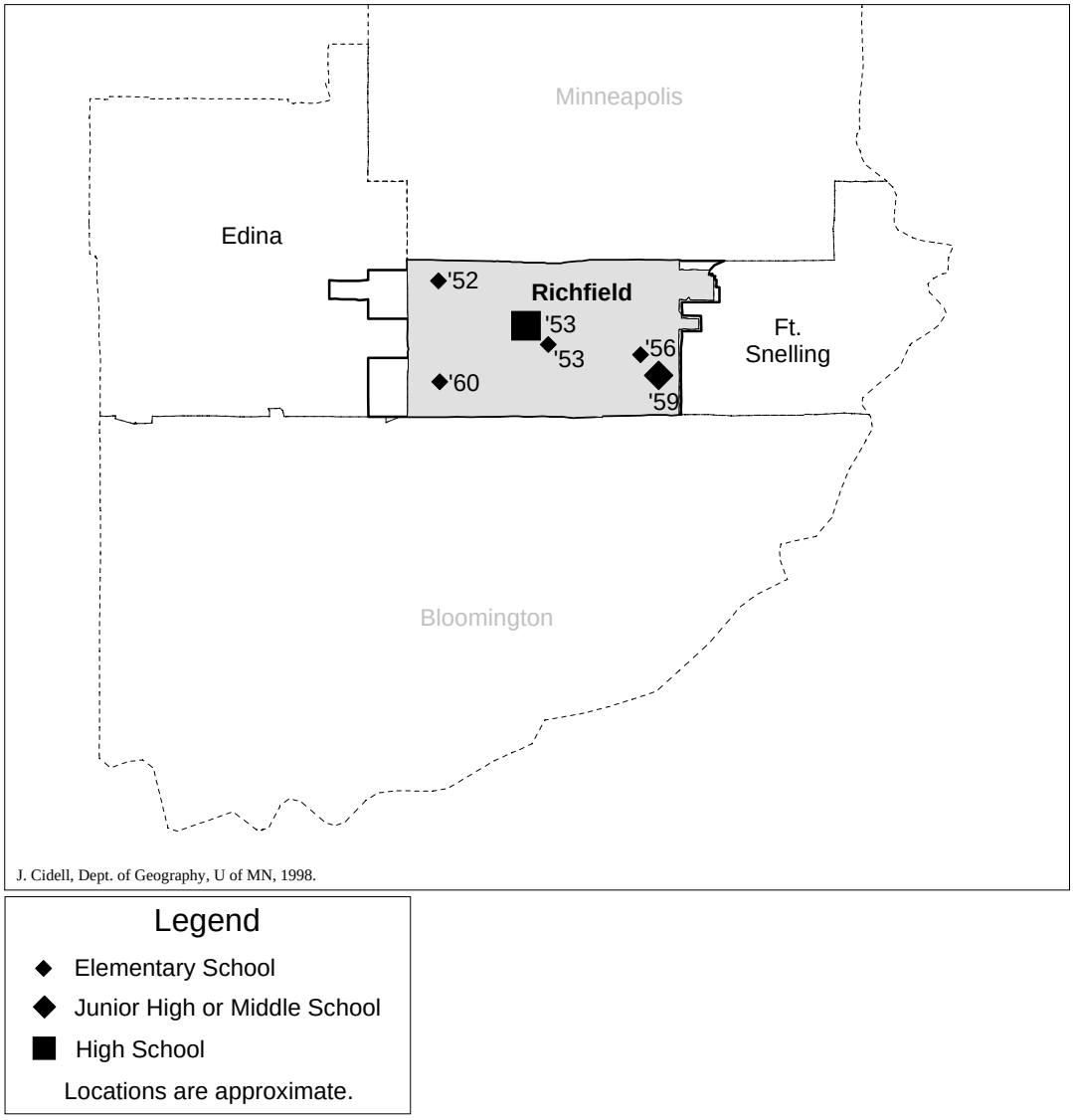


Figure 4.14. City of Richfield Within Richfield School District (#280).

elementary schools, plus one special education center (Figure 4.14).

Richfield's pattern of school sites is that of an older suburb. All of its school construction took place between 1950 and 1960 (with later additions). Its highly developed commercial-industrial base and dense residential structure are reflected in its high tax capacity throughout the study period. The district's per pupil transportation costs are lowest among the five, reflecting the

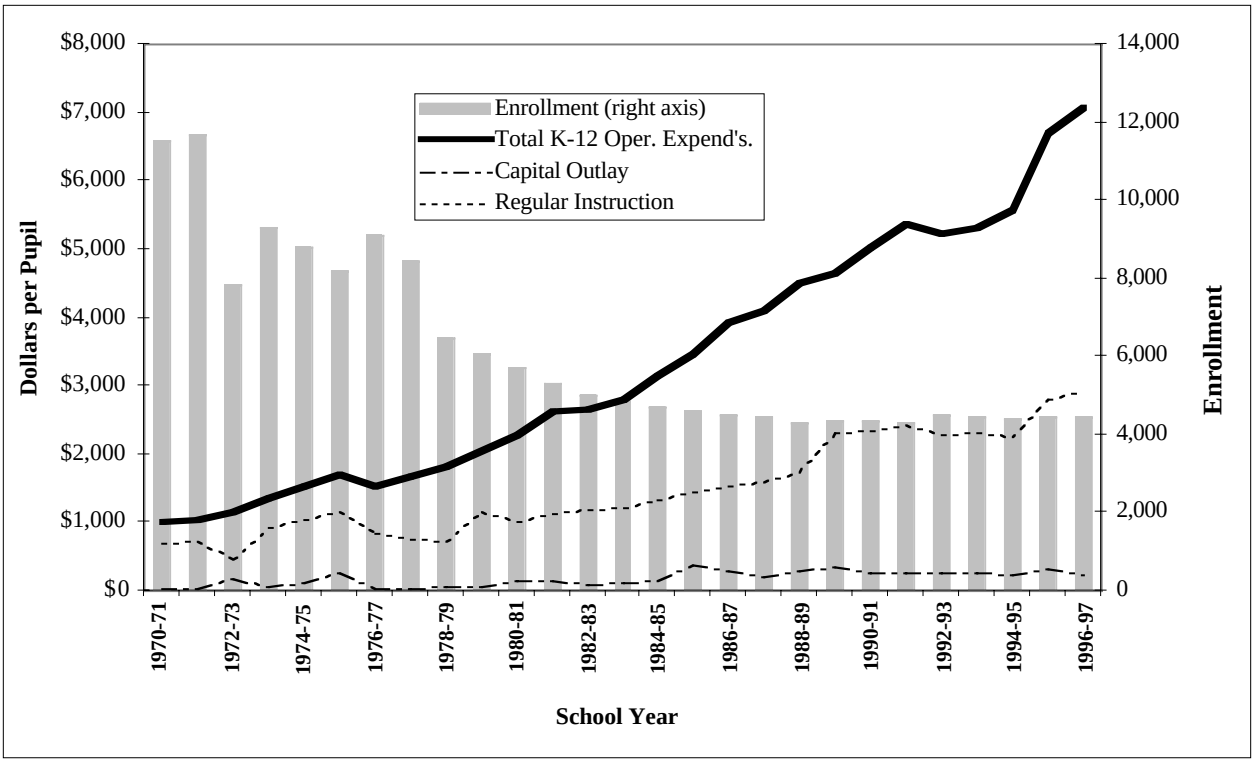


Figure 4.15. Enrollments and Major Expenditures, Richfield School District, 1970-71 to 1996-97.

small areal size of the district.

Enrollments declined sharply between 1975 and 1985, and have since stabilized (Figure 4.15). Regular instruction has been a decreasing proportion of total operating expenses since 1980. Total operating expenses per pupil have risen as enrollments have declined, lending credence to the notion that economies of scale apply to school districts, because of the fixed costs of physical plant operation and maintenance, among others. Of the five sample districts, Richfield is by far the leader in the share of education revenue raised from local sources (Figure 4.16).

CASE #5: ROSEMOUNT-APPLE VALLEY SCHOOL DISTRICT, #196 (DAKOTA COUNTY)

This CSD, situated 20 miles southeast of Minneapolis, is the fourth-largest in the state. It encompasses the City of Eagan, which is in our sample of MCDs, and also serves Rosemount, Apple Valley, Lakeville, Coates, Empire and Vermillion Townships, and parts of Burnsville and Inver Grove Heights (Figure 4.17). It is a fast-growth area and most densely settled in its

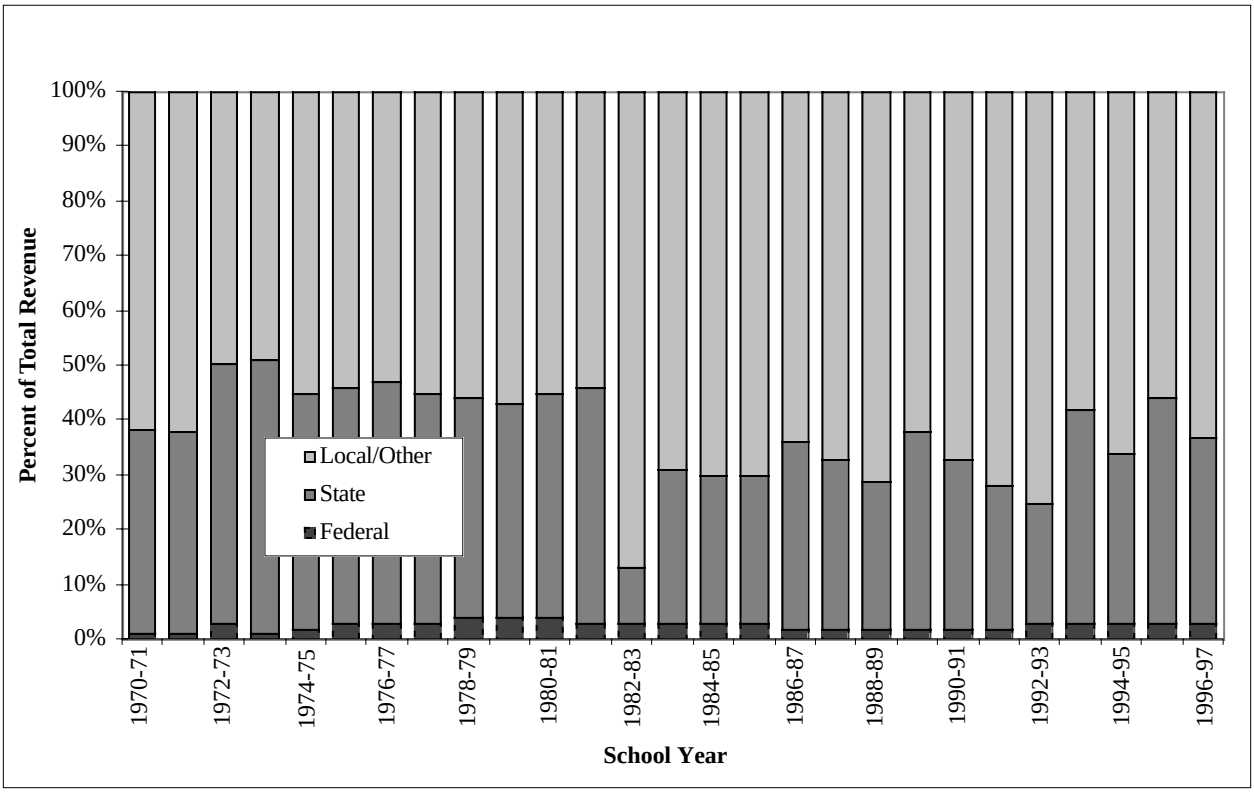


Figure 4.16. Revenue Sources, Richfield School District, 1970-71 to 1996-97.

northwestern extent, in Apple Valley, Rosemount and Eagan.

Enrollments in 1996-97 were 25,254, and 1990 population was 94,029 (Tables 4.4, 4.5). The district is a product of several consolidations, and now is so large that school clusters have been formed within it to share resources on a more local level, and to achieve closer interaction among schools and with parents. Seventeen elementary, four middle, three senior high schools plus a number of special learning centers currently serve the district, which covers about 110 square miles in area.

Bridges across the Minnesota and Mississippi Rivers plus freeway construction along district boundaries facilitated population growth outward from the metro core which, along with the post-war surge in birth rates, created a housing boom since the 1950s. The Village of Rosemount alone experienced a population growth rate of 56 percent between 1940 and 1950.

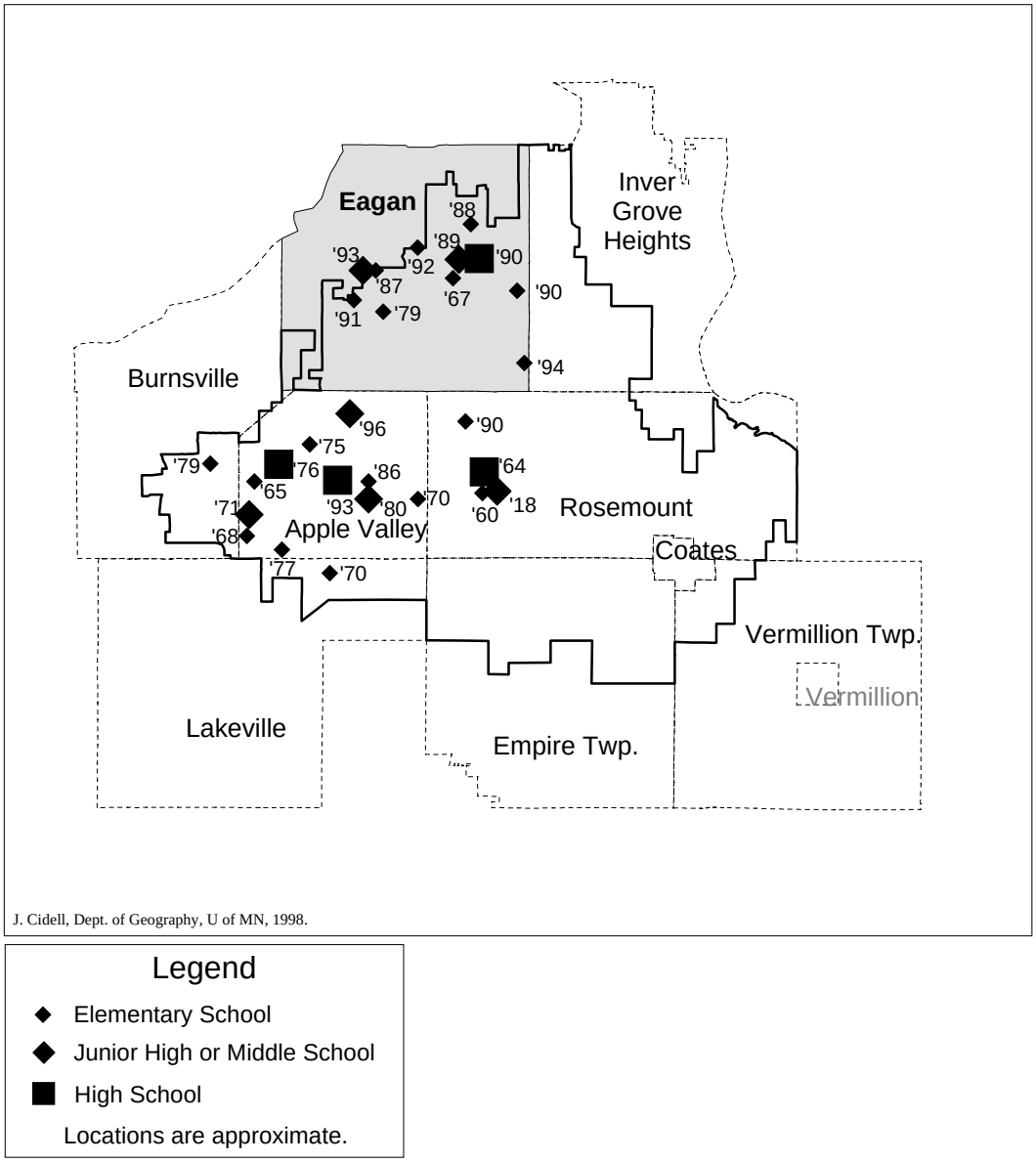


Figure 4.17. City of Eagan Within Rosemount-Apple Valley-Eagan School District (#196).

As might be expected, all of the district's schools sit within its northwestern half, closest to the built-up area. There is a clear pattern of elementary schools built in the years of initial suburban expansion of baby-boomers (1960s) in Eagan and Apple Valley, followed by middle schools and high schools as the cohort moved into those age groups in subsequent decades.

Of the five districts, Rosemount-Apple Valley's growth in operating expenditures has most

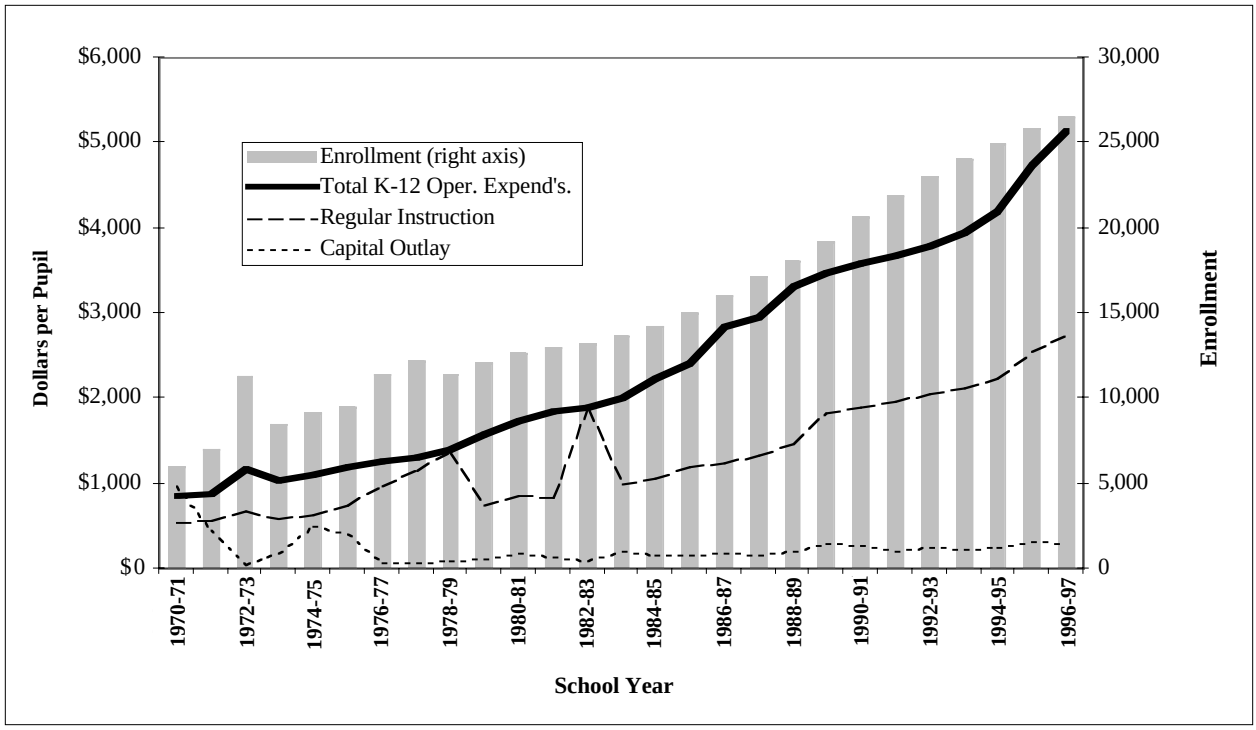


Figure 4.18. Enrollment and Major Expenditures, Rosemount-Apple Valley School District, 1970-71 to 1996-97.

closely followed the trend of its enrollment increases, and it has spent the least per pupil over and above the formula allowance throughout the study period (Figure 4.18). Its operating costs have been the lowest among the five, and its transportation expenditures per pupil have been consistently lower than 3 or 4 of the others (Figures 4.19, 4.10). There is extreme variety among civil jurisdictions within the district–from city to village to township to agricultural land–which produces a large diversity in their local tax effort for education (Figure 4.20). The district's tax capacity falls in the middle of the group.

Five Districts Compared

Our five sample districts show great variation in different categories of per-pupil spending, and proportions of revenue from different sources.

Regular instruction decreased as a portion of total spending in all cases, especially since the early 1980s, reflecting great increases in special education programs and staffing.

Transportation Costs (Figure 4.10). Per-pupil transportation costs vary along with the geographic characteristics of the districts. Chaska ranks highest, reflecting a population scattered

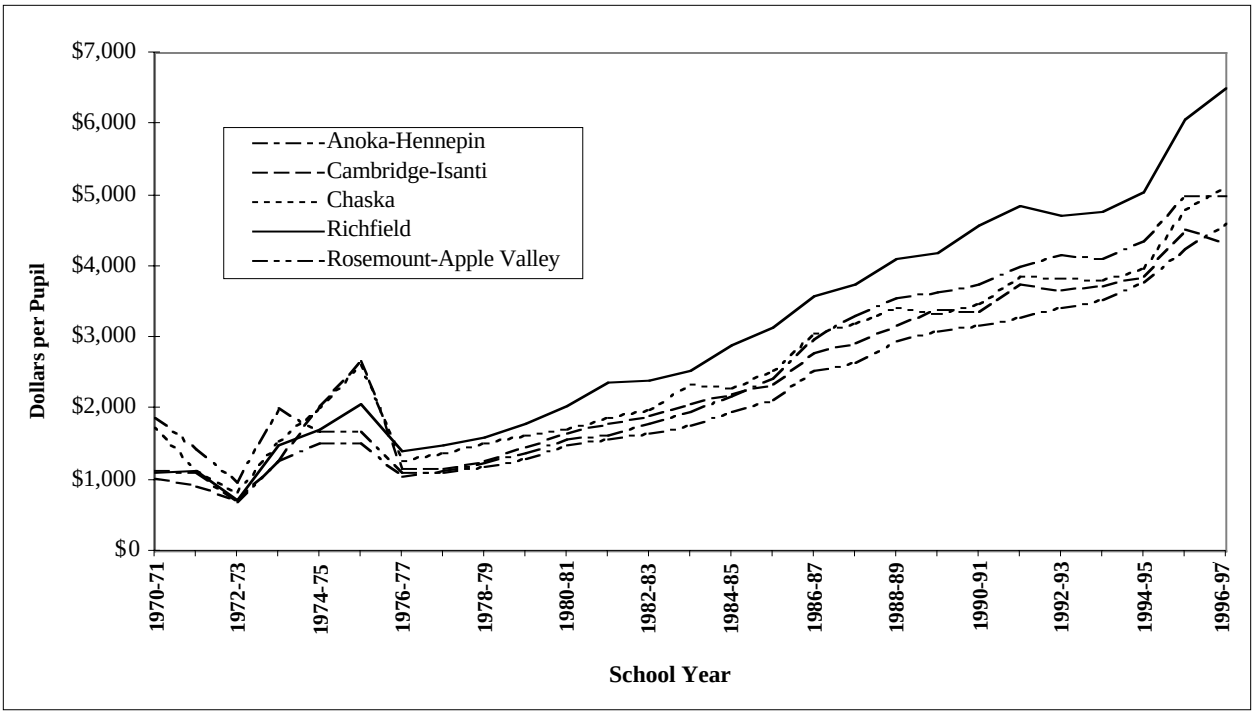


Figure 4.19. Per-Pupil State and Local Operating Costs, Five Sample School Districts, 1970-71 to 1996-97.

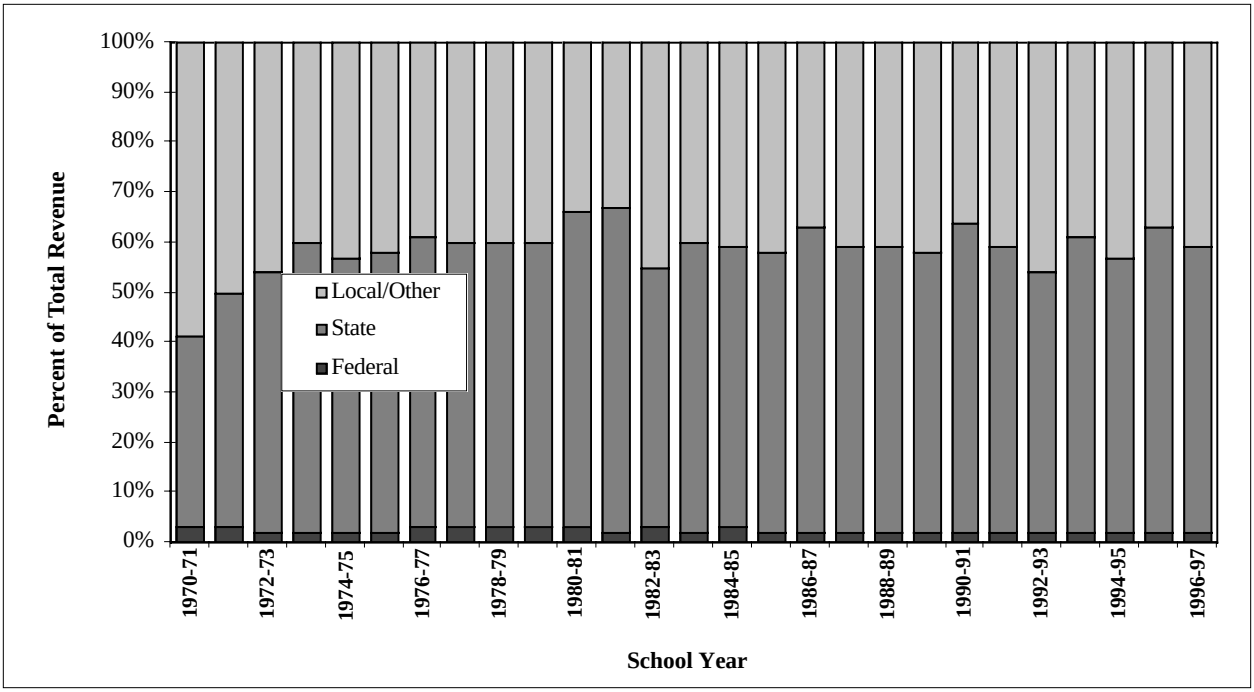


Figure 4.20. Revenue Sources, Rosemount-Apple Valley School District, 1970-71 to 1996-97.

over a large district, with schools clustered around Chaska and Chanhassen. Anoka-Hennepin is second, for similar reasons. Richfield was lowest until the mid-1980s, when enrollments began to decline. Since then, Cambridge-Isanti has spent the least within the group, reflecting its clustered development pattern around the two cities.

Tax Capacity Measures (Figure 4.8). Richfield consistently has the highest levels of local tax base support available per pupil, throughout the study period. This is due to the city's low enrollments per capita, to its fully developed and densely-settled area, and to its relatively high proportion of non-residential property, which is taxed at a higher rate than residential. Chaska ranks second, reflecting concentrations of industrial development around the City of Chaska. Cambridge-Isanti is lowest, reflecting its low development densities.

***Revenue Sources*.** Shares of revenue provided by various sources have varied somewhat throughout the study period for all districts as enrollments have increased or decreased, but have varied more widely *among* districts. Local per-pupil tax base and the level of local referendum revenues affect this balance, as well as the number of special or categorical state aids received for pupils with special needs (including low-income and disabled) (Table 4.6).

Capital Outlay. Within our sample, the fastest-growing districts have the lowest excess school capacity, as they try to keep building program up with enrollment gains: Anoka-Hennepin, Chaska, Rosemount-Apple Valley. Richfield is among those districts in the fully developed area of the seven core counties that experienced their highest population and enrollment growth in 1970-75, and had little or no household growth in the early 1990s, and thus have among the highest excess school capacities in the area. In recent years the changing proportions and trends operating and non-operating expenditures reflect these differences (Table 4.7).

Conclusion: Schools and Metropolitan Growth

Several of the trends that are evident from the school district data and histories have implications for metropolitan growth patterns in the Twin Cities region:

• Just as low-density agricultural settlement patterns led to enlargement of schools districts early in the century, low-density suburban and exurban development at the edge of the Twin Cities region continues to encourage large district sizes.

. • Lower-density settlement patterns impose higher per-pupil transportation costs than do those of higher density (more pupils have to be transported further).

Table 4.6. Revenue Source by District, 1991-1997 (percent)

Anoka-Hennepin	Local Property Taxes	Other Local	State	Federal
1991	24	13	61	3
1992	27	12	58	3
1993	29	12	55	3
1994	23	13	62	3
1995	24	13	60	3
1996	20	14	63	3
1997	24	13	60	3
Cambridge-Isanti				
1991	13	13	69	5
1992	14	12	69	5
1993	15	11	68	6
1994	13	11	70	6
1995	15	12	68	5
1996	13	12	70	4
1997	15	14	65	5
Chaska				
1991	32	7	59	2
1992	39	6	54	2
1993	65	8	24	4
1994	62	7	29	2
1995	32	11	56	2
1996	30	8	60	2
1997	34	7	56	2
Richfield				
1991	60	7	31	2
1992	65	7	26	2
1993	69	6	22	3
1994	48	10	39	3
1995	59	8	31	3
1996	49	7	41	3
1997	56	7	34	3
Rosemount-Apple Valley				
1991	31	5	62	2
1992	36	6	57	2
1993	38	8	52	2
1994	31	8	59	2
1995	34	9	55	2
1996	29	8	61	2
1997	34	7	57	2

Source: Minnesota Department of Children, Families, and Learning.

Table 4.7. Total Operating and Non-Operating Expenditures, 1994-5 to 1996-7

(millions of dollars)	1994-5	1995-6	1996-7
Anoka-Hennepin			
Operating	205	218	222
Non-Operating	243	285	265
Chaska			
Operating	58	55	47
Non-Operating	28	32	35
Cambridge-Isanti			
Operating	23	24	26
Non-Operating	28	27	31
Richfield			
Operating	27	30	32
Non-Operating	54	40	37
Rosemount-Apple Valley			
Operating	114	121	136
Non-Operating	167	216	209
Totals	$947	$1,048	$1,040

Source: Minnesota Department of Children, Families, and Learning.

• The social geography of districts affects their expenditure levels, both directly and indirectly. Declining school-age populations and increasing concentrations of low-income households both raise costs through the need for special programs and support, and these features are seen most vividly in the core cities and first-ring suburbs.

The same trends that lead municipalities into fiscal distress create inefficiencies for school districts. Constant enlargement of school districts is one way to address these problems, by creating "economies of scale" in educational service delivery. This strategy is not without costs, however. The state offers financial incentives to encourage districts to consolidate and enlarge, thus lowering some categories of cost, and transferring other costs from local to state sources. There is no evidence that legislative efforts to get more bang for the K-12 educational buck have been tied to efforts to influence metropolitan development patterns for greater economic efficiency and fairness. We know what drives up school costs. Maintaining aging and outmoded physical plants, increases in staffing levels, salaries, and fringe benefits, expansion of exceptional education programs, and increased transportation costs in suburban districts all have contributed to growth in per-pupil spending. We know that some of those extra costs are

imposed by low-density settlement patterns. The regional dynamics that encourage household migration from the core to the edge leave behind aging and expensive city schools and costly senior staff, as well as a population that raises the demand on special programs. Now the question is: how shall we put this knowledge into action?

Chapter 4

REFERENCES

1. Article XIII, Section 1.

2. *MN Session of Laws*, 1901, Ch. 262, Sec. 8.

3. *The Holmberg Act, MN Session of Laws*, 1911, Ch. 207, Sec. 8.

4. *MN Session of Laws*, 1915, Ch. 238, Sec. 11.

5. Minnesota Department of Education, *Biennial Report*, 1939.

6. State of Minnesota, Department of Education, *Laws Relating to the MN Public School System*, ch. 122, secs. 18-27: 44-47; and secs. 28-29.

7. C. O. Fitzwater, *School District Reorganization. Policies and Procedures*, Special Series No. 3. (Washington, D.C.: Office of Education, U.S. Department of Health, Education, and Welfare, 1957).

8. M.S. 122.244.

9. M.S. 122.22.

10. M.S. 122.21.

11. M.S. 122.23.

12. The Department of Children, Families, and Learning has proposed to rescind the 1974 law requiring busing to achieve racial balance, partly because the changing social geography of the metro area has rendered integration efforts ineffective, and also in response to the increasing public preference for neighborhood and community schools. Districts will be required to devise plans to heighten integration, and schools with 20 percent higher minority enrollment than neighboring districts will be deemed “racially isolated.”

13. This section discusses only operating costs. Capital costs, which are funded mostly by local district property tax levies, are a separate category of expenditure and can greatly affect a district's quality of service. This is especially true for older districts with declining enrollments and aging physical plants, and for fast-growth districts where enrollment increases may outpace the ability to pass bond referenda to finance new buildings.

14. For taxes payable in 1999, the credit increases to 66.2 percent, up to $320; for taxes payable in 2000, to 67.2 percent, up to $335 [MN. Statute 273.1382].

15. Adjusted Net Tax Capacity (ANTC) is the property value used for assessing most school taxes. ANTC is determined by equalizing differences in tax capacities by property type in different counties. This process compares market value to actual sales price, and is intended to neutralize the effect of differing assessment practices. The ANTC also reflects the application of different property tax classification rates to the market value of property. Property Tax Classification Rates vary by value of parcel and type of property.

16. Pupils at different grade levels are counted with different weights, based on the assumption that the costs to educate them differ. In 1998-99, pupil-unit (PU) weights are: one kindergarten pupil = .53 PU; one elementary pupil (grade 1-6) = 1.06 PU; and one secondary pupil (grade 7-12) = 1.3 PU. Source: Minnesota House of Representatives, *Financing Education in Minnesota 1998-99*, 1998.

17. Ibid.

18. Office of the Legislative Auditor, *Trends in State and Local Government Spending* (1996): 71.

19. United States Department of Commerce, Bureau of the Census, *1990 Census of Population,* Washington, D.C.

Chapter 5

LAND DEVELOPMENT AND HIGHWAY TRANSPORTATION IN THE GREATER TWIN CITIES METROPOLITAN AREA, 1970-1997

Introduction

We now turn to the question, "Which comes first in a locality, land development or highway transportation?" This chicken-and-egg question has been asked about development along rural interstate highways, and results have been inconclusive. As part of our examination of Twin Cities Regional Dynamics, we explore the chronological links between transportation improvements and various types of central city and suburban development. First we do this by scoring each local unit of government within our 24-county study area on a 13-point scale of highway transportation access, then comparing that score with development activity measured by building permits for residential, commercial, industrial, and office construction. Second, we extend the analysis by looking for statistical relationships among a longer list of geographical variables.

We begin with a brief review of both sides of the story–how transportation leads development and how development leads transportation. We review selected features of urban economies and how they are linked with highway transportation. Then we describe our study area and methods, and present the results of our statistical analysis.

How Are Transportation Infrastructure and Land Development Related?

Transportation Leads Development

Four Stages in Transportation. Historically, a sequence of urban transportation eras has been tied to successive stages of land development inside American cities [1]. Commercial and industrial activity of the pre-1890 era concentrated in and near the downtown, and urban residents relied on walking and on the horse-drawn streetcar to move from place to place within the city. Nearly all transportation within the urban area depended on the pedestrian mode, and even horse-drawn streetcars failed to add much range to the distance the average worker or resident was able to travel in a reasonable length of time. The areal extent of cities was severely restricted, and settlement was dense.

After 1890, the electric streetcar enabled workers to commute longer distances to jobs and shopping opportunities downtown. Private streetcar company owners often made the transportation-land use connection explicit by purchasing the land over which their streetcar lines would run, thus controlling and encouraging development in the same manner that railroad companies had influenced settlement patterns across the Great Plains.

Extension of transit lines into agricultural lands located on the edge of town expanded the supply of urban land available for residential and commercial development. As the supply of buildable land expanded and the urban area grew in population and levels of economic activity, land prices changed, some dropping due to the overall expansion in supply and some rising due to the superior accessibility provided by streetcar service. For example, land values in the heart of downtown increased sharply as radially oriented streetcar lines focused ever more employment and commercial activity on the downtown. The downtown core was the easiest place for the most people to visit, and merchants and employers were willing to pay a premium for land offering access to the entire urban market and urban labor force. Land along transit lines radiating outward from downtown was highly favored by developers who eagerly paid a premium for it, knowing that residents would be willing to pay a premium for housing adjacent to the streetcar lines. Where radial streetcar lines intersected crosstown lines, access to consumer markets was enhanced and commercial value of land parcels at such intersections reflected the value of that accessibility. At the edge of town, formerly agricultural land now served by transit increased in value as it became part of the urban realm and available for development.

As residential development expanded outward along and near streetcar lines, it produced a distinctive spoke-like pattern, with much higher densities of land development along streetcar lines than between them. In the case of Minneapolis-St. Paul, as discussed in Chapter 2, Twin Cities streetcar company owners erroneously projected that the growth rates of the 1880s and early 1890s would persist into the years beyond 1900. Their excessive optimism led to significant overbuilding of the lines to serve a volume of population and business expansion that failed to materialize, and left the Twin Cities with much lower land prices and significantly lower-density land use patterns than were typical for other big cities that developed during the streetcar era, from 1890 to the 1920s. The contrast between Minneapolis and Chicago is instructive. Land prices were so low (supply of residential land exceeding demand) in south Minneapolis between Franklin Avenue and Lake Street in the 1890s that single-family houses were built on 40-foot lots. Meanwhile in Chicago land prices were so high on new land served

by streetcars (demand for residential land vastly exceeding supply) that three-unit houses were built on 25 foot lots.

The increasingly widespread ownership of the private automobile in the 1920s introduced the third urban transportation era. The private car and motor bus enabled developer-builders and their customers to fill in the spaces between the spokes of earlier residential settlement that had been fostered by radial streetcar lines. Density remained relatively high throughout the urbanized area since available transportation options limited the distance people could live from downtown, which remained the job and retail center of the metropolitan area. Additionally, the road and parking infrastructure was not in place yet to allow the automobile to be the common mode of transportation for journeys to work or shop.

It was not until the post-World War II freeway era that private automobiles and trucks quickly became the mode of transportation primarily responsible for influencing patterns of development. High-capacity, high-speed radial roads were built initially with the express purpose of getting people in and out of downtown, with the implicit hope that they would stimulate redevelopment in declining urban centers. But roads run in two directions. What was initially understood as a means to facilitate access to downtown also provided access by city residents to the urban fringe as commercial, industrial, and office activity steadily decentralized after 1950.

Types of Development. As interstate highways increased the area of land within a reasonable commuting distance of downtown, households and businesses took advantage of the fact that they could obtain more land for less money. Residential development still is the first to be found at the suburbanizing edge of a metropolitan area. Within the Twin Cities area, Eagan is a prime example of a suburb springing to life in response to transportation improvements, in this case I-35E. Commercial services follow residential, first to meet the needs of local residents and travelers, then as centers serving larger markets from a wider area, such as the Burnsville Shopping Center. Industrial development takes advantage of land with good access to highways but little congestion, such as 3M's move to Maplewood in the eastern suburbs along I-94. Office development similarly is encouraged by the accessibility of a site for its workers. Prominent companies besides 3M that left downtown for suburban settings include Cargill, General Mills, and the regional headquarters of Prudential Insurance Company. These early examples were followed by hundreds of other new and relocating businesses with executives and employees

avoiding trips into downtown–thus stimulating development along the I-494 corridor on the south and southwest sides of the metropolitan area.

Development Leads Transportation

At the same time that innovations in urban transportation affect location decisions by households and businesses, new development encourages transportation improvements. First, increased residential development at the edge of the built-up area requires better access to existing jobs. Additionally, the common suburban cul-de-sac land use pattern funnels traffic onto arterial roads, requiring expansion of road capacity as traffic loads increase. As discussed in Chapter 2, the traditional response to congested roads has been to enlarge the roads or build new ones, though in recent years resistance to continual highway expansions has intensified, on environmental as well as other grounds. Recent conflict over extending Scott County Highway 27 through the Savage Fen in southwest suburban Savage is but one example.

Automobile-oriented commercial development requires the use of these same arterials, as well as extra infrastructure for parking. Large developments like shopping malls can incorporate transportation improvements, as did the Mall of America in Bloomington. Office and industrial developments need highway access systems that can handle large numbers of people arriving or leaving within a short time period. This accommodation may take the form of extra turn lanes or traffic lights, which are largely unnecessary except at the beginning and end of the work day. Where job or commercial centers are involved, transportation improvements may include public transit stations as well.

A Process of Circular and Cumulative Causation

The answer to the question, “Does transportation lead development, or does development lead transportation?” is most likely, “Yes, it’s a circular process.” One compromise is to suggest that, rather than stimulating development, transportation improvements channel development that would have happened somewhere within the metropolitan area [2]. Whereas this approach allows for the influence of other factors such as location, demographics and entrepreneurship in determining the success of local interests and local governments at attracting development or promoting it from within, it also portrays the metropolitan economy as a zero-sum game, where growth that happens in one place simultaneously means that the growth failed to occur somewhere else within the metropolitan area, or that an activity relocating within the metro area from one site to another yields no net gain or loss to the overall metropolitan economy.

Chapter 2 briefly explored the relation between transportation improvements and building permit activity, concluding that each process contributes to the other. In this chapter we study in greater detail the relation between the timing of transportation improvements and four kinds of development, in an attempt to discover a statistical relationship between the two.

Relating Highway Transportation Improvements and Patterns of Land Development in Metropolitan Regions

The Regional Economy and Its Relationship to Highway Transportation

The role that an interstate highway through a community plays in promoting or facilitating local economic development in that community has been studied by many authors [3]. It seems intuitively obvious that local economic development of the sort that requires vehicular interaction internally as well as with such wider markets as suppliers and customers cannot succeed without satisfactory roads. On the other hand, there are numerous examples of places that enjoy good highway access to other places, yet their local economies seem to languish. What accounts for the different experiences of places with respect to their economic development prospects and experiences? And how are these differences related to highway transportation infrastructure serving those places? Highways would seem to be a necessary but far from sufficient element of support for vigorous regional and local economies.

Consider the United States as composed of a mosaic of urban-centered regional economies that aggregate to the national economy. Some are small urban-centered economies, some are large urban-centered regions, and some are metropolitan in scale. Part of each regional economy is engaged in producing goods and services for export to other regions and the rest of the world. The remainder of each regional economy is devoted to producing goods and services for its own local consumption and investment. As urban-centered regional economies grow into large metropolitan regions, they become steadily more self-sufficient; that is, the share of their productive activity that is devoted to meeting their own goods and services needs keeps expanding. Another way of saying the same thing is that the smaller a regional economy is, the more it must depend on external markets to sell its goods and services. A small regional economy must sell to outside markets to earn the money needed to buy the goods and services that it is unable to produce for itself because of its small size. Thus, as a metropolitan economy grows larger, the nature of its internal and external highway transportation requirements also changes. The changed transportation needs come about in part as a consequence of economic

changes. Small places that have something to sell that the rest of the world wants to buy must have satisfactory transportation and communications links with their markets. Metropolitan economies also need good transportation links with the rest of the world, but they especially need good transportation within the metropolitan region itself.

Urbanization Economies and Transportation. Regional economists and urban geographers distinguish two types of economic development advantages associated with *economies of scale* that firms and other organizations located in large urban or metropolitan regions can enjoy, in contrast to their counterparts in small urban areas. Grocery stores, factories, hospitals, municipal water supply systems, post offices and other kinds of urban economic activity can achieve economies of scale in a large place that are difficult or impossible in small markets. Large operations allow for more specialization in production processes, better prices when making large purchases of inputs, and the chance for competitive pricing of products and services sent to market. As firms and other organizations grow, economies of scale provide greater returns on investment and cycles of profitability are reinforced compared with smaller-scale operations in small urban regions.

The economic advantages that large urban or metropolitan settings offer are of two types: *urbanization economies* and *localization economies*. If we examine each of the two kinds of advantages, we can see some of the relationships between the urban economy and its highway transportation requirements. *Urbanization economies* permit urban areas to produce and distribute goods and services at lower unit cost because they are able to achieve significant economies of scale (through large volumes of production). Both capital equipment and labor can be used more efficiently in large urban areas. Even if wages and salaries are high, as they are in large labor markets compared with rural settings, labor costs per unit of output in large urban areas often are low because urban workers can be more productive. Busy urban workers are usually more highly trained, more efficient, and can get more done in less time because they are better supported and have a continuous supply of work with little or no down time. Services are more professionalized in large urban settings, and although life in the big city is more complex, the means exist for handling all manner of complex challenges. Large urban areas contain a broader range of infrastructure support and greater financial resources. Often start-up firms obtain advantages by locating in the heart of larger areas, but then decentralize to larger sites on the suburban periphery as they grow.

If a metropolitan economy is expanding, workers are willing to change jobs more readily in order

to match their talents and ambitions with available career opportunities and thereby become more productive. If an employee proves to be unsatisfactory, employers have an easier time letting the employee go and hiring a replacement knowing that other local employment opportunities exist, and expecting that the replacement worker will enhance productivity. In a stagnant metropolitan economy, workers are reluctant to leave unsatisfactory jobs, and employers know that a fired employee will have difficulty locating equivalent local employment, and extended unemployment means their unemployment tax will rise.

When highway facilities within a metropolitan region support quick and convenient interaction among specialized producers and consumers, the full benefits of urbanization economies can be achieved. If specialists are widely scattered–due to zoning restrictions that segregate activities that need to interact, or due to difficult terrain (Pittsburgh, New Orleans), water obstacles (New York-New Jersey, San Francisco-Oakland, Seattle-Everett), or sheer size (Chicago, Los Angeles-Long Beach) that requires excessive movement to achieve interaction–or if roadways are constantly congested and slow down interaction, then efficiencies that otherwise might be achieved may be difficult or impossible to obtain.

Localization Economies and Transportation. The second group of economic development advantages that an urban region may enjoy are called *localization economies*, which include concentrations of similar firms tapping a common skilled labor pool, or engaging in interfirm communication to keep abreast of innovation, or taking advantage of opportunities for greater levels of specialization. Examples include cities containing pools of exceptionally skilled workers in a certain industry, such as computer programmers, screenwriters, or engineering consultants. Many industries are composed of clusters of localized firms, such as aerospace, steel, automobiles, carpet, and machinery industries, with a few cities capturing a large share of employment in each of these sectors. Some cities have large pools of venture capital managed by imaginative investors willing to bankroll promising new products and processes. In metropolitan areas where there is intense interaction among elements in the same industry, the local transportation and communications systems accommodate intrametropolitan interactions to the advantage of all. Sometimes there is a natural resource available locally, such as petroleum, metal ores, snow-covered ski slopes, or warm winter beaches that supports an industry or attracts vacationers and retirees. In these cases, access to the resource from other regions will be required so that products can be marketed or that visitors can be accommodated.

The Study Area and Data

The fact that there are over 300 different metropolitan-centered urban regions of different sizes and types in the United States, each of which was developed and built at a different time under different circumstances at a unique location and in a specific physical setting, means that the question "How are highway transportation facilities and land development related?" is a complicated one. Among other things, it means that the relationship probably differs depending on the time period being considered, the place and its unique physical and cultural features, the type of metropolitan economy that supports it, the type of land development activity being considered, and the geographical scale of the analysis. There are so many ways in which regions differ from one another that without exhaustive comparative analysis over time, and from place to place, it is hard to know whether relationships discovered in one setting will also be characteristic of other places. Given the many ways in which places differ, it is not a simple task to demonstrate relationships between (1) *patterns of land development of different kinds in specific places*, on the one hand, and the (2) *quality of highways and highway improvements serving those places*, on the other.

Previous research on the question of the impact of an interstate highway on local economic development has tended to focus on the question in a one-directional manner, that is "Does a new road bring about new development?" Earlier research also tended to focus on rural economies examined with counties as the areal units of analysis. In addition, employment seems to be the most common measure of development. But this indicator may be misleading in a short-term analysis because temporary new jobs are created by the construction projects themselves, and may not reflect longer-term changes in employment of county residents, or changes in the number of jobs located inside the county. Other simple measures of local growth in addition to jobs held by residents or jobs located in an area include population and population change, and population density and density change.

In urban or metropolitan settings the questions differ from the county-based rural investigations and ask: "Which comes first, roads or development, and what kind of development?" One way to answer the question is to compare the changing accessibility of part of a region with the volume of development it experiences during that same period of time, as measured by building permit activity.

Geographic Scale of Analysis. In order to answer these questions at an appropriate geographical scale of analysis, we used highway and development data for the 631 *minor civil divisions*

(MCDs) within our 24-county study area. We judged *counties* to be too large in areal extent because in counties such as Hennepin (557 mi.^{2}), Dakota (570 mi.^{2}), Wright (661 mi.^{2}) or Pine (1,411 mi.^{2}) a parcel of land undergoing improvement can be in the same county as a major highway or highway improvement yet for all practical purposes be located many miles from it. At the other extreme, *census tracts* with an average size under 5 mi.^{2} along with census county divisions in non-tracted counties are too numerous and too small for convenient statistical analysis. The 24-county study area covers 11,287 mi.^{2} for an average size of about 18 mi.^{2} per MCD, which seemed like a reasonable size for evaluating relationships between locations of land development of different kinds and proximity to major highways or highway improvements.

Accessibility to Major Highways. It is necessary to know the timing of road construction and development in the area, which was explored in Chapter 2 of this report. We assigned to each MCD a numerical score based on its accessibility to the system of *Principal Arterials* (as classified by the Minnesota Department of Transportation), and then compared for each MCD (1) its highway accessibility score, and changes in score over time, with (2) the number of building permits granted in successive time periods in the MCD. Four classes of building permits were separately analyzed (residential, commercial, industrial, office) in order to determine any relationship between road building and/or improvements, and land development during the period 1970 to 1997.

Our highway-accessibility scoring system considers the existence of Principal Arterials within or adjacent to each MCD, and consists of 13 values, 0-12 (Table 5.1) [4]. The lowest score of zero indicates the lowest level of access, that is, no convenient or direct access to the system of metropolitan arterials. Since a city or township still can have access to a major arterial if that arterial is in the neighboring MCD, the scoring system starts with all such possibilities (1-4) [6]. Multi-lane highways are considered to provide less accessibility than limited-access roads, which provide less accessibility than interstate highways [7]. Two-lane arterials are not likely to strongly influence development, and thus are counted only if that is the only type of Principal Arterial within an MCD.

Next higher in rank are places with one major arterial of their own, but none in neighboring cities or townships (5-7) [8]. Scores 8-10 refer to places with a major arterial within their borders and one or more major arterials in an adjacent city or township. The highest scores (11-12) are achieved by those places containing more than one major arterial, with any number in adjacent MCDs. Initial scores were calculated from the 1970 official state highway maps of Minnesota

Table 5.1. Transportation Scoring System.

Score	Meaning
0	no arterials within, none adjacent
1	no arterials within, 1 multi-lane adjacent
2	no arterials within, 1 limited-access adjacent
3	no arterials within, 1 interstate adjacent
4	no arterials within, two or more adjacent OR any number of two-lane arterials within
5	1 multi-lane within, no arterials adjacent
6	1 limited-access within, no arterials adjacent
7	1 interstate within, no arterials adjacent
8	1 multi-lane within, any number of arterials adjacent
9	1 limited-access within, any number of arterials adjacent
10	1 interstate within, any number of arterials adjacent
11	2 or more multi-lanes within, any number of arterials adjacent
12	any combination of multi-lane and limited-access/interstates OR two or more limited-access/interstates within, any number of arterials adjacent

"Arterials" include multi-lane, limited access, or interstate highways categorized as Principal Arterials under the Functional Classification system of the Minnesota Department of Transportation. Two-lane arterials are considered only if they are the only Principal Arterials present within an MCD (such MCDs receive a score of 4). A limited-access or interstate highway only counts if it has an exit within the MCD, or one clearly meant to serve the MCD [5].

and Wisconsin, and subsequent changes were made as noted on the same maps for 1979/80, 1985/86, 1989/90, and 1997/98.

Building-permit data for residential, industrial, commercial, and office development were obtained as described in Chapter 2. For residential permits, we considered the number of units to be built, while industrial, commercial, and office permits were recorded in the total (current) dollar values of the permits granted. Care must be taken when comparing data from the single years 1972 and 1979 with data from the periods of 1980-84, 1985-89, and 1990-94 (or 1990-97 in the case of residential data). Data for 1972 and 1979 are for those years only (intended to be representative of the time periods of the early and late 1970s); data for the time periods 1980-84, 1985-89, and 1990-94 are five year totals. One problem with using the single-year data of 1972 and 1979 (the only years reported by Bureau of the Census) is that it may be unrepresentative of the half-decade due to the volatility of events in any one year that might affect the development situation of an MCD.

Statistical Methods

Step 1: Scatter Plots. With such a large volume of data (transportation scores and building permit data for five different time periods for 631 MCDs), our statistical analysis began with simple descriptive statistics and exploratory visualizations of the data. The relationship of each type of land development to transportation is analyzed in a subsequent section of this chapter. [An extended multivariate statistical analysis of land development related to highway improvements and other events will be presented in a later report in this series.] For each presentation below, we begin with a scatterplot matrix of transportation versus the specified type of real estate development. Each scatterplot matrix displays separate arrays for each possible pairing of variables (in our analysis, each possible pairing of time periods). Therefore, for our exploration of the association between transportation and residential development, the scatterplot matrix contains a plot of transportation for each of five time periods versus rates of new residential development for each of five time periods (25 plots in all).

Scatterplots are a useful visual method of exploratory data analysis. Each scatterplot portrays the degree and nature of a statistical relationship between two variables: whether there is a positive or negative direction of correlation; whether the assumption of a linear relationship between the variables appears to be appropriate; and how strong the relationship appears to be. We include the best fitting lines (using ordinary least squares regression) on each of the scatterplots in the matrix. The slope of the best fitting line suggests the extent to which the quality of local highway transportation facilities leads real estate development in the same or in another time period. The scattering of points away from the best fitting line reveals the strength of the association, while also portraying outlying MCDs that for unspecified reasons depart significantly from the trend followed by other MCDs.

Step 2: Correlation Analysis. The scatterplots are the first step in the correlation analysis. The second step is the calculation of *correlation coefficients*, which provide a quantitative measure of the association between a pair of variables. However, correlation does not necessarily imply a cause-and-effect relationship; it merely measures the degree of association between two variables. In our analysis, we assume a linear relationship between the quality of highway transportation facilities serving an MCD and land development within the MCD, and employ a widely used measure of statistical association, Pearson's correlation coefficient (r). These coefficients vary between the minimum possible value of minus 1.0, which indicates perfect inverse correlation, and the maximum possible value of plus 1.0, which indicates perfect positive

correlation. A value of 0.0 indicates no correlation or statistical association between the two variables. For each section below, we present the correlation coefficients for all of the scatterplots in the matrices.

Some notes of caution are necessary in interpreting the results of our preliminary correlation analysis. First of all, it is possible that different geographical scales of analysis would produce different degrees of correlation. We have used data for local units of governments (MCDs), but the calculations might have been different had we used data at the county scale, or from census tracts or block groups. By analyzing relationships at the MCD scale, we assume that highway access at any location within the MCD will be relevant for real estate development at any other location in the MCD. This assumption will not apply uniformly across our study area because of varying shapes and sizes of MCDs in the 24 counties. However, throughout this study we treat municipal and township governments as active agents in the development process, so we feel that statistical analysis at the MCD level is the most feasible and appropriate. A second caution is that this initial correlation analysis is highly simplified. We consider only a few of the many variables that govern development activity. Later analysis will consider the roles of a broader array of variables that are related to the development process in addition to the quality of an MCD's highway access.

We assume a linear relationship between transportation and development based on our hypothesis that increased transportation access will lead to increased development (and vice versa) and on the scatterplots of transportation versus each type of development. But we recognize that there exists non-constant variance in the plots of residuals from our regression analysis; variability in the sizes of the residuals rises as MCD transportation scores increase. This variation occurs because of the wide range of development data values. For example, many places have no office development even though they have a high transportation score, while others with similar transportation scores have millions of dollars of office development. These large values of development have more "room" to vary than do small values, and they generally occur with higher values on the x-axis (MCD transportation scores). However, this non-constant variance does not suggest that development is a *nonlinear* function of transportation.

Step 3: Linear Regression. In each section, our statistical analysis of the relationship between MCD transportation scores and levels of land development continues with a closer examination of the scatterplot and regression line for the time period of the early 1980s (the center scatterplot of the matrix). By displaying the regression line in this way (with transportation scores on the x-

axis, and measures of land development on the y-axis), we are assuming that transportation is the *independent* variable, and that variations in highway transportation services are associated with variations in the *dependent* variables, that is, the levels of various types of real estate development. Each type of development is affected by transportation.

Transportation in turn is affected by each type of development. At this time however, we do not perform regression analysis with transportation as the dependent variable. Scatterplot matrices with highway transportation scores as the response and levels of new development put in place as the independent predictor revealed a need for more detailed analysis, such as multiple regression. Further complicating a multiple regression analysis is the high degree of correlation between the development variables themselves. Such an analysis will be attempted in a later report. In the present report, we use a simple linear regression analysis, along with a comparison of the scatterplots in the matrices and correlation analysis, to address the timing question.

Step 4: Residuals from Regression. Like correlation analysis, regression analysis attempts to reveal the nature of the empirical relationships among the variables. Here, we examine in a preliminary way the influence of highway transportation on each type of development, using only a single-variable model. The slope of the line shown on the scatterplots indicates the level of change in development activity associated with a change in highway transportation score. We performed residual analysis on the major outliers (the large development values that usually occur with larger transportation scores), and the leverage values for these points are not statistically significant. That result means that we can safely conclude that these prominent outliers are not having a noticeably disproportionate influence on the fit or the slope of the regression lines.

Step 5: Statistics from Regression. The next analytical step in each section is a presentation of informative statistics from the regression analysis [9]. Five different regression analyses were performed in each section, one for each of the five scatterplots along the diagonal of the scatterplot matrix (those plots showing relationships between transportation and development during the same time period, i.e., 1972, 1979, 1980-84, 1985-89, and 1990-94 or 1990-97). In a regression analysis, the value of the coefficient of determination (r^2) measures the ability of the independent variable (MCD highway transportation score) to account for variation in the dependent variable (amount of land development). This coefficient ranges from 0.0 to 1.0, and can be interpreted as the percentage of the variation in development experienced by MCDs that is explained by variation in the transportation score. Finally, the F statistic is used to evaluate the

significance of the r^2 value. Using this test, we concluded in every regression analysis that we ran that variations in highway transportation infrastructure serving MCDs account for a statistically significant amount of the variation in real estate development within MCDs [10].

Step 6: Investigation of Specific Residuals. In each section, the final step in our statistical analysis investigated the major outliers from the expected trends for the relationships between transportation scores and development levels (as determined by the regression analysis). The deviation of each plotted observation from the expected trend (the regression line) is termed a residual from regression. In each section, we present and discuss the ten largest residuals from our expected trends for each time period [11].

Residential Development and Transportation

The relationship between residential development and highway transportation may be hypothesized to involve causality in either direction. Added or improved highways may open up new areas for residential development, and new residents would then already have access to transportation. However, the development and occupation of new residential areas (whether previously served by major transportation routes or not) generates demand for improved or expanded highway transportation infrastructure.

We can see from the descriptive statistics of our data on residential development (Table 5.2) that the median and mean numbers of residential units added are quite low when compared with the maximum numbers added in each time period. For example, in 1972, 329 MCDs reported permit granting activity to the Bureau of the Census. The maximum number of new housing units authorized in 1972 by a single MCD was 2,825, the median number of units permitted was 9, and the arithmetic mean across all 329 MCDs was 88 new housing units. Some MCDs added extraordinary numbers of units in certain time periods, which may represent a boom in development of land newly served by transportation, or which may require the extension of transportation services to the newly developed areas.

The scatterplot matrix (Figure 5.1) illustrates the relationships between highway transportation access and number of residential units authorized by building permits for each pairing of time periods. Consider the scatterplots along the diagonal of the matrix from lower left to upper right. The correlation values for the relationship between transportation scores and residential development change over the five time periods from the early 1970s to the 1990s, but not by

Table 5.2. Descriptive Statistics for the Data on Number of Residential Units, by Time Period.

Time Period	Number of Cases	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation
1990-97	413	7,435	58	372	892	2
1985-89	414	7,257	20	281	825	3
1980-84	414	6,079	20	188	589	3
1979	260	1,000	15	68	158	2
1972	329	2,825	9	88	265	3

Data Source: U. S. Department of Commerce, Bureau of the Census, Residential Building Permits, tape file. Calculations by authors.

much (Table 5.3). From the early 1970s to the early 1980s, the correlation coefficient for transportation and residential development is a constant 0.49, indicating a strong positive correlation between the two variables. In the late 1980s this value rises to 0.52, one of the highest associations that we find between transportation and any type of development. In the 1990s the correlation value drops to 0.44, which indicates a continuing strong positive association between transportation access and residential building activity at the scale of the MCD.

The other scatterplots in the matrix (those off the diagonal) allow us to investigate the relationships between transportation scores in one time period and residential development activity in different time periods. For example, the top left scatterplot shows the relationship between MCD transportation scores in 1970 and residential developments in the 1990s. With a coefficient of 0.40 we see that there is not as strong a correlation between variables in this case as there was in the case of transportation scores in 1970 and residential development activity in 1972.

We also can see from the scatterplot of transportation scores in 1970 and residential development in the 1990s that there are many more points that appear as outliers from the expected trend, and that they also occur for low transportation scores. Most of our major outliers (especially in the plots along the diagonal of the matrix, which relate variables in the same time period) occur associated with large transportation scores. This result makes sense intuitively because a place

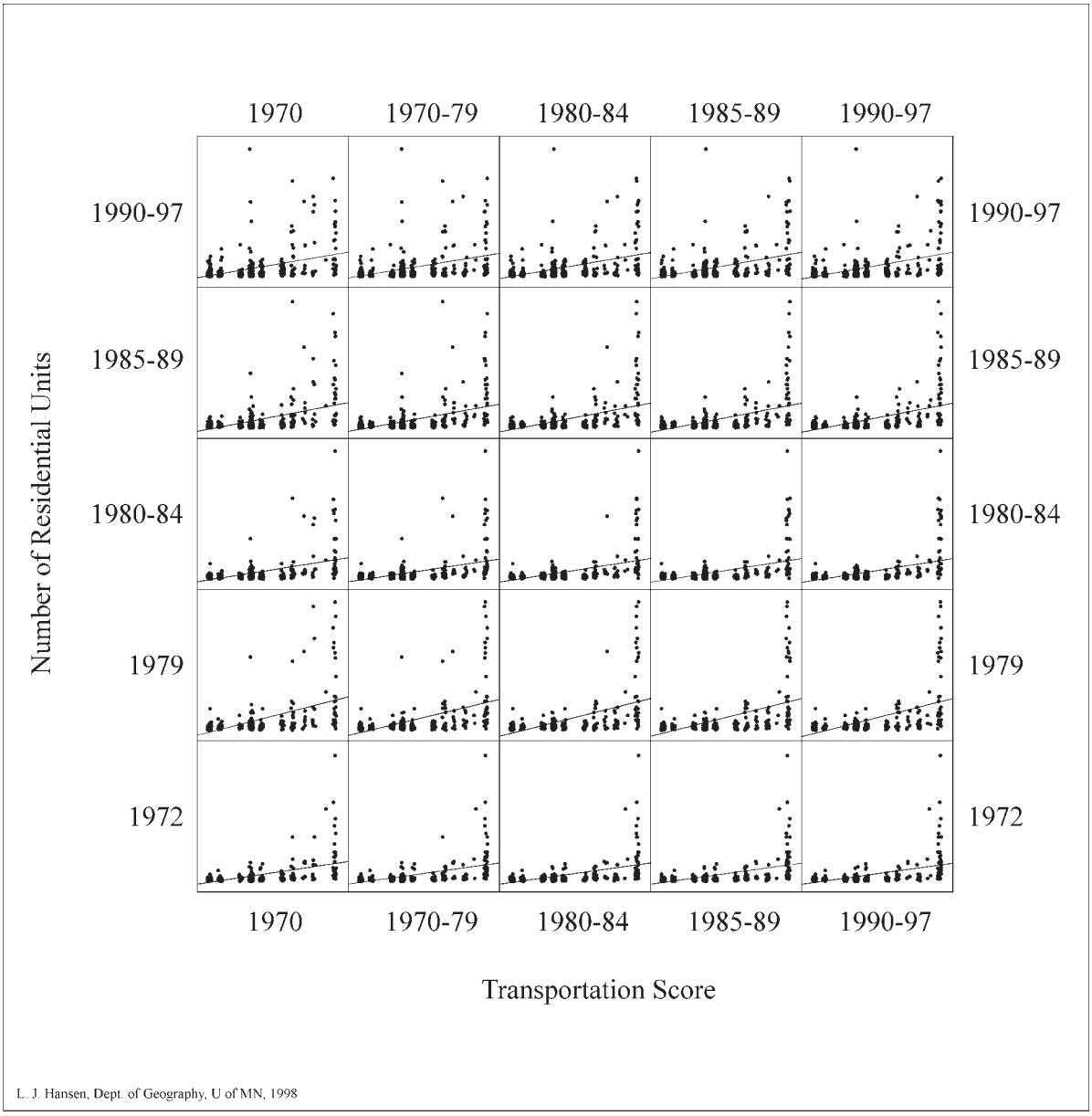


Figure 5.1. Scatterplot Matrix Showing Relationship Between Transportation and Number of Residential Units, by Time Period.
Data Source: U. S. Department of Commerce, Bureau of the Census, Residential Building Permits, tape file.

that has achieved the highest level of highway transportation accessibility as we have defined and scored it has ample transportation support to develop any open areas it may have available; alternatively it may not have much ability to develop further if it is already built up. Therefore the range of values of residential development for the higher transportation scores usually is much greater than for lower transportation scores.

Table 5.3. Correlation Values of the Relationships Between Transportation and Number of Residential Units, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Residential	1990-97	0.40	0.40	0.43	0.44	*0.44*
	1985-89	0.48	0.48	0.51	*0.52*	0.52
	1980-84	0.47	0.46	*0.49*	0.49	0.49
	1979	0.50	*0.49*	0.52	0.53	0.52
	1972	*0.49*	0.47	0.48	0.48	0.47

Values are Pearson's correlation coefficients, *r*.
Data Source: Calculations by authors.

The scatterplots below and to the right of the diagonal in the matrix allow us to explore the relationships between the two variables where the time period of residential development precedes the time period of the transportation scores. For example, the correlations between residential units added in 1979 and transportation scores from the early 1980s to the 1990s are quite high (0.52 to 0.53). Again, we must be careful not to infer from these results that residential development alone brought about the construction of transportation improvements. However, whether influenced by other outside factors or not, there exists a strong association between residential development and transportation.

In the scatterplot of transportation scores versus residential development in the early 1980s (Figure 5.2) we see an example of the increasing range of development values as transportation scores increase, and of the obvious positive correlation between the variables. The coefficient of determination (r^2) for this regression line is 0.24 (Table 5.4), indicating that 24 percent of the variation in the number of residential units added in an MCD can be explained by that place's transportation score. This result is quite remarkable, as there would seem to be many other factors that influence residential development such as location within the developing urban area, availability of developable land, demand for large lots and other consumer preferences, natural amenities, and so forth, some of which may also be correlated with a place's transportation score. [A later report in this series will explore these possibilities in greater detail.]

The coefficients of determination for other regression analyses (Table 5.4) reveal that

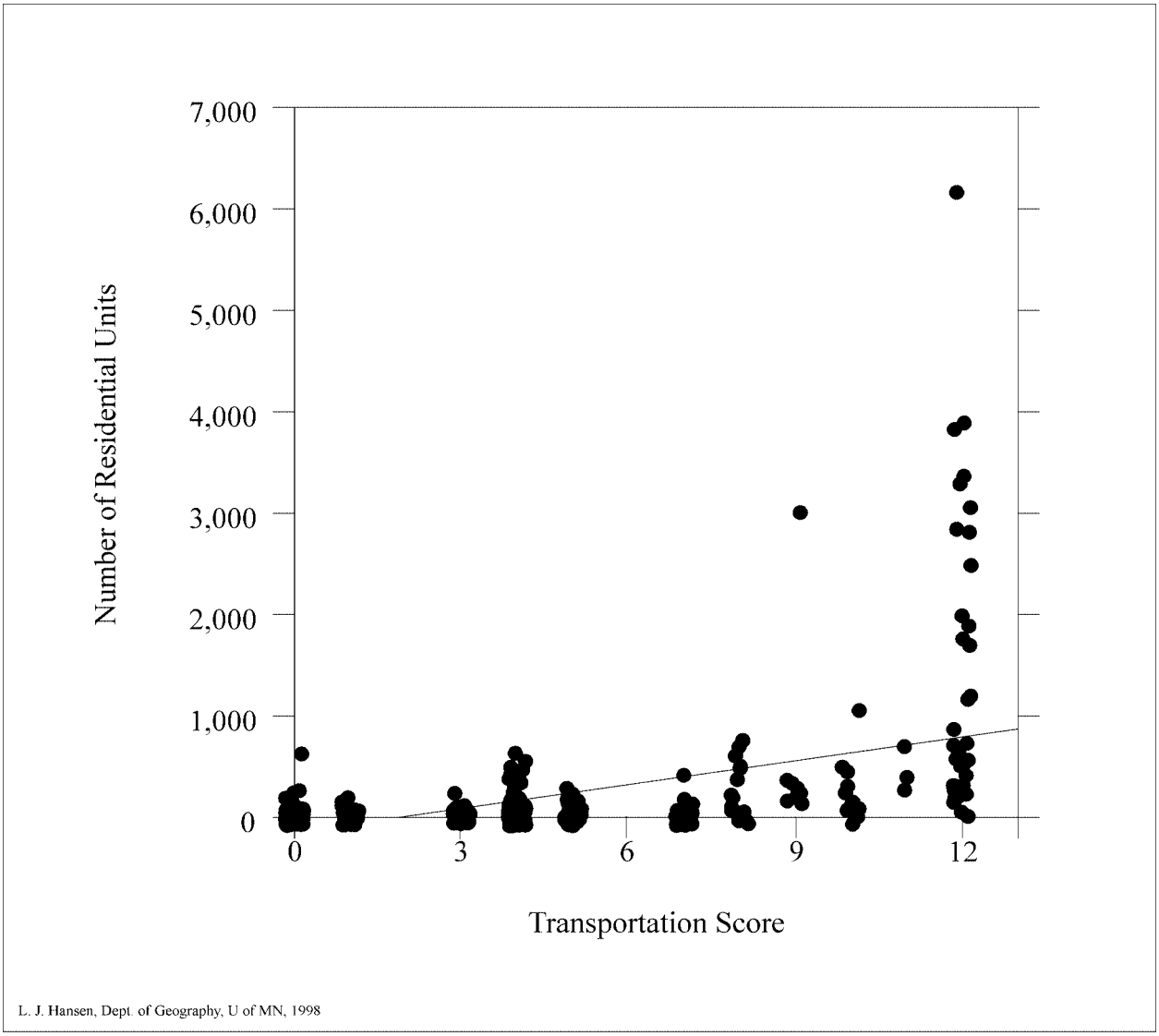


Figure 5.2. Scatterplot Showing Relationship Between Transportation and Number of Residential Units, 1980-84.
Data Source: U. S. Department of Commerce, Bureau of the Census, 1980-84 Residential Building Permits, tape file.

transportation accounts for a significant share of the variations in levels of residential development in all time periods, especially the late 1980s (27 percent). The lowest coefficient occurs in the 1990s (20 percent of the variation in residential development in the 1990s can be accounted for by variations in transportation access in the 1990s). This result possibly reflects the fact that central city and inner-ring MCDs with high transportation scores have no more land available for residential development. It may also reflect consumer preferences for suburban

Table 5.4. Coefficient of Determination Values (r^2) from Regression Analysis of the Relationship Between Transportation and Number of Residential Units, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Residential	1990-97					0.20
	1985-89				0.27	
	1980-84			0.24		
	1979		0.24			
	1972	0.24				

The p-value for each regression's F-statistic = 0.000.
Data Source: Calculations by authors.

low-density residential areas, even in places so far poorly served by major highways.

These arguments are supported by the fact that most of the major outliers from the expected trend in the 1990s occur in MCDs located in second-ring suburbs and beyond, such as Eden Prairie, Eagan, Lakeville, Coon Rapids, Plymouth, and Apple Valley (Table 5.5). In contrast, both Minneapolis and St. Paul appear as outliers from the 1970s through the early 1980s. Winthrop and Andover, two non-metropolitan MCDs, appeared as outliers in the 1990s scatterplot because they experienced far more residential development than would be expected given their low highway transportation accessibility scores.

Most of the residential outliers in all time periods are places with the highest possible transportation score (12), and that experienced the addition of far more residential units than expected [12]. This result may reflect the position of these places on the edge of the developing urban area, where an MCD might contain highly developed transportation infrastructure as well as large areas of undeveloped land. However, some of these places were developing suburbs that added more residential units than expected while improving their transportation scores. Eagan was an outlier in both 1972 and 1979 with a transportation score of eight, was an even larger outlier in the early 1980s when its transportation score jumped to 12, and maintained its rank as one of the top three outliers through the 1990s. Apple Valley was an outlier in 1979 with more units added than would be expected for its transportation score of 4, but it again appeared as an

Table 5.5. Outliers from Expected Trend, from Regression Analysis of the Relationship Between Transportation and Number of Residential Units, by Time Period.

	Transportation Score	Residential Units	Predicted Residential Units	Studentized Residual
1972				
Minneapolis	12	2,825	365	13.2
St. Paul	12	1,761	365	6.4
Edina	11	1,626	329	5.9
Burnsville	12	1,380	365	4.5
Fridley	12	1,246	365	3.9
Eagan	8	993	221	3.4
Bloomington	12	1,080	365	3.1
Brooklyn Park	10	992	293	3.1
Brooklyn Center	12	791	365	1.9
Pine Springs	12	0	365	-1.6
1979				
Minneapolis	12	1,000	206	6.2
Maple Grove	12	970	206	6.0
Bloomington	12	906	206	5.4
Eden Prairie	12	811	206	4.6
Apple Valley	4	584	46	4.0
Brooklyn Park	12	724	206	3.9
Coon Rapids	9	619	146	3.5
Minnetonka	12	674	206	3.5
St. Paul	12	656	206	3.4
Eagan	8	528	126	3.0
1980-84				
Minneapolis	12	6,079	794	12.0
Eagan	12	3,830	794	6.2
St. Paul	12	3,828	794	6.2
Eden Prairie	12	3,330	794	5.1
Plymouth	12	3,318	794	5.1
Coon Rapids	9	2,989	558	4.9
Minnetonka	12	3,055	794	4.5
Brooklyn Park	12	2,876	794	4.1
Bloomington	12	2,786	794	4.0
Maple Grove	12	2,544	794	3.5

Table 5.5 (continued)

	Transportation Score	Residential Units	Predicted Residential Units	Studentized Residual
1985-89				
Eagan	12	7,257	1,179	9.5
Eden Prairie	12	6,589	1,179	8.3
Plymouth	12	5,420	1,179	6.3
Burnsville	12	5,301	1,179	6.1
Coon Rapids	12	4,540	1,179	4.9
Minnetonka	12	3,894	1,179	3.9
Maple Grove	12	3,839	1,179	3.8
Bloomington	12	3,535	1,179	3.4
Apple Valley	12	3,137	1,179	2.8
Lakeville	10	2,629	945	2.4
1990-97				
Winthrop	4	7,435	335	9.9
Eden Prairie	12	5,752	1,199	6.0
Eagan	12	5,683	1,199	5.9
Lakeville	10	4,775	983	4.9
Coon Rapids	12	4,474	1,199	4.2
Plymouth	12	4,440	1,199	4.2
Apple Valley	12	4,267	1,199	3.9
Brooklyn Park	12	4,077	1,199	3.7
Andover	4	3,088	335	3.5
Burnsville	12	3,885	1,199	3.4

Outliers are listed in order of magnitude of residual from expected value.
Data Source: U. S. Department of Commerce, Bureau of the Census, Residential Building Permits, tape file. Calculations by authors.

outlier in the late 1980s and 1990s with a transportation score of 12. These places were developing rapidly both in transportation access and in residential units, with the number of units added outpacing what was expected for the level of improvement in highway transportation serving them.

Industrial Development and Transportation

Improved or added highway transportation access for an MCD may open up areas within it for industrial development because most industry requires a high level of transportation infrastructure of some type. It is not always important for industrial development to locate near other types of development, but it usually seeks good access to highway transportation routes with little congestion. New industrial development also may generate demand for improved highway transportation services, especially improved access for trucks or other freight-hauling vehicles.

Although most MCDs reported adding at least a few residential units in each time period, the reported permit data on industrial valuations reveal that many places issued no industrial development permits during a time period (Table 5.6, the median value of industrial development for each time period was $0). In contrast, MCDs that did report one or more major industrial developments may account for tens of millions of dollars worth of industrial permits. Comparing the coefficients of variation [13] for residential development (Table 5.2) with those for industrial development (Table 5.6) shows an increase in the variability of the data.

The scatterplot matrix (Figure 5.3) discloses the relationships between transportation and value of industrial building permits for each pairing of time periods. There is still a positive correlation

Table 5.6. Descriptive Statistics for the Data on Industrial Value, by Time Period.

Time Period	Number of Cases	Maximum	Mean	Standard Deviation	Coefficient of Variation
1990-94	379	$22,170,062	$937,667	$2,549,045	3
1985-89	380	$63,106,483	$1,406,422	$5,414,128	4
1980-84	380	$47,225,937	$1,194,429	$4,563,072	4
1979	260	$28,809,595	$619,447	$2,491,354	4
1972	329	$4,876,800	$167,610	$614,221	4

Median Value for each time period = $0.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

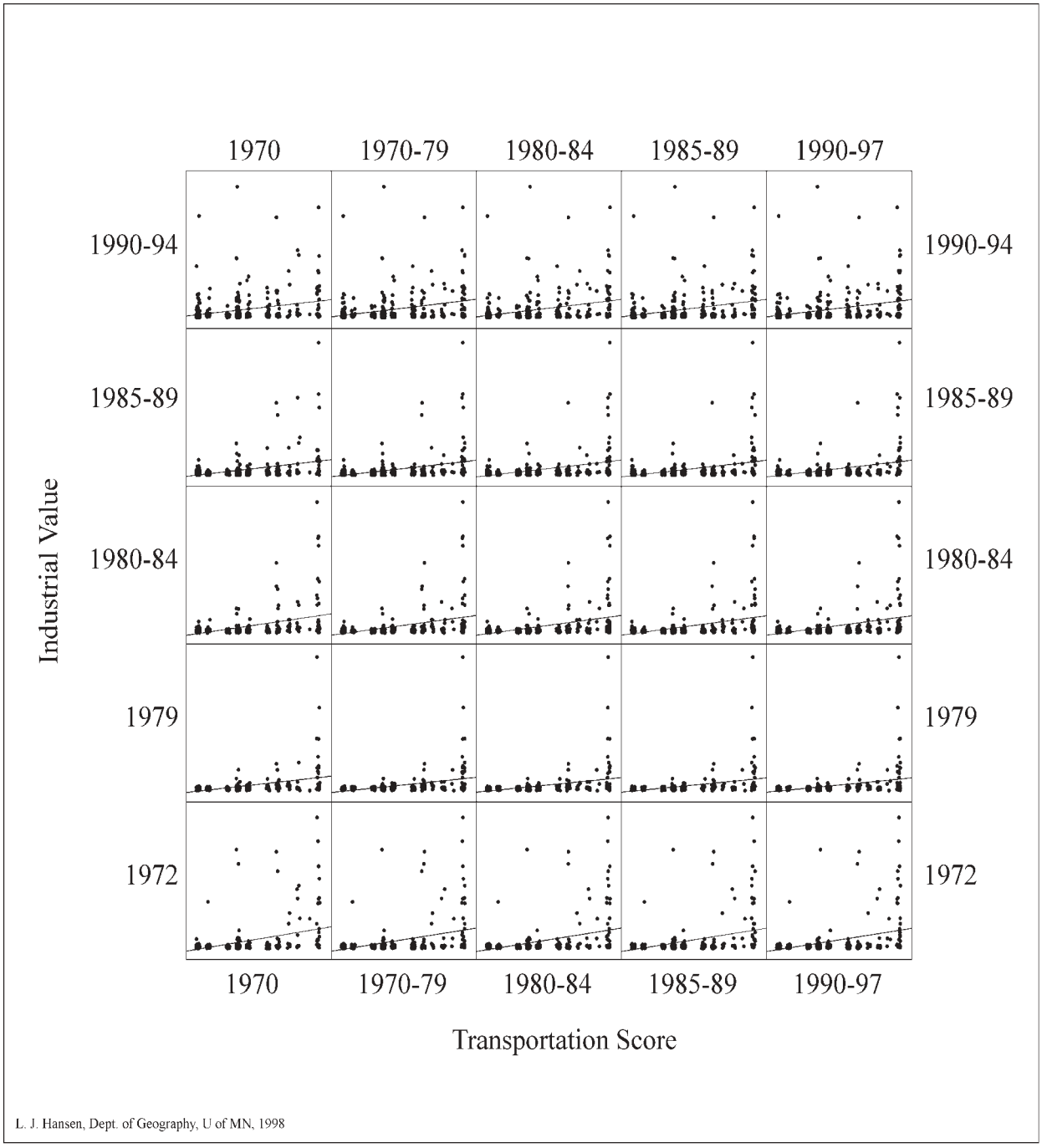


Figure 5.3. Scatterplot Matrix Showing Relationship Between Transportation and Industrial Value, by Time Period.

Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file.

between highway transportation accessibility scores and values of industrial building permits; however, this relationship is less strong than the statistical link between transportation scores and residential development activity. The correlation values of these relationships support this perception (Table 5.7). The correlation values for the plots along the lower left to upper right diagonal of the residential development matrix ranged from 0.44 to 0.52, while the correlation values for the plots along the corresponding diagonal of the industrial development matrix range from 0.29 to 0.40.

If we consider only the plots along the diagonal (Table 5.7), the correlation values are fairly consistent through time and reveal moderate positive correlation between the variables, until the 1990s when the correlation value drops from 0.37 to 0.29. Industrial development in the 1990s as disclosed by industrial building permits is not highly correlated with the highway transportation scores of any time period. We see many more outlying points for all levels of highway transportation scores in the 1990s scatterplot (the top right plot in the matrix); the spread of points appears similar to the plot in the top left, which portrays the relationship between transportation in 1970 to industrial development in the 1990s (and for which we would probably not expect a strong association).

Except for the plots that include industrial development in the 1990s (the top row of plots in the matrix), there is not much variation between the correlation coefficients when transportation

Table 5.7. Correlation Values of the Relationships Between Transportation and Industrial Value, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Industrial	1990-94	0.26	0.29	0.29	0.29	*0.29*
	1985-89	0.35	0.36	0.37	*0.37*	0.37
	1980-84	0.41	0.40	*0.40*	0.40	0.40
	1979	0.38	*0.36*	0.35	0.35	0.35
	1972	*0.37*	0.37	0.37	0.37	0.37

Values are Pearson's correlation coefficients, r .
Data Source: Calculations by authors.

leads versus when industrial development comes first. The amount of correlation between transportation in the 1970s and industrial development in the early 1980s is the same as the amount of correlation between industrial development in the early 1980s and transportation in the late 1980s. Thus, it is difficult to hypothesize about leads and lags in the timing of transportation and industrial development.

Another difference between the scatterplot matrices of residential development (Figure 5.1) and industrial development (Figure 5.3) is the appearance of outlying points across the time periods. As discussed in the section on residential development, most of the outlying points occurred for larger transportation scores, until the 1990s. For industrial development, many more outlying points occur for smaller transportation scores, not just in the 1990s but throughout all the time periods. In the early 1970s (bottom left plot in the matrix), outliers occurred even for transportation scores of one and four. These outliers will be discussed in more detail later in this section.

One final point concerning the scatterplot matrix emerges from the plots below and to the right of the diagonal. These plots show the relationship between transportation and industrial development when industrial development precedes the time of the transportation scores. If we consider only the bottom row of plots in the matrix, the succession of plots from left to right should reveal changes in transportation in the time periods after industrial construction authorized in 1972. Therefore, if we hypothesize that industrial development directly causes transportation access for the MCD to be improved, then outlying points of high industrial value that occur at lower transportation scores in early time periods should gradually disappear as those MCDs' highway transportation scores rise. However, we can see that there continue to be a number of outlying points associated with lower transportation scores across all time periods. This pattern indicates that many of these MCDs that received major industrial development never experienced a rise in their highway transportation scores. This characteristic seems to distinguish non-metropolitan MCDs with their generally lower transportation scores from the MCDs inside the built-up metropolitan area.

In the scatterplot of highway transportation scores versus industrial development investment in the early 1980s (Figure 5.4), we see that outlying points exist for smaller and mid-range transportation scores as well as for the largest scores. There is still a positive correlation between the variables, but the coefficient of determination (r^2) for this regression line is 0.16 (Table 5.8), not quite as high as the coefficient values we found in the analysis of transportation scores and

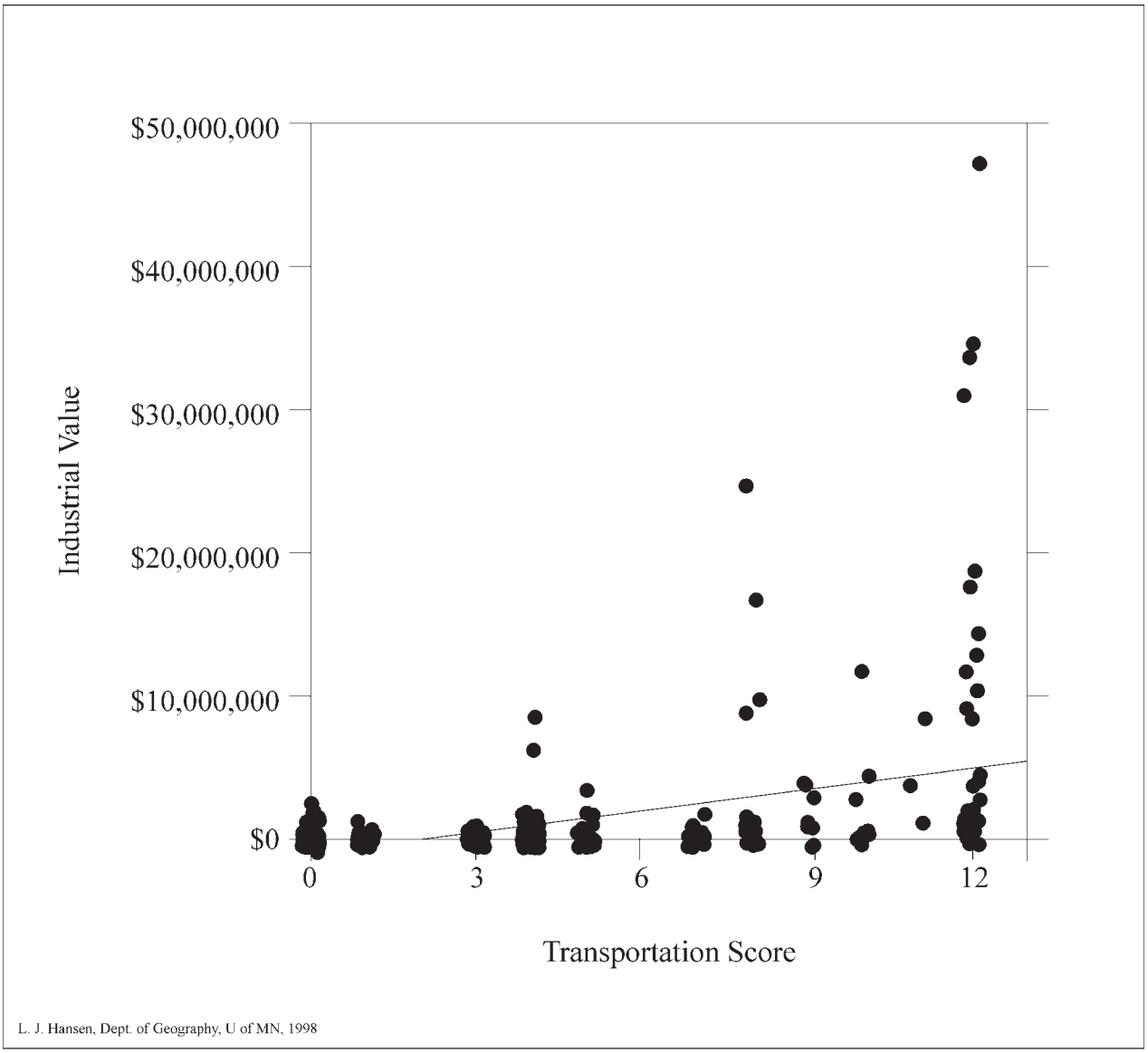


Figure 5.4. Scatterplot Showing Relationship Between Transportation and Industrial Value, 1980-84.

Data Source: U. S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

residential development activity. The coefficient values for transportation and industrial development are fairly consistent across time periods (ranging from 13 to 16 percent), until the 1990s when only eight percent of variation in industrial development can be explained by transportation. This result may reflect a tendency for industry to locate or expand in small, outlying cities that may not have high transportation scores, but may have just one or two

Table 5.8. Coefficient of Determination Values (r^2) from Regression Analysis of the Relationship Between Transportation and Industrial Value, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Industrial	1990-94					0.08
	1985-89				0.14	
	1980-84			0.16		
	1979		0.13			
	1972	0.14				

The p-value for each regression's F-statistic = 0.000.
Data Source: Calculations by authors.

important highway routes, and possibly a local population base from which to draw employees. In the 1990s, major industrial development occurred in Hutchinson (transportation score of four), Winsted (score of zero), Winthrop (score of four) and Rogers (score of seven).

The table of outliers (Table 5.9) shows a tendency for many major industrial developments to locate in places without high transportation scores, and in places removed from the central city and inner ring. Suburbs such as Chaska, Shakopee, and Fridley consistently receive more than their expected share of industrial development based on their transportation scores (4, 8, and 12, respectively). The fact that these suburbs cover a range of transportation scores seems to indicate that the location of industrial development does not depend solely on quality of local highway transportation accessibility, but on other factors as well (e.g., labor costs, property taxes, local government support, resistance to industrial development from users of adjacent land, and so forth).

Commercial Development and Transportation

Although we expect commercial land development within an MCD to be influenced by highway transportation facilities serving the MCD, we also expect other factors to be just as important in the location of commercial developments, such as residential density and consumer incomes in

Table 5.9. Outliers from Expected Trend, from Regression Analysis of the Relationship Between Transportation and Industrial Value, by Time Period.

	Transportation Score	Industrial Value	Predicted Industrial Value	Studentized Residual
1972				
St. Paul	12	$4,876,800	$658,013	8.2
Chaska	4	$3,592,600	$147,435	6.4
Fridley	12	$3,978,197	$658,013	6.2
Shakopee	8	$3,500,000	$402,724	5.7
New Hope	4	$3,086,161	$147,435	5.4
Eagan	8	$2,784,576	$402,724	4.3
Minneapolis	12	$2,988,400	$658,013	4.2
Bloomington	12	$2,502,519	$658,013	3.3
Brooklyn Park	10	$2,330,940	$530,368	3.2
Bayport	1	$1,718,000	($44,031)	3.1
1979				
St. Paul	12	$28,809,595	$2,223,888	16.5
Bloomington	12	$18,016,012	$2,223,888	7.5
Minneapolis	12	$11,157,993	$2,223,888	4.0
Eden Prairie	12	$11,138,690	$2,223,888	4.0
Fridley	12	$7,003,250	$2,223,888	2.1
Shakopee	8	$5,907,513	$1,298,933	2.0
Brooklyn Park	12	$5,813,989	$2,223,888	1.6
New Hope	8	$4,253,418	$1,298,933	1.3
Plymouth	12	$5,143,248	$2,223,888	1.3
Burnsville	12	$4,509,000	$2,223,888	1.0
1980-84				
St. Paul	12	$47,225,937	$4,912,726	11.9
Plymouth	12	$34,023,144	$4,912,726	7.5
Fridley	12	$33,146,644	$4,912,726	7.2
Minneapolis	12	$31,121,431	$4,912,726	6.6
Shakopee	8	$24,373,736	$2,962,480	5.3
Shoreview	12	$18,399,295	$4,912,726	3.3
Chanhassen	8	$16,414,500	$2,962,480	3.3
Bloomington	12	$17,277,250	$4,912,726	3.0
Eagan	12	$14,666,900	$4,912,726	2.4
Eden Prairie	12	$13,019,000	$4,912,726	2.0

Table 5.9 (continued)

	Transportation Score	Industrial Value	Predicted Industrial Value	Studentized Residual
1985-89				
Minneapolis	12	$63,106,483	$5,495,926	14.3
Plymouth	12	$38,939,933	$5,495,926	7.1
Chanhassen	8	$34,138,000	$3,345,045	6.5
Maple Grove	12	$36,014,549	$5,495,926	6.4
Bloomington	12	$31,858,687	$5,495,926	5.5
Eagan	12	$27,927,000	$5,495,926	4.6
Chaska	4	$14,094,283	$1,194,164	2.6
Mounds View	12	$16,599,805	$5,495,926	2.2
Brooklyn Park	12	$14,477,285	$5,495,926	1.8
Northfield	0	$7,180,285	($956,717)	1.6
1990-94				
Hutchinson	4	$22,170,062	$853,041	9.8
Winsted	0	$17,000,000	$56,190	7.4
Plymouth	12	$18,329,583	$2,446,743	6.9
Shakopee	8	$16,547,000	$1,649,892	6.4
Chaska	4	$9,749,984	$853,041	3.7
Maple Grove	12	$11,032,083	$2,446,743	3.6
Winthrop	4	$9,394,000	$853,041	3.6
Brooklyn Park	12	$10,583,634	$2,446,743	3.4
Little Canada	12	$10,035,000	$2,446,743	3.2
Rogers	7	$8,145,000	$1,450,680	2.8

Outliers are listed in order of magnitude of residual from expected value. Negative values appear in parentheses.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

the area, or the presence of office development and a consumer base of office workers. In fact, calculating Pearson's correlation coefficients for commercial development against other types of development does reveal strong positive relationships, especially with residential and office development. For example, in the early 1980s, the correlation coefficient for commercial development and residential development was 0.80, and 0.82 for commercial development and office development. Even the correlation coefficient for commercial and industrial development was 0.65. The correlation coefficients for commercial development with other types of land development were consistently around or above 0.5 for all time periods.

Thus, we may expect highway transportation scores to show a less direct influence on commercial development than they have on other types of development. High quality highway transportation opens up areas for residential development, and commercial development may follow. However, there is no question that commercial development (especially clustered, car-oriented commercial development) generates demand for improved highway transportation services. Commercial development also may lead to further commercial development in the same area. We see that commercial development values are about as variable as industrial values among places (Table 5.10, similar coefficients of variation), and that the maximum values of commercial development for some MCDs in a time period are quite extreme, reaching into the hundreds of millions of dollars.

The maximum values for commercial development building permits issued by individual MCDs are striking in the plots of the late 1980s and 1990s in the scatterplot matrix (Figure 5.5). The single highest commercial development value in the 1990s occurred in Bloomington (associated with the Mall of America) and in the late 1980s in St. Paul (associated with the World Trade building). These MCDs are only two of the 380 or so that reported commercial permit values. The correlation values between highway transportation scores and value of commercial development building permits issued reveal a moderate positive correlation once again (Table 5.11). The correlation values for the plots along the diagonal from lower left to upper right of the matrix range from 0.33 to 0.42. For the plots along the diagonal, the lowest correlation value (0.33) again occurs in the 1990s, and the highest (0.42) in the early 1980s.

Table 5.10. Descriptive Statistics for the Data on Commercial Value, by Time Period.

Time Period	Number of Cases	Maximum	Mean	Standard Deviation	Coefficient of Variation
1990-94	379	$126,136,499	$1,906,453	$7,912,193	4
1985-89	380	$128,707,151	$2,158,545	$8,885,779	4
1980-84	380	$28,046,261	$861,902	$3,119,299	4
1979	260	$12,752,835	$501,720	$1,602,580	3
1972	329	$10,862,895	$182,909	$924,108	5

Median Value for each time period = $0.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

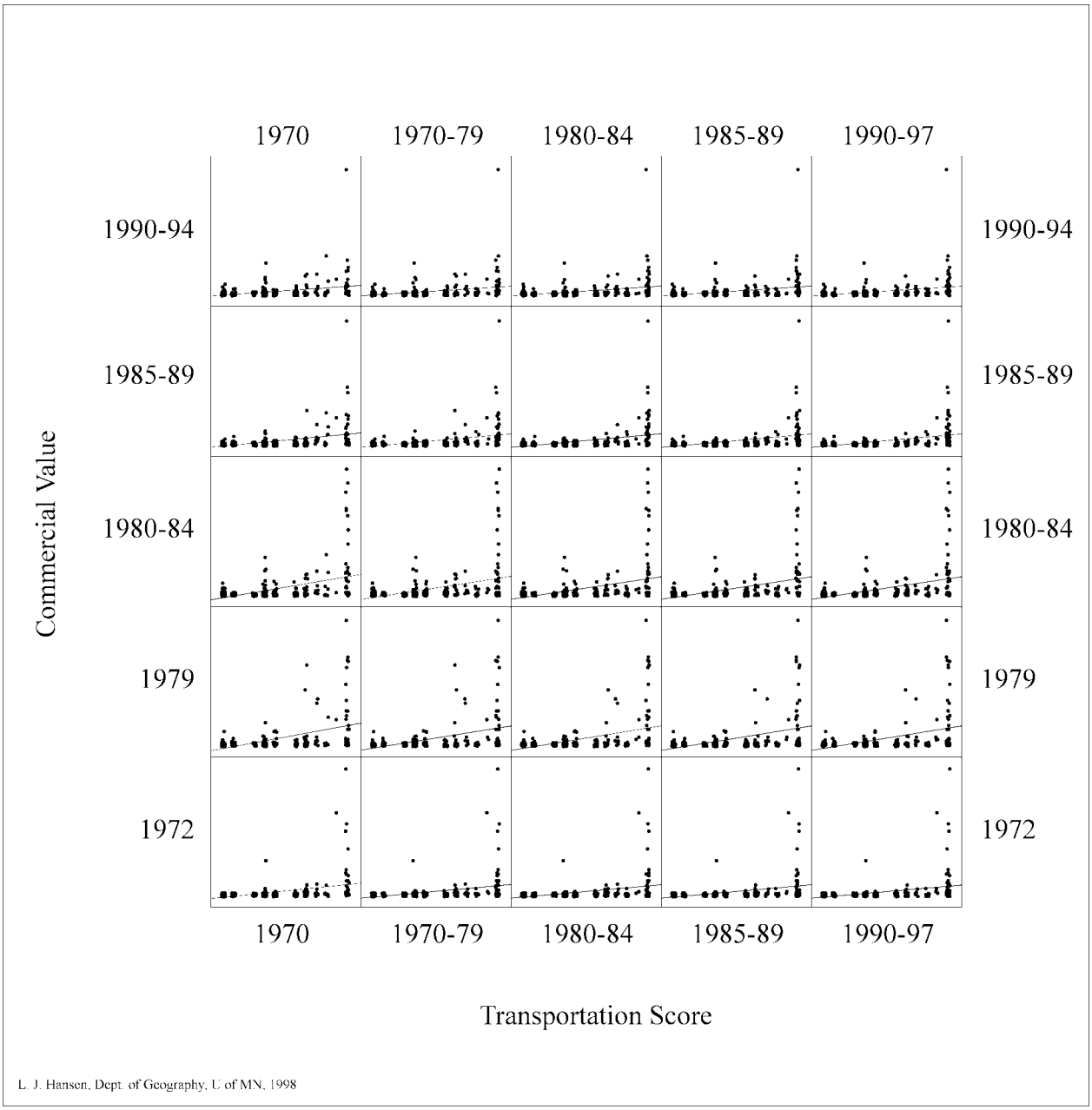


Figure 5.5. Scatterplot Matrix Showing Relationship Between Transportation and Commercial Value, by Time Period.

Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file.

Table 5.11. Correlation Values of the Relationships Between Transportation and Commercial Value, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Commercial	1990-94	0.33	0.32	0.33	0.34	*0.33*
	1985-89	0.40	0.39	0.40	*0.40*	0.40
	1980-84	0.44	0.42	*0.42*	0.42	0.42
	1979	0.45	*0.42*	0.43	0.43	0.43
	1972	*0.36*	0.34	0.33	0.33	0.33

Values are Pearson's correlation coefficients, r .
Data Source: Calculations by authors.

The highest correlation value in the matrix (0.45) occurs for the relationship between transportation in 1970 and commercial development in 1979. However, similarly high correlation values (0.43) occur for the relationships between commercial development in 1979 and transportation in the early 1980s, late 1980s, and even 1990s. This might lead us to hypothesize that high transportation access in 1970 led to commercial development in the late 1970s and early 1980s, which led to improved transportation access in the 1980s and 1990s. Again, it is difficult to prove causality in either direction, but we observe the circularity of the relationship between transportation and development.

The spread of points around the regression line for the early 1980s (Figure 5.6) contains a few outliers representing places with a transportation score of four, but again most of the major commercial developments occurred in places with the highest possible transportation score of 12 (and which probably also have large amounts of other types of development). The coefficient of determination (r^2) for this regression line is 0.18 (Table 5.12), indicating that 18 percent of the variation in commercial development can be explained by variations in highway transportation scores. This result is similar to the amount of industrial development explained by transportation scores. Both are much lower than the coefficients of determination for residential development as related to highway transportation scores.

Besides the extreme outliers of Bloomington in the 1990s and St. Paul in the late 1980s, many of the outliers are MCDs from various parts of the metropolitan area that have major malls or significant existing commercial developments, such as Roseville, Burnsville, Edina and

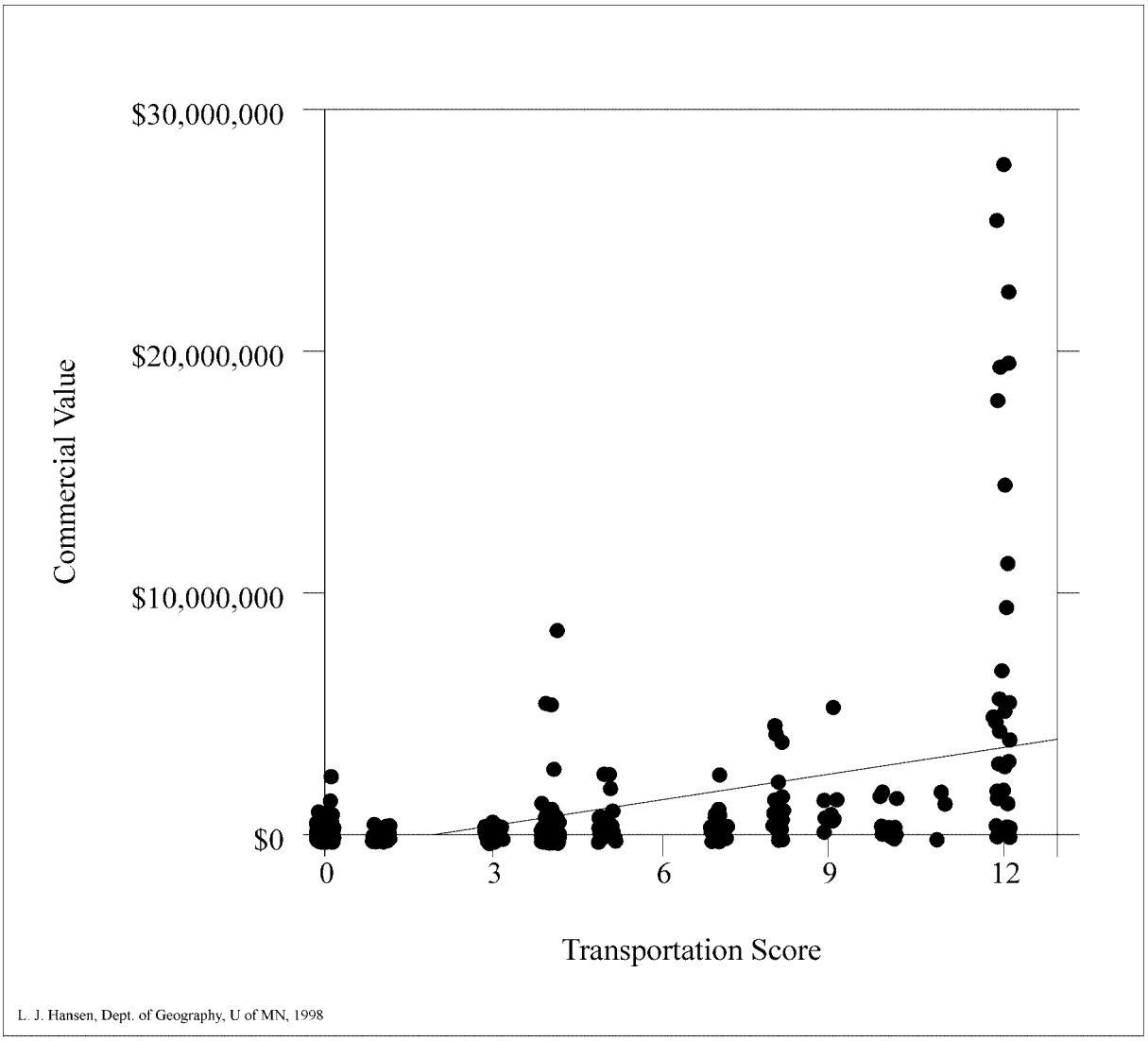


Figure 5.6. Scatterplot Showing Relationship Between Transportation and Commercial Value, 1980-84.

Data Source: U. S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

Maplewood (Table 5.13). Interestingly, two of the places with low transportation scores that were outliers in industrial development in the 1990s, Hutchinson and Winthrop, are also outliers in commercial development in the 1990s. Finally, the negative outliers in 1972 are places that failed to receive commercial development despite their high transportation scores. In cases like Eden Prairie, transportation infrastructure (a score of 12 in 1972) may have preceded residential development (the MCD is an outlier for office development and number of residential units added in 1979), which in turn preceded commercial development (also an outlier in commercial development in the early 1980s).

Table 5.12. Coefficient of Determination Values (r^2) from Regression Analysis of the Relationship Between Transportation and Commercial Value, by Time Period.

		Transportation				
		1970	1970-79	1980-84	1985-89	1990-97
Commercial	1990-94					0.11
	1985-89				0.17	
	1980-84			0.18		
	1979		0.18			
	1972	0.13				

The p-value for each regression's F-statistic = 0.000.
Data Source: Calculations by authors.

Office Development and Transportation

Office development locations are clearly the most sporadic among the four classes of development considered in this preliminary statistical analysis. Coefficients of variation (Table 5.14) disclose the values of office development to be much more highly variable from MCD to MCD than for any of the other types of development, with 1972 and the early 1990s the most variable of the five time periods. The maximum values of office development within a time period are also extremely large, reaching a maximum of $350 million.

These maximum values show up distinctively on the scatterplots (Figure 5.7). The data point removed from the rest in 1972 was St. Paul; for both the late 1980s and the 1990s it was Minneapolis. It is probable that office development depends upon locational factors in addition to highway transportation accessibility, such as proximity to other office development, corporate headquarters and so forth, since MCDs with the same transportation scores as the central cities failed to receive large amounts of office development. However, as highway transportation opens up new areas for real estate development, and as office technologies improve so that choice of advantageous geographic location for offices is less constrained, office developments may follow new or improved highway transportation routes. The development and occupation of newly-built offices may generate demand for additional transportation services, although it is unlikely that transportation scores are a function of office development.

Table 5.13. Outliers from Expected Trend, from Regression Analysis of the Relationship Between Transportation and Commercial Value, by Time Period.

	Transportation Score	Commercial Value	Predicted Commercial Value	Studentized Residual
1972				
Minnetonka	12	$10,862,895	$895,260	15.2
Edina	11	$7,304,800	$802,553	8.3
St. Paul	12	$6,326,869	$895,260	6.8
Blaine	12	$5,489,302	$895,260	5.6
Maplewood	12	$4,084,300	$895,260	3.8
West St. Paul	4	$2,865,000	$153,603	3.2
Roseville	12	$2,109,000	$895,260	1.4
Bloomington	12	$1,967,763	$895,260	1.3
New Brighton	12	$1,955,164	$895,260	1.2
Shoreview	12	$0	$895,260	-1.0
Woodbury	12	$0	$895,260	-1.0
Eden Prairie	12	$0	$895,260	-1.0
Pine Springs	12	$0	$895,260	-1.0
Mendota Heights	12	$0	$895,260	-1.0
1979				
Bloomington	12	$12,752,835	$1,699,357	8.7
St. Louis Park	12	$9,015,500	$1,699,357	5.3
Eagan	8	$8,253,000	$1,008,924	5.2
Burnsville	12	$8,624,502	$1,699,357	5.0
Plymouth	12	$8,459,483	$1,699,357	4.9
St. Paul	12	$7,849,228	$1,699,357	4.4
Shakopee	8	$5,501,600	$1,008,924	3.1
Minnetonka	12	$6,061,300	$1,699,357	3.1
Robbinsdale	9	$4,546,000	$1,181,532	2.3
Coon Rapids	9	$4,210,000	$1,181,532	2.1
1980-84				
St. Paul	12	$28,046,261	$3,547,977	9.7
Minneapolis	12	$25,328,286	$3,547,977	8.4
Minnetonka	12	$22,753,340	$3,547,977	7.3
Bloomington	12	$19,209,550	$3,547,977	5.8
Roseville	12	$19,102,000	$3,547,977	5.8
Eden Prairie	12	$17,752,200	$3,547,977	5.2
Burnsville	12	$14,472,612	$3,547,977	4.0
Hutchinson	4	$8,789,006	$730,286	2.9
Maplewood	12	$11,011,455	$3,547,977	2.7
Brooklyn Park	12	$9,253,810	$3,547,977	2.0

	Transportation Score	Commercial Value	Predicted Commercial Value	Studentized Residual
1985-89				
St. Paul	12	$128,707,151	$9,490,482	22.6
Plymouth	12	$58,307,855	$9,490,482	6.3
Minneapolis	12	$52,195,340	$9,490,482	5.5
Eagan	12	$34,726,900	$9,490,482	3.2
Brooklyn Park	12	$30,672,787	$9,490,482	2.6
Roseville	12	$29,245,367	$9,490,482	2.5
Burnsville	12	$28,000,273	$9,490,482	2.3
Edina	11	$27,037,960	$8,526,421	2.3
Maplewood	12	$26,409,589	$9,490,482	2.1
Eden Prairie	12	$22,333,000	$9,490,482	1.6
1990-94				
Bloomington	12	$126,136,499	$7,296,965	28.3
Brooklyn Park	12	$38,872,624	$7,296,965	4.4
Winthrop	4	$30,737,519	$1,604,164	4.0
Plymouth	12	$33,103,889	$7,296,965	3.5
Burnsville	12	$25,703,990	$7,296,965	2.5
Minneapolis	12	$25,313,600	$7,296,965	2.4
Roseville	12	$23,993,590	$7,296,965	2.3
Hutchinson	4	$13,659,414	$1,604,164	1.6
Shakopee	8	$16,435,335	$4,450,564	1.6
Eagan	12	$19,127,000	$7,296,965	1.6

Outliers are listed in order of magnitude of residual from expected value.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

Statistical relationships between highway transportation infrastructure and office development appear quite different from the statistics for the other types of real estate development (Figure 5.7). Significant office-building activity occurs only in MCDs with high transportation scores, and almost all outlying points from the expected trend occur only in places with the highest transportation score. The correlation values for the plots along the diagonal of the matrix range from 0.18 to 0.32 (Table 5.15), much lower than the correlation values for transportation scores and any other type of real estate development. The highest correlation value in the matrix (0.34) occurs for the relationship between highway transportation scores in 1970 and office development in 1979 and the early 1980s. Similar correlation values (0.28 to 0.32) occur for

Table 5.14. Descriptive Statistics for the Data on Office Value, by Time Period.

Time Period	Number of Cases	Maximum	Mean	Standard Deviation	Coefficient of Variation
1990-94	379	$350,475,800	$1,938,756	$18,454,916	10
1985-89	380	$314,951,312	$3,036,553	$20,064,083	7
1980-84	380	$191,314,171	$2,658,235	$16,061,448	6
1979	260	$51,628,482	$857,946	$4,245,929	5
1972	329	$29,082,106	$174,429	$1,693,934	10

Median Value for each time period = $0.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

most of the plots in the matrix, except for those associated with office development in 1972 or the 1990s (which are very low, 0.18 to 0.19). Overall, there appears to be only a rather weak positive correlation between transportation and office development.

The scatterplot of transportation scores and permit values for office development for the early 1980s (Figure 5.8) reinforces our interpretation of the minimal relationship between these two variables. All significant activity occurs in places with transportation scores of 11 and 12. Regression analysis yields very low coefficients of determination (r^2) (Table 5.16). The highest value occurs for both 1979 and the early 1980s, but indicates that only 10 percent of the variation in office development can be explained by variations in highway transportation scores. In 1972, this proportion is only 4 percent, and in the 1990s a mere 3 percent of the variation in levels of office development among MCDs can be explained by variation in highway transportation scores.

The table of outliers (Table 5.17) reflects the extreme range and variability of values of office development. Many places are considered negative outliers because they received no office development despite their high transportation scores. However, the extreme positive outliers also are places with high transportation scores, which received office development at a level many times higher than expected [14]. The only outliers with transportation scores less than 11 or 12 for any of the time periods are Chaska and Northfield, both in the 1990s, and both receiving more office development than would be expected from their low transportation scores (4 and 0, respectively).

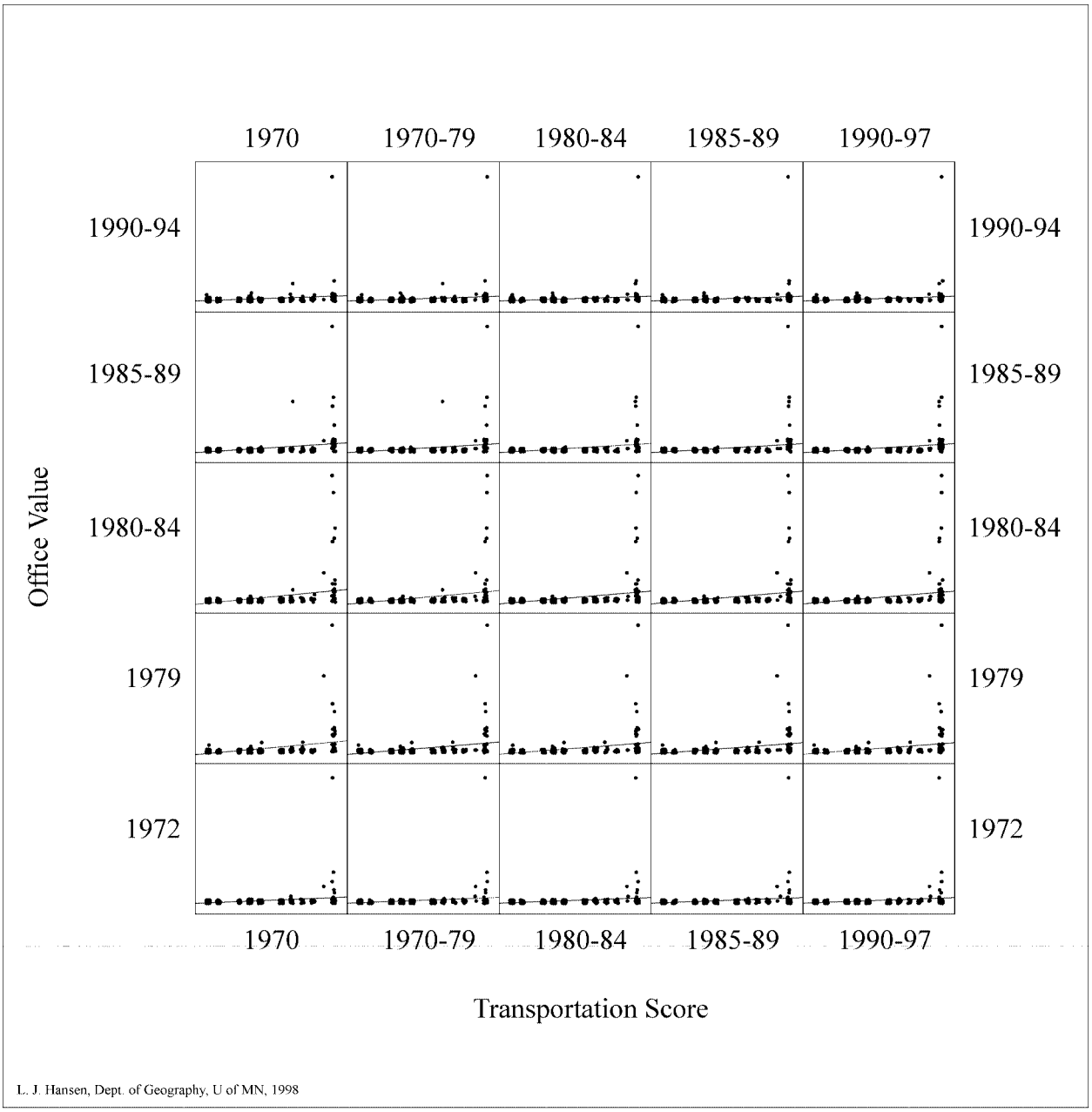


Figure 5.7. Scatterplot Matrix Showing Relationship Between Transportation and Office Value, by Time Period.

Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file.

Table 5.15. Correlation Values of the Relationships Between Transportation and Office Value, by Time Period.

Office \ Transportation	1970	1970-79	1980-84	1985-89	1990-97
1990-94	0.19	0.18	0.19	0.18	*0.18*
1985-89	0.30	0.28	0.29	*0.29*	0.29
1980-84	0.34	0.32	*0.32*	0.32	0.31
1979	0.34	*0.31*	0.31	0.30	0.30
1972	*0.21*	0.19	0.19	0.19	0.19

Values are Pearson's correlation coefficients, r .
Data Source: Calculations by authors.

HIGHWAY TRANSPORTATION AND REAL ESTATE DEVELOPMENT: A SUMMARY

In this section we analyzed statistically the relationship between MCD highway transportation access scores and four classes of real estate development within MCDs. The results of the correlation analysis indicate that each type of development (residential, industrial, commercial, and office) is positively correlated with highway transportation accessibility at the MCD-scale as measured by a 13-point scoring system, as well as with all other types of development. Residential development is the most strongly correlated with transportation scores, while office development is least correlated. Industrial and commercial development are both moderately correlated with highway transportation scores.

We used simple linear regression analysis to investigate the degree of causality in the relationship between highway transportation and development, and through this single-variable analysis found transportation to be a statistically significant explanatory variable for each type of development, for each of the five times periods under investigation. Transportation is a strong explanatory variable in predicting the amount of residential development, although it is quite weak in predicting the amount of office development. The interrelationships among (and the clustering of) residential, industrial, commercial, and office development warrant further investigation, as non-transportation-related variables also may prove to be important in accounting for real estate development patterns.

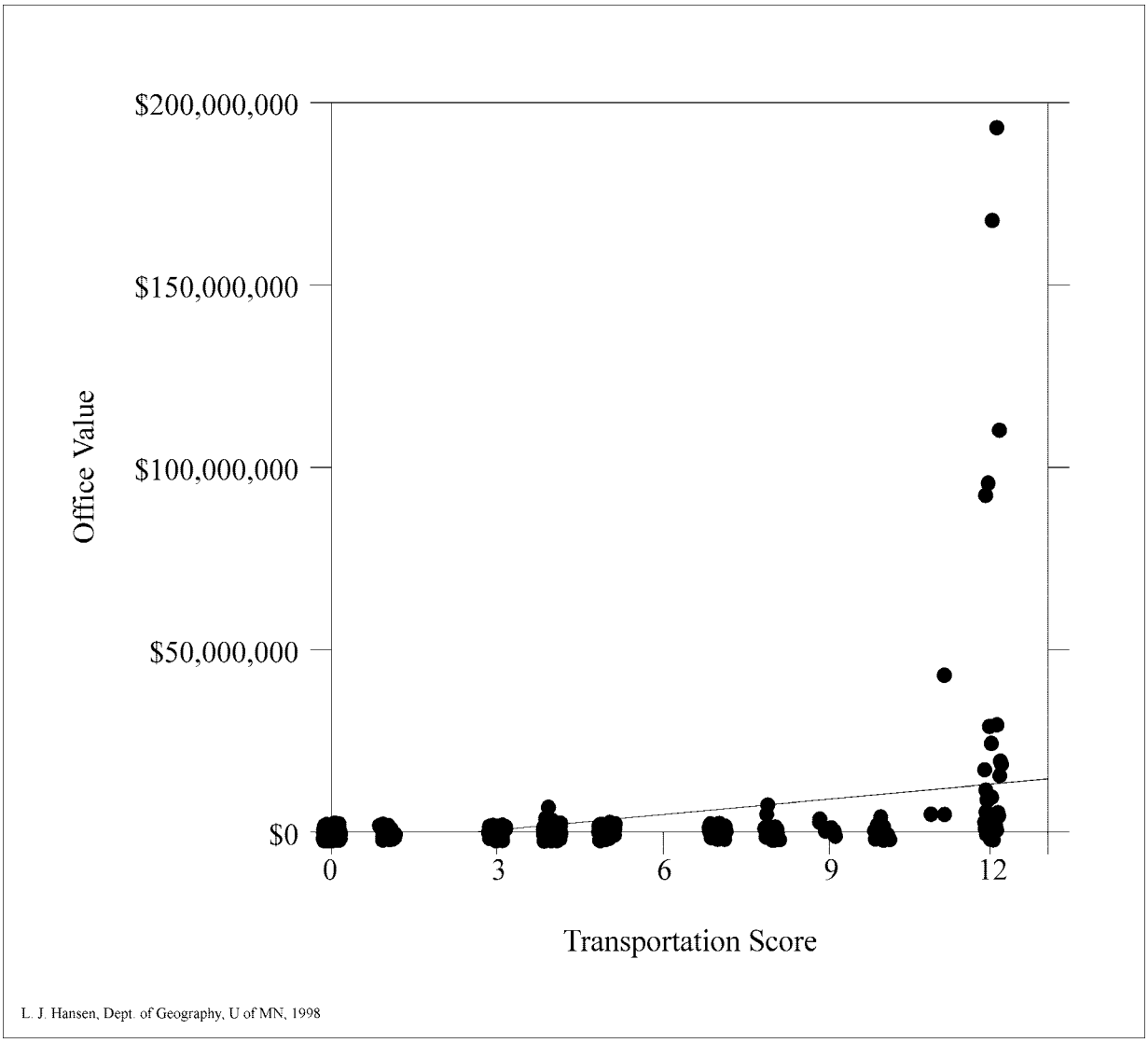


Figure 5.8. Scatterplot Showing Relationship Between Transportation and Office Value, 1980-84.
Data Source: U. S. Department of Commerce, Bureau of the Census, 1980-84 Non-Residential Building Permits, tape file.

Not surprisingly, our statistical analysis fails to definitively settle the question of whether transportation improvements lead or lag development. However, it does illuminate specific characteristics of the relationship of transportation access with different types of development, and reveals the importance of transportation access as an explanatory variable in the development process.

Table 5.16. Coefficient of Determination Values (r^2) from Regression Analysis of the Relationship Between Transportation and Office Value, by Time Period.

Office \ Transportation	1970	1970-79	1980-84	1985-89	1990-97
1990-94					0.03
1985-89				0.09	
1980-84			0.10		
1979		0.10			
1972	0.04				

The p-value for each regression's F-statistic = 0.000.
Data Source: Calculations by authors.

The foregoing analysis invites further investigation into relationships between transportation and different types of development, as well as with additional variables such as population, population change, and population density. In the next section, we consider these additional variables. The refinement or disaggregation of the "transportation access" variable will be addressed in a later report in this series.

TRANSPORTATION SCORES, LAND DEVELOPMENT, MCD POPULATION, AND POPULATION CHANGE

The original question posed in our statistical analysis was whether the quality of highway transportation infrastructure assessed at the scale of the MCD led or lagged real estate development within MCDs. In this section we elaborate this question with additional queries:

•Does the quality of highway transportation infrastructure serving an MCD account for more development than its *area,* its *population,* its rate of *population growth,* or its *population density*?

•Do the statistical relationships between transportation scores and levels of real estate development *vary by location* within the greater Twin Cities region such that there is a stronger transportation/development relationship in MCDs to the south and west than in MCDs in sectors to the north and east?

Table 5.17. Outliers from Expected Trend, from Regression Analysis of the Relationship Between Transportation and Office Value, by Time Period.

	Transportation Score	Office Value	Predicted Office Value	Studentized Residual
1972				
St. Paul	12	$29,082,106	$923,907	52.7
Bloomington	12	$7,044,451	$923,907	3.8
Minneapolis	12	$4,995,957	$923,907	2.5
Edina	11	$3,783,300	$826,368	1.8
Brooklyn Center	12	$2,759,235	$923,907	1.1
St. Louis Park	12	$2,330,000	$923,907	0.9
Burnsville	12	$0	$923,907	-0.6
Shoreview	12	$0	$923,907	-0.6
Pine Springs	12	$0	$923,907	-0.6
Eden Prairie	12	$0	$923,907	-0.6
New Brighton	12	$0	$923,907	-0.6
Arden Hills	12	$0	$923,907	-0.6
Woodbury	12	$0	$923,907	-0.6
Inver Grove Heights	12	$0	$923,907	-0.6
Little Canada	12	$0	$923,907	-0.6
Newport	12	$0	$923,907	-0.6
Plymouth	12	$11,520	$923,907	-0.6
Roseville	12	$50,000	$923,907	-0.5
Fridley	12	$58,463	$923,907	-0.5
1979				
Minneapolis	12	$51,628,482	$3,234,544	18.3
Edina	11	$31,538,675	$2,892,018	7.9
St. Paul	12	$19,689,000	$3,234,544	4.2
St. Louis Park	12	$16,513,064	$3,234,544	3.4
Maplewood	12	$9,177,936	$3,234,544	1.5
Eden Prairie	12	$9,079,000	$3,234,544	1.5
Blaine	12	$8,767,677	$3,234,544	1.4
Minnetonka	12	$7,956,000	$3,234,544	1.2
Roseville	12	$7,300,000	$3,234,544	1.0
Plymouth	12	$7,066,000	$3,234,544	1.0

Table 5.17 (continued)

	Transportation Score	Office Value	Predicted Office Value	Studentized Residual
1980-84				
Minneapolis	12	$191,314,171	$13,100,000	14.8
Bloomington	12	$167,002,597	$13,100,000	11.9
Minnetonka	12	$109,627,740	$13,100,000	6.7
Eden Prairie	12	$98,067,334	$13,100,000	5.8
St. Paul	12	$90,761,024	$13,100,000	5.3
Edina	11	$42,722,857	$11,700,000	2.1
Burnsville	12	$30,469,376	$13,100,000	1.1
Arden Hills	12	$26,525,000	$13,100,000	0.9
Pine Springs	12	$0	$13,100,000	-0.9
Blaine	12	$0	$13,100,000	-0.9
Richfield	12	$38,000	$13,100,000	-0.9
1985-89				
Minneapolis	12	$314,951,312	$15,000,000	26.7
Bloomington	12	$139,043,083	$15,000,000	6.9
Eagan	12	$122,404,000	$15,000,000	5.9
St. Paul	12	$111,016,335	$15,000,000	5.2
Eden Prairie	12	$59,914,000	$15,000,000	2.4
Golden Valley	12	$31,653,722	$15,000,000	0.9
Pine Springs	12	$0	$15,000,000	-0.8
Forest Lake Township	12	$0	$15,000,000	-0.8
Mounds View	12	$116,203	$15,000,000	-0.8
Lino Lakes	12	$283,000	$15,000,000	-0.8
Forest Lake	12	$313,500	$15,000,000	-0.8
1990-94				
Minneapolis	12	$350,475,800	$8,856,563	85.5
Maplewood	12	$52,983,774	$8,856,563	2.5
Eagan	12	$43,632,000	$8,856,563	1.9
Chaska	4	$18,763,893	$1,550,819	0.9
Northfield	0	$11,297,784	($2,102,053)	0.7
Mendota Heights	12	$19,879,409	$8,856,563	0.6
Woodbury	12	$0	$8,856,563	-0.5
Mounds View	12	$0	$8,856,563	-0.5
Forest Lake Township	12	$0	$8,856,563	-0.5
Pine Springs	12	$0	$8,856,563	-0.5
Lake Elmo	12	$0	$8,856,563	-0.5
Lino Lakes	12	$262,000	$8,856,563	-0.5
Newport	12	$674,334	$8,856,563	-0.5
Hopkins	11	$10,000	$7,943,345	-0.4

Outliers are listed in order of magnitude of residual from expected value. Negative values appear in parentheses.
Data Source: U. S. Department of Commerce, Bureau of the Census, Non-Residential Building Permits, tape file. Calculations by authors.

•Does the quality of an MCD's highway infrastructure play more of a role in residential and commercial development than it does in industrial and office development when other variables are taken into consideration?

Variables Used in the Expanded Statistical Analysis

Population and Population Change. Populations of MCDs were obtained from the U.S. Census of Population and Housing for decennial census years 1970, 1980 and 1990. Population change was calculated for the two-decade period 1970 to 1990.

MCD Area. Areas of MCDs were obtained from the 1990 Census of Population and Housing. For purposes of this preliminary analysis, areas were assumed not to have changed over the study period.

MCD Population Density. Population density values for each MCD were derived by dividing MCD population in various decennial census years by MCD area.

Highway Infrastructure Access Scores. Highway access for each MCD was rated on the same 13-point scale as used in the previous analysis (Table 5.1).

Sectoral Locations within the Twin Cities Metro Area. Each of the 631 MCDs was defined as located within one of four geographical sectors of the greater Twin Cities region. The Minnesota and Mississippi Rivers were used as dividing lines, along with a line to the northeast that roughly matched the route of highway I-35E/I-35 north of St. Paul. Four dummy variables identified the four sectors: (1) west of the Mississippi River and north of the Minnesota River ("West"); (2) south of the Minnesota River and west of the Mississippi River ("South"); (3) east of I-35 and east of the Mississippi River ("East"); and (4) west of I-35 and east of the Mississippi River north of Minneapolis ("North") (Figure 5.9).

Building Permit Data. Permit data for residential, commercial, industrial and office development for each MCD were the same data used in the previous analysis. The residential permits report number of housing units authorized. The other three classes report the value of new construction authorized in current dollar terms.

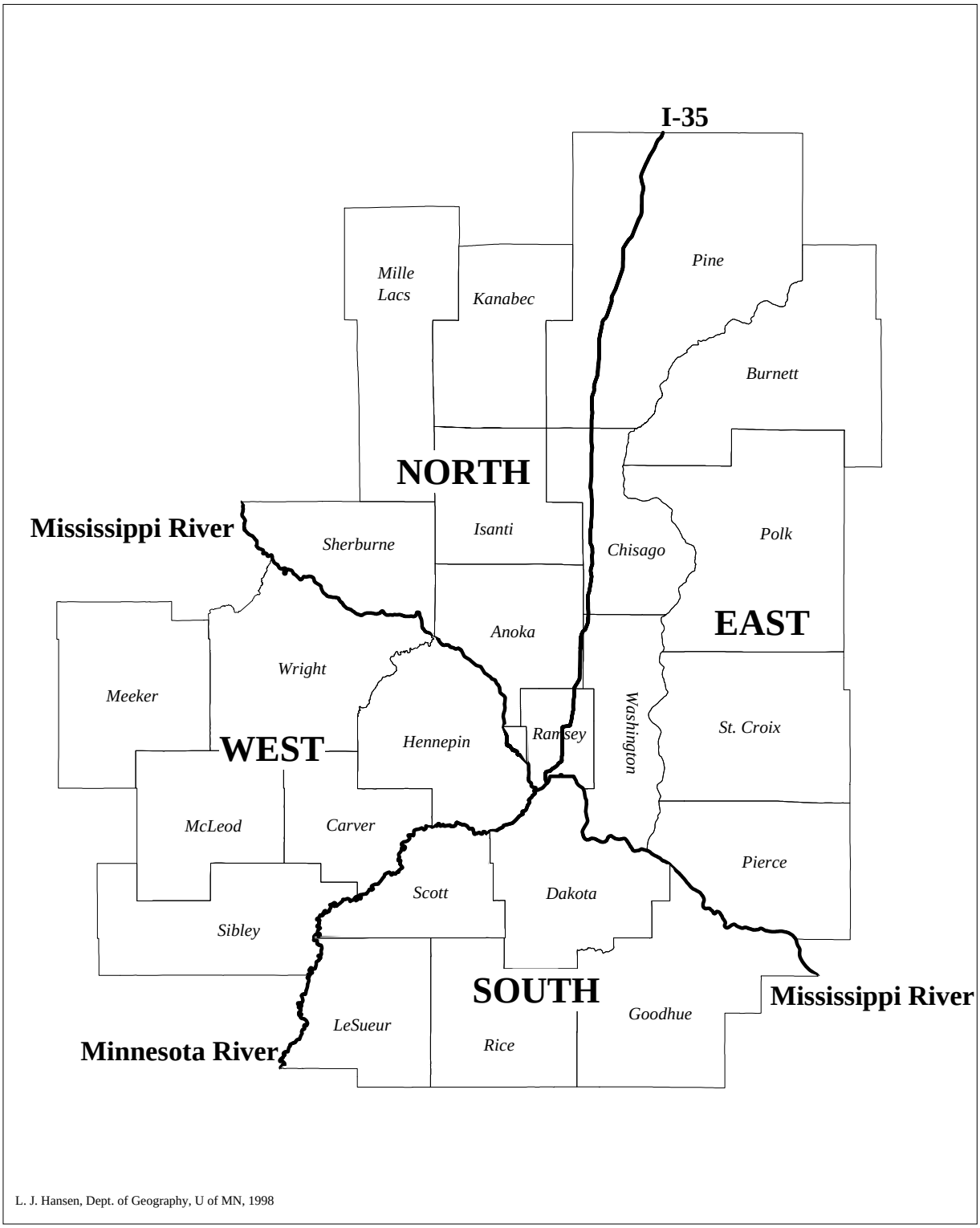


Figure 5.9. Sectoral Locations within the Twin Cities Metro Area.

Correlation Analysis

The correlation analysis that follows focuses on nine independent variables (MCD population, MCD population change, MCD area, MCD population density, MCD highway accessibility score, and four dummy variables specifying MCD geographical location), and the four dependent variables in the form of levels of land development (residential, industrial, commercial, office) during five different time periods.

Development and MCD Area. Correlations between levels of development and MCD areal size did not differ markedly across types of development, but all non-residential development had peak correlations in the periods 1980-84 or 1985-89, followed by sharp drops in correlations in the early 1990s (Figure 5.10). Correlations ranged from about 0.35 for residential in 1979 to a low of about 0.10 for commercial development in 1972. These results indicate that bigger MCDs do not automatically receive larger volumes of new development.

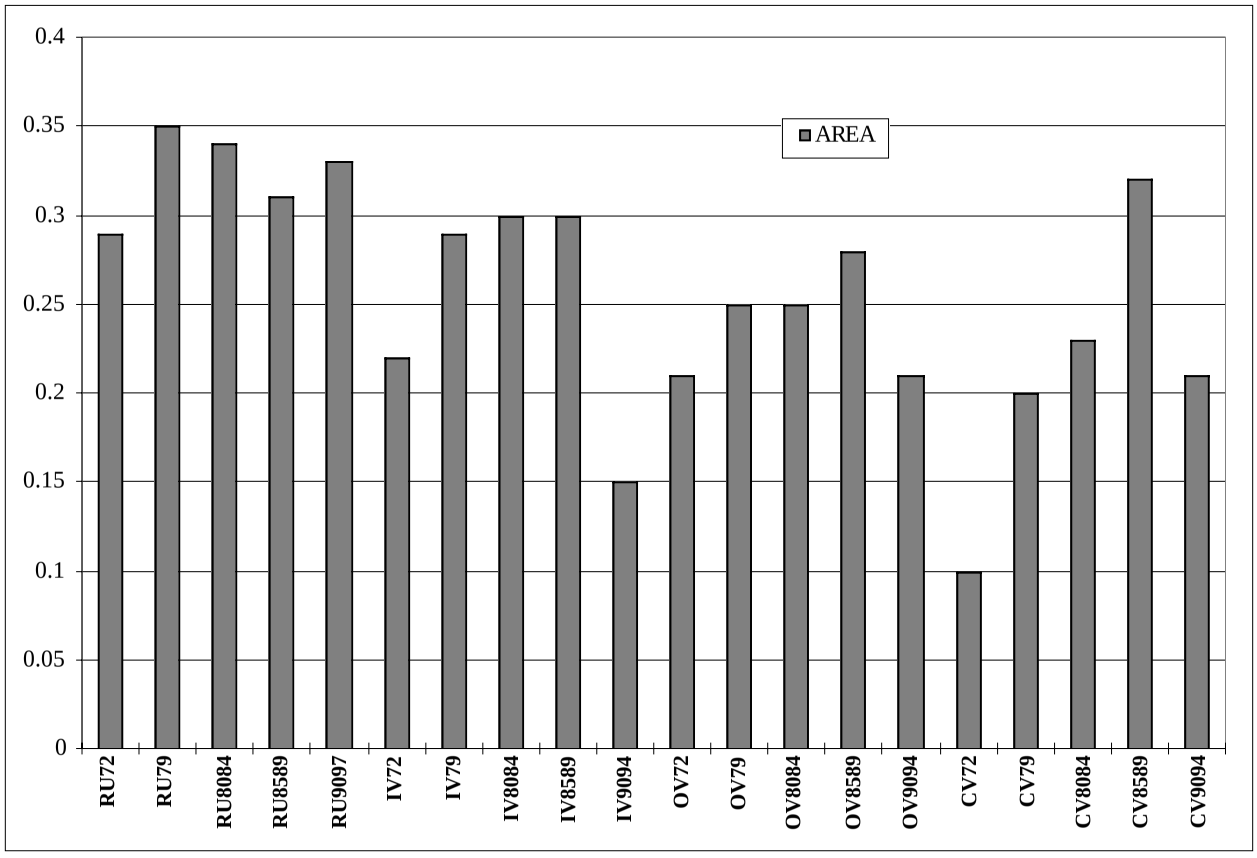


Figure 5.10. Correlations Between MCD Area and Four Types of Development, 1972, 1979, 1980-84, 1985-89, and 1990-94.

Data Source: Calculations by authors.

Development and MCD Population Density. Whereas correlations between rates of MCD land development and MCD area differ little from one class of development to another, population density correlates differently with different types of development (Figure 5.11). For *industrial* development, the correlation between population density and volume of development is consistently lowest (although positive) in each of the five time periods. For *office* development, the correlation with population density reaches a peak of 0.4 in the 1980-84 period, with much lower numbers in other periods. This result may occur because office development tends to concentrate in already developed MCDs, so that variations in office development would not be associated with variations in population density. MCD *commercial* development in 1972 had the highest correlations with MCD population density, with the correlations dropping sharply for commercial developments of the 1980s and 1990s. The decline in correlations in the later periods may reflect large-scale commercial activity seeking ever larger sites farther out from the built-up urbanized area along with the larger facilities drawing clientele from ever wider trade areas. To the extent that this phenomenon occurs, the correlations between density and commercial permit values will diminish.

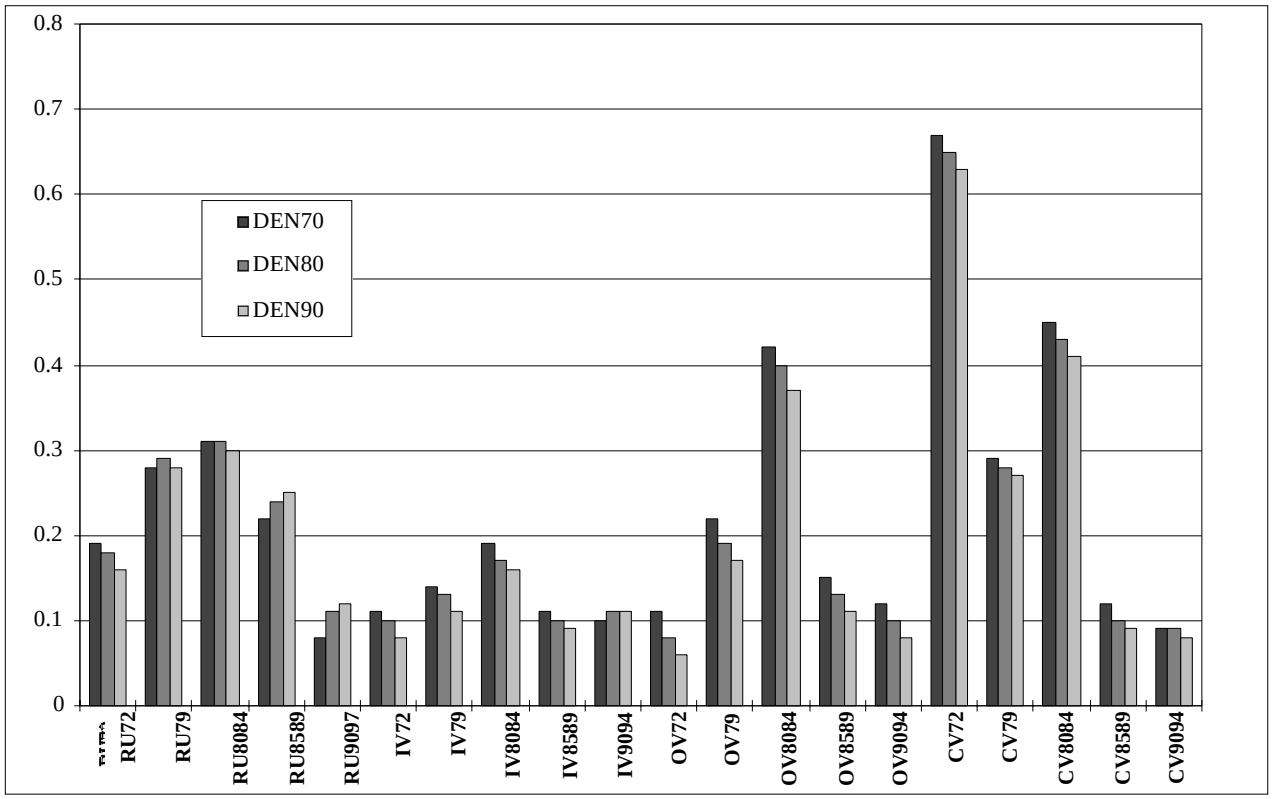


Figure 5.11. Correlations Between MCD Population Densities in 1970, 1980, and 1990; and Four Types of Development, 1972, 1979, 1980-84, 1985-89, and 1990-94.
Data Source: Calculations by authors.

Residential development is the only one of the four types of land development for which 1970 population density matters more for development in the 1970s, and 1990 density matters more for development in the 1990s. Residential development correlations with population density are generally lower than those for commercial and office developments, but exceed those for industrial development.

Development, MCD Population, and Population Change. As we expect, MCD *population* correlations with MCD development levels are similar to *density* correlations with development, except that the correlation coefficients fluctuate around 0.70 rather than around 0.30 (Figure 5.12). The correlations report that MCDs with large populations generally experience more development than places with small populations. In the 1990s, however, the correlations indicate that levels of new development (with the exception of office) are much less tied to MCD population levels. Office development activity in the period 1985-89 actually approaches a 90-percent correlation with 1990 MCD population size.

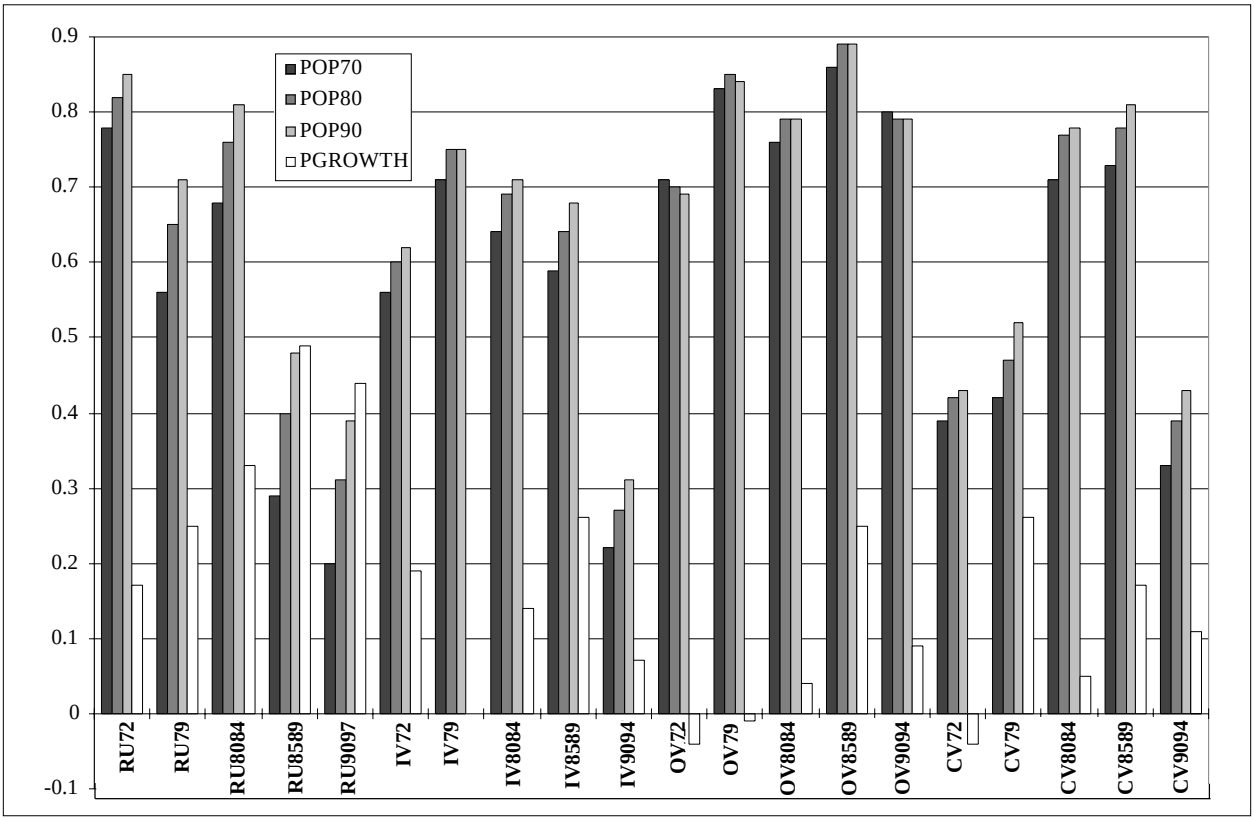


Figure 5.12. Correlations Between MCD Population in 1970, 1980, 1990, and MCD Population Change 1970-90; and Four Types of Development, 1972, 1979, 1980-84, 1985-89, and 1990-94 .

Data Source: Calculations by authors.

Population change between 1970 and 1990 is much less highly correlated with development than is MCD population, except in the case of new residential units authorized by permit. In the last two time periods, 1985-89 and 1990-97, population change and new housing units authorized were closely correlated.

Development, Highways, and Highway Improvements. Highway transportation accessibility scores varied little from 1970 onward, nevertheless the correlations between MCD highway transportation accessibility scores and MCD residential and commercial development over the study period were noteworthy (Figure 5.13). Correlations with industrial development were lower, and with office development they were lowest of all four development types.

Transportation accessibility scores had their highest correlations with residential development. For example, residential development at the MCD scale in 1979 was closely correlated with MCD transportation scores in 1970 (r=0.50), as well as with scores for highway improvements

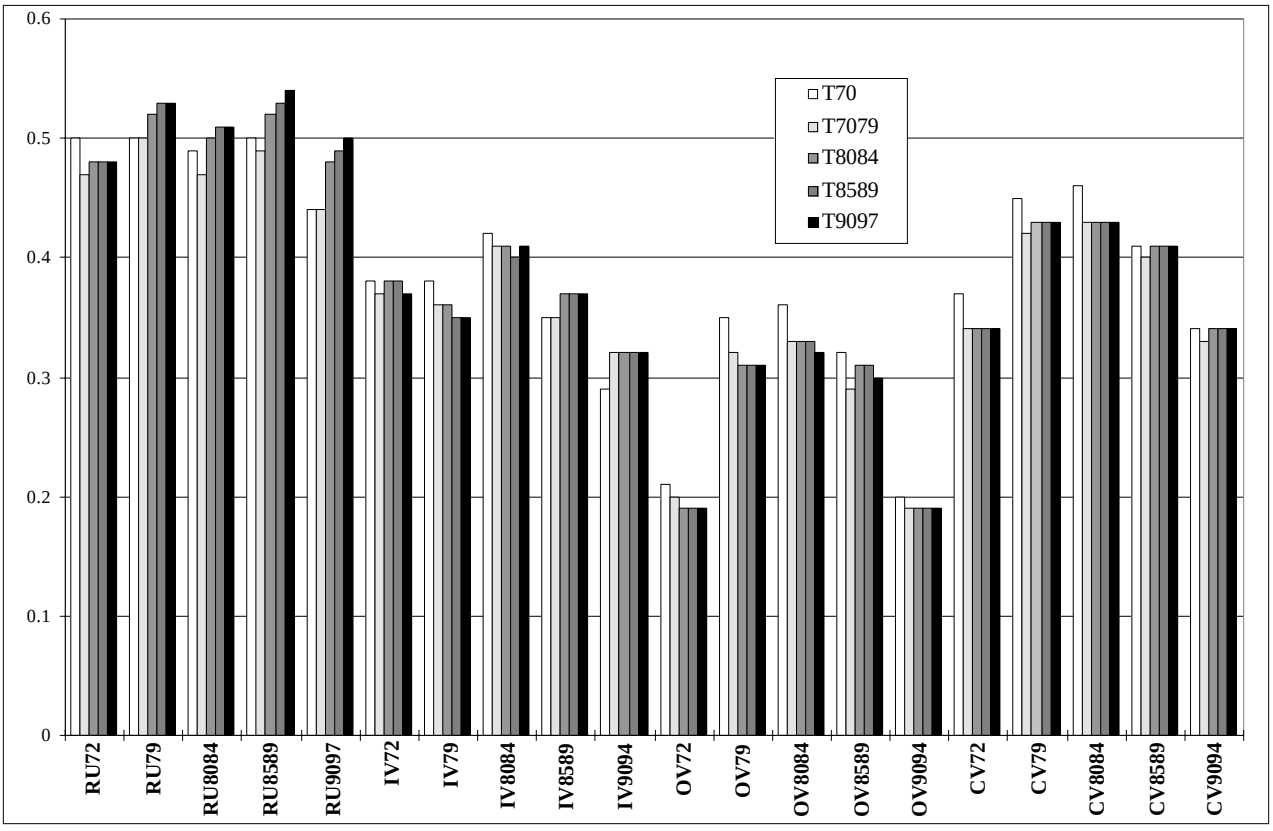


Figure 5.13. Correlations Between MCD Highway Transportation Access Scores in 1972, 1979, 1980-84, 1985-89, and 1990-94; and Four Types of Development, 1972, 1979, 1980-84, 1985-89, and 1990-94.
Data Source: Calculations by authors.

1970-79 (r=0.50); but residential development in 1979 was even more highly correlated with highway improvements added in the 1980s and the 1990s.

Transportation accessibility scores had their most conspicuous correlations with commercial development levels of 1979 and the decade of the 1980s. Transportation accessibility scores for 1970 display slightly higher correlations with commercial and office developments of 1972, 1979, and the early 1980s than with transportation scores of the late 1980s and 1990s, implying that the highway system in place in 1970 was influential in the location of major commercial developments that followed. Correlations are well below r=0.50, however, so it is evident that other factors were at work in directing the location of commercial activity in this time period.

Industrial development and transportation accessibility and improvements showed significant correlations during the study period, ranging from about r=0.30 to r=0.40 or more, although the correlations declined to their lowest levels by the 1990s. On the basis of the correlations, MCD transportation scores seemed to neither lead nor lag MCD industrial development.

Office development generally had the lowest correlations with transportation accessibility and highway improvement scores. Correlations were lowest across the board for the early 1970s and the early 1990s–years associated with general business recessions, which may have had more to do with the nature and location of office developments than did transportation accessibility scores at those times.

Development by Geographical Sector. Correlations between geographical sector of development and type of development disclose a slight difference between the west and the east sides of the greater Twin Cities area (Figure 5.14). The highest correlation coefficient is a modest +0.20 for office development in 1980-84 and industrial development in 1990-94 in the western sector, and the lowest is about -0.18 for residential development in the eastern sector during the 1990-97 period. Neither the northern nor southern sectors ever display a correlation coefficient higher than +0.10 or lower than -0.10.

To summarize, these correlations suggest that (1) MCD population is the most important indicator of absolute levels of real estate development, followed by (2) highway transportation accessibility (as discussed earlier), with (3) MCD population density and (4) MCD area of equal importance, and (5) geographic sector of only marginal significance.

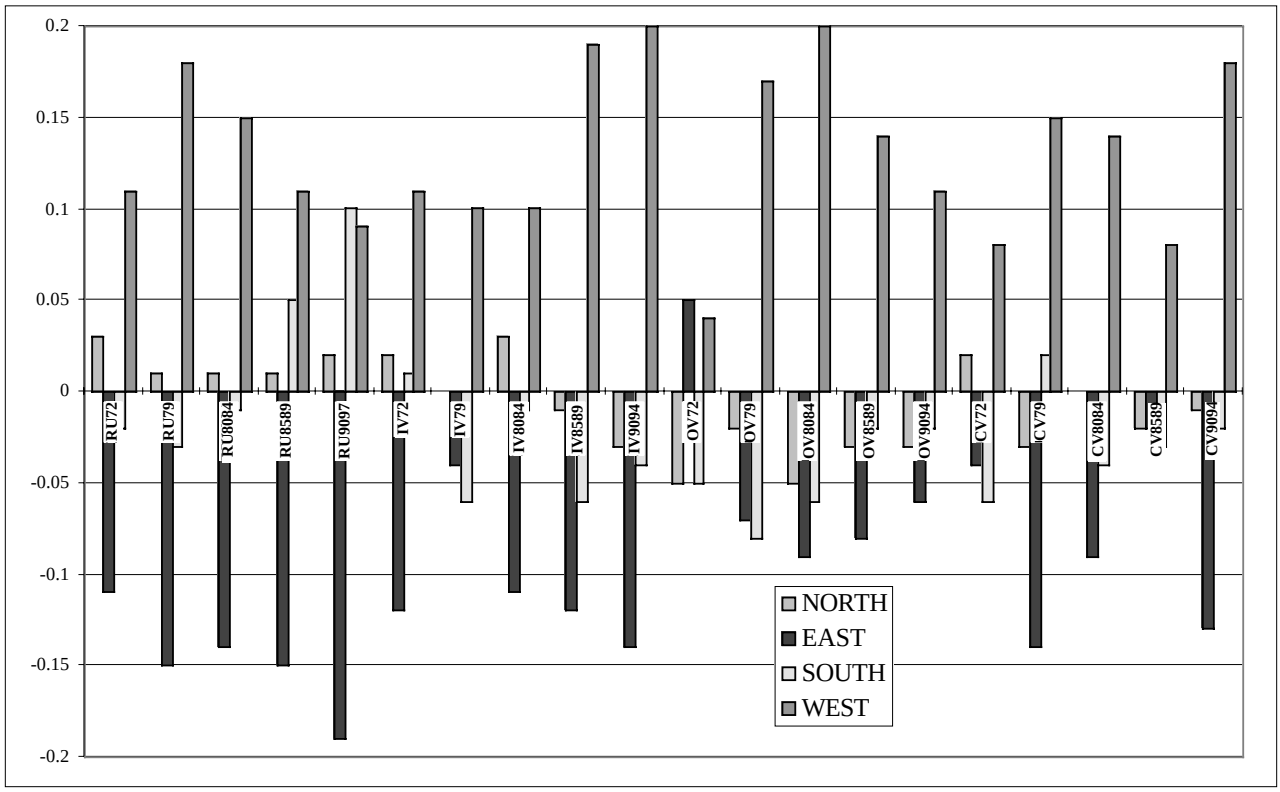


Figure 5.14. Correlations Between Sectoral Location Within the Greater Twin Cities Area; and Four Types of Development, 1972, 1979, 1980-84, 1985-89, 1990-94.

Data Source: Calculations by authors.

REGRESSION ANALYSIS

Regression analysis was initially carried out for all four types of land development using all nine independent variables described above. Since the first two time periods for which we had data were only single years (1972 and 1979), they were excluded from the regression analysis because there was no way to verify that those two specific years were representative of the earlier and later halves of the 1970s.

The scoring system used for measuring MCD highway accessibility does not permit a comprehensive examination of the lead/lag question, because only 42 MCDs of the 631 MCDs changed their scores over the 27-year study period. In other words, more than 93 percent of the MCDs retained the same score throughout the study period. Therefore, including more than one time period's highway transportation score in the regression analysis turned out not to be useful due to the extremely high correlation of one period's score with that of later periods.

The 42 MCDs that saw their highway infrastructure scores change during the study period are fairly well distributed in terms of location, size, and population, although there is some concentration within the second-ring suburbs. Further detailed analysis of only these 42 places might shed additional light on the lead/lag question.

The low number of MCDs that changed access scores is in part a product of our research design, and partly a product of the geography of our study area. We considered changes in primary arterials only, which limited the number of MCDs out of the 631 that either contained or were adjacent to either an existing or upgraded highway during the study period. Thus a large number of MCDs (129) began with a score of zero in 1970 and kept that score through 1997. On the other end of the scale, 26 MCDs began with the top possible score of 12 in 1970, and so the effect of road upgrades in or near those MCDs is masked. These 26 tend to be inside the already built-up metropolitan core area. Beyond that area primary arterials form a general pattern of spokes radiating in all directions from the center, with the majority of our MCDs connected to them by lesser roads in the interstices, which do not register within our scoring system.

A few further caveats about the regression analysis must be mentioned:
• Neither level of development within an MCD in 1970 nor location of the MCD within or outside the built-up metropolitan core area in 1970 were considered. Thus we have not examined the "development effect"—the extent to which existing development attracts further development. In most cases, however, high levels of development in 1970 are accompanied by well developed road infrastructure by that year, resulting in scores of 12 for most MCDs in the category. Thus our results would not change greatly with the inclusion of such a measure.

• Distance from downtown Minneapolis/St. Paul (the metropolitan area's central cities) was not included as a "proximity" or "gravity effect" measure. Such a measure assumes that travel time to the center is a factor in development investment decisions. This measure is highly correlated with the "development effect", since new development tends to occur at the outer edge of existing development, which tends to grow from the central cities outward. Considered independently, proximity to the center has decreased in importance over the past three decades, but still deserves attention as a factor in development. We plan to incorporate it in the next round of analysis.

Results of the regression confirm trends revealed in the earlier correlation analysis, although in most cases only MCD population and MCD transportation accessibility are shown to be

significant correlates of development activity. Explanatory power of the regression model dropped sharply in the 1990s despite inclusion of all nine independent variables. This finding has implications for our later investigations, because many of what are traditionally understood as "causal agents" of development turn out not to be statistically significant in this particular model.

After regressions were run including all nine independent variables, the variables that were identified as significant (i.e., with $p < 0.0005$) were re-run for each of three time periods for each type of development, yielding multiple regression correlation coefficients (r^2). Standardized regression coefficients permit the assessment of the importance of each significant independent variable on the specific type of development within the specified time period (Table 5.18). For example, commercial development in the early 1980s is significantly related (1) to MCD population, (2) to MCD population density, and (3) to MCD highway transportation accessibility.

The conclusions from the regression analysis can be summarized as follows:

• *Geographic location* was never a significant independent variable accounting for variations in development levels. Therefore location with respect to direction from downtown plays no significant explanatory role.

• *Area of an MCD* turned out to be insignificant as an independent variable, although it came close for all four types of development in the 1980-84 period. Therefore we tentatively conclude that areally extensive MCDs are no more likely than small ones to experience development.

• *MCD population density* turned out to be significant in only four instances, and none of them in the 1990s. Evidently development of whatever kind displays no particular preference for density, nor does it reveal any particular aversion.

• *Highway transportation accessibility* as measured by our 13-point MCD scoring procedure was statistically significant in all but one case (office development, 1980-84), though it actually displayed a negative influence on office development in the latter two time periods. This finding is at odds with the conventional wisdom suggesting that office development is heavily reliant on highway transportation access. For commercial and industrial development, the percentage of variance explained by highway transportation accessibility actually appears to increase over time. Interestingly, in the most recent time periods, MCD transportation accessibility accounted for more variance in residential development than did MCD population.

Table 5.18. Regression Coefficients and Multiple Correlation Coefficients Relating Selected Independent Variables with Levels of Development, 1980-1997.

	Development Type (dependent variable)			
	Commercial	**Office**	**Industrial**	**Residential**
1980-84				
Indep. Variables:				
Population	0.67	0.75	0.63	0.67
Pop'n. Density	0.29	0.26		0.16
Transportation	0.14		0.18	0.19
Pop'n. Change				0.25
r^2	0.70	0.70	0.51	0.73
1985-89				
Indep. Variables:				
Population	0.74	0.90	0.59	0.28
Pop'n. Density				0.15
Transportation	0.13	-0.05	0.14	0.33
Pop'n. Change	0.11	0.18	0.18	0.38
r^2	0.64	0.83	0.47	0.49
1990-97				
Indep. Variables:				
Population	0.36	0.84	0.23	0.24
Pop'n. Density				
Transportation	0.20	-0.13	0.20	0.28
Pop'n. Change				0.32
r^2	0.22	0.63	0.13	0.34

Note: Multiple regressions were carried out for each of three time periods for each of four types of land development, with levels of development per MCD as the dependent variables, and nine independent variables. Statistically significant regression coefficients ($p < .0005$) were identified and regressions were re-run. Regression coefficients reported above, with squared multiple correlations, r^2.

Data Source: Calculations by authors.

• Variations in either *MCD population* or *MCD population change* (1970-1990) always had the most power to account for variations in development levels. Somewhat surprisingly there is almost no correlation between population and population change, at least none higher than 0.10. For commercial and office development, population's significance as an explanatory variable peaked in the period 1985-89, while for industrial and residential development the significance of population size has steadily declined. Population change was statistically significant for residential development in all three time periods, and also peaked in 1985-89. Population change was of modest significance in the late 1980s for commercial, office and industrial development, but then dropped from significance in the 1990s.

Conclusions

These statistical results are interesting in themselves, but in some respects they raise more questions than they answer. Our inquiry in this chapter began with the question, "Which comes first in a locality, land development or highway transportation?" It turns out that the question is far more complex than it initially appears to be. We have examined four types of real estate development, and nine different independent variables that customarily are thought to wield an influence on development at the scale of the MCD. A later report in this series will take a closer look both at the methodology for exploring this question, and a wider range of variables that can be included in producing additional insight and answers.

Chapter 5

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2. G. Giuliano, "The Weakening Transportation-Land Use Connection–It Still Eludes Us," *ACCESS*, Spring 1995.

3. See, for example, D. J. Forkenbrock and N.S.J. Foster, "Economic Benefits of a Corridor Highway Investment," *Transportation Research A* 24A, no. 4 (1990): 302-312; T. Rephann and A. Isserman, "New Highways as Economic Development Tools: An Evaluation Using Quasi-Experimental Matching Methods," *Regional Science and Urban Economics* 24, no. 6 (1994): 723-751; L. Singletary, M. Henry, K. Brooks, and J. London, "The Impact of Highway Investment on New Manufacturing Employment in South Carolina: A Small Region Spatial Analysis," *The Review of Regional Studies* 25, no. 1 (1995): 37-55; Y. J. Stephanedes and D. Eagle, "Highway Impacts on Regional Employment," *Journal of Advanced Transportation* 21 (Spring 1987): 67-79. On the topic of economies of scale accompanying urban growth see T. A. Hartshorn, *Interpreting the City: An Urban Geography*, 2nd ed. (New York: John Wiley & Sons, 1992): 121-22.

4. In our opinion, the differences in the results of the analysis using one ordinal ranking system rather than another are trivial. For a discussion of the power and the information content of ordinal ranking systems, see J. S. Adams, R. F. Abler, and P. R. Gould, "The Problem of Measurement and Scaling," Chapter 4 in *Spatial Organization. The Geographer's View of the World (*Englewood Cliffs, N.J.: Prentice-Hall, 1971): 93-110.

5. If an MCD contains a multi-lane road which becomes an interstate highway in the adjacent MCD, the first MCD is considered to have an interstate exit (for example, Faribault in 1970).

6. Adjacency did not count if the MCDs in question were separated by a river with no bridge between them. Distance between adjacent MCDs (or within an MCD) is not considered by this scoring system.

7. This assumption may not always prove true, however. For example, the conversion of

Highway 12 to Interstate 394 in the 1990s added nothing other than a High-Occupancy Vehicle lane. In fact, until the recent restriping/overlay reconverted the road to six lanes for single-occupant vehicles, the old multi-lane highway provided more capacity for single-occupant vehicles than did the new interstate.

8. Forks count as two separate roads–for example, I-35E and I-35W in Lino Lakes Township are considered two different arterials.

9. The values of the y-intercept (constant *a*) and the slope (*b*) for each line are not presented here because they are not useful to our analysis. The y-intercept represents the amount of real estate development of a particular type that an MCD should have with zero transportation access. However, our definition of an MCD with a score of zero does not mean that the place has absolutely no transportation access. In many cases, the best fitting line has an intercept indicating a negative value of development, which is obviously not meaningful. The slope of the line reveals how responsive development is to a change in transportation access; however, the magnitude of the slope is affected by the units of measurement (here, we use both number of units and value of permits), and thus cannot be used as a valid index of the *relative* relationship between two variables.

10. The p-value of the F statistic for every regression analysis was 0.0.

11. As measured by their studentized residuals–residuals that have been scaled to relate the magnitude of each residual to the size of the typical residual (or standard error). This procedure is followed to avoid problems with large values for residuals measured in absolute terms.

12. Or note Pine Springs in 1972, which had a transportation access score of 12 but did not add any residential units, therefore making it appear as a negative outlier.

13. A coefficient of variation is the standard deviation divided by the mean. It is a relative measure of variability, allowing for direct comparison of the amount of variability in different variables.

14. The studentized residuals of Minneapolis in the 1990s (85.5) and St. Paul in 1972 (52.7) are enormous when compared to all other studentized residuals for any type of development in any time period.

Chapter 6

DEVELOPMENT AND TRANSPORTATION: SUMMARY AND CONCLUSIONS

INTRODUCTION

This study began by noting that certain dynamic forces act on highway transportation infrastructure and the ways that it is used. At the same time, transportation itself acts on other elements within the metropolitan system. These dynamic forces directly affect regional economic vitality and establish the conditions for stable, livable neighborhoods. They are recognized as:

- trends within contemporary *society*;
- transportation *infrastructure* and patterns of its use;
- changes in natural and built *environments*; and
- the structure and operation of the expanding *economy*.

They serve as the background or framework within which our analysis has proceeded, and were frequently invoked in the interpretation of the data we presented.

This report focused on changes in the built environment of the greater Twin Cities region, and changes in its transportation infrastructure since 1970. Our approach has been organized around a general argument concerning:

- Some of the economic and social *incentives* that guide behaviors of individuals, households, businesses, institutions, public agencies, and local governments;
- *Land use patterns* and *transportation activity* that come about as a consequence of those behaviors; and
- How land use arrangements and transportation systems influence subsequent behavior in a continuing process of *circular and cumulative causation.*

Linkages and Feedbacks That Drive the Development Process

As summarized in Chapter 1 of this report, the general argument that structured our investigation includes the following sequence of events, and their feedbacks upon one another:

- First, metropolitan economic growth, higher levels of living, and population expansion combine to stimulate new housing construction, most of it on the edges of the built-up area.
- Economic growth brings with it additional jobs.
- Commercial development in the form of retail trade and consumer services pursues household purchasing power into the developing suburbs.
- Industrial expansion adds job opportunities on large open sites at and beyond the built-up edges of the metropolitan area.
- Office construction continues at the downtown cores, and at high-amenity and easily accessible locations around the region.
- The area's extensive highway network facilitates dispersal of households and jobs, and until recently permitted fast, trouble-free movement among all parts of the built-up metropolitan area.
- Overall population and economic growth, changes in population composition, and changes in life styles and labor force participation, coupled with dispersed low-density development, has meant more trips, by more people, in more vehicles over longer distances.
- Recent travel demand has begun to exceed what the highway infrastructure can accommodate, and highway congestion is increasing, which is one of the prices that the state and the Twin Cities region is paying for developing and dispersing in the customary manner.
- Outcomes of the land development and transportation process are neither benign nor fully intended: the economic benefits of the process accumulate disproportionately within one set of geographical subareas of the state and metropolitan region, while many of the associated costs are imposed through time and over space in a different set of subareas, raising questions of social and environmental justice.
- Benefits of low-density development flow disproportionately to individual households and businesses located in the newer suburbs, but aggregate costs to the community of dispersed, low-density development–both immediately and over time–are high and going higher, with many of them concentrating geographically in the central cities of Minneapolis and St. Paul and

increasingly in parts of the first- and second-ring suburbs.

• The 192 MCD governments in the 7-county area, as well as many of the remaining 400-plus within our 24-county study area, which are obligated to match their annual revenues with annual costs, are often motivated to manipulate their land use plans by promoting and subsidizing land development of specific types, and by zoning land with an eye toward revenue and cost consequences of one development pattern over another.

• Meanwhile, school districts are required to respond to land use decisions that are made by other local governmental units and over which they have no control.

Twin Cities Regional Dynamics

Our first report in this research series examined housing market activity, regulatory frameworks that influence development and redevelopment, and the general relations between development, local units of government, and highway transportation infrastructure. The chapter on housing market dynamics looked within the 7-county Twin Cities area and described where new housing had been built since 1970, and how real estate wealth has been slowly redistributed across the metropolitan area. The section on laws and regulatory frameworks that shape new development and the redevelopment of older settled areas noted that as a consequence of legal and regulatory frameworks, developers usually find it easier in time and money, and ultimately less risky and more profitable, to develop on greenfield sites on the built-up metropolitan edges than to redevelop older areas of the central cities and inner suburbs.

The third section outlined how the growth of population and expansion of economic activity within local municipal jurisdictions are accompanied by increases in per-capita revenues and expenditures, and how increased traffic pressure on major highways accompanies development. It also illustrated how local units of government are able to zone land for different uses in ways that affect their own tax capacity, as well as the tax capacities available to the school districts that serve the cities.

The chapters in the present report build on the three topics in Report #1. Chapter 2 portrayed residential, commercial, industrial, and office development in the 24-county study area for the period 1970 to the present. It described the emergence of the greater Twin Cities area as the capital of the Upper Midwest region and the economic and population center of the state of Minnesota. It portrayed the timing and density of residential development around the cores of Minneapolis and St. Paul, with emphasis on the period after 1950, and showed how the pre-

World War II highway system serving the Twin Cities area tied the Twin Cities area to its region, while providing direction to post-war suburban expansion.

The profile of industrial, commercial, and office development in the 24-county study area after 1970 showed that extensive office and industrial development brings employees and businesses into a local area, which in turn provides customers for retail trade and services. Much of the retail trade in downtown Minneapolis, for example, has come from dollars spent by employees and businesses located inside the CBD. Local government is attentive to the needs of commercial-industrial interests, who in turn pay a significant share of local property taxes. To the extent that house prices advance beyond rates of general inflation in certain parts of the region, household "wealth effects" stimulate and support vigorous retail trade and service activity in and near those parts.

Chapter 3 examined changes in revenues and expenditures during the development process for a sample of 28 local units of government from throughout the study area, 1970 to 1996, with the sample representing six development eras (pre-1940, 1940s, 1950s, 1960s, 1970s, 1980s) and the diversity within their respective housing stocks (high variability in housing ages, to highly homogeneous stocks). The analysis observed that residential development that takes place on greenfield sites initially enjoys low local property taxes, but soon the newly-arriving households expect and demand the full range of urban services, which must be supplied and paid for. The cost must be passed on either to the newcomers themselves, or by shifting some portion of incremental capital and operating costs to existing residents, shifts that can lead to political tension.

Chapter 4 examined changes in school enrollments, revenues, and expenditures as development affected five sample school districts which found themselves at different stages in the development process during the period 1970-96. When school enrollments were rising rapidly, new schools had to be built and staffed. When school enrollments decline, statistics show that operating costs often fail to drop as fast as expected because school buildings are older and sometimes less efficient, and because older teachers are paid at higher rates than newcomers to the classroom. The chapter also explained that resources available to school districts from local tax sources depend on the tax capacity supplied by local development, a process that is out of the hands of the school districts, and regulated by the municipalities that the school districts serve. The difference between local needs and available tax revenues is shifted largely onto state general revenues. The degree of efficiency or inefficiency in these financial arrangements and

linkages is hard to assess.

Chapter 5 presented a statistical analysis of how major highway infrastructure and highway improvements have both *led* and *lagged* the development process within the 24-county Twin Cities study area during the period since 1970. Statistical relationships were shown to differ by decade, as well as by type of development. The location of major highway routes evidently influences some developer decisions on where to place new housing. Major office developments seem to cluster at major transportation nodes but, conversely, many important nodes support little or no office development. Industrial development appeared to be tied closely to highway transportation routes in the earlier periods, but in later years the close correlations fade. Further analysis tested the correlations of development with MCD land *area*, population *density*, population *size* and *change*, and with *location* in a particular geographic sector of the metropolitan area. Results revealed little relationship between development and land area or location, and a changing relationship over time with population density, size, and change. Residential development and highway improvements showed the strongest relationship over the entire study period.

Conclusion

The Transportation and Regional Growth study (TRG) forms part of a strategic reexamination of the role of transportation in supporting economically vital communities and livable neighborhoods in Minnesota. Its principal aim is to describe and explain the elements, relationships, causes, and effects within a dynamic land use and transportation system, and to show how structures and relationships might be modified in order to achieve outcomes different from what is expected to occur if present trends run what many observers judge to be an increasingly unsatisfactory course.

We hope that the foregoing investigations of (1) residential, commercial, industrial, and office development; (2) changes in revenues and expenditures during the development process for a sample of 28 local units of government; (3) school enrollments, revenues and expenditures for a sample of five districts; and (4) how major highway infrastructure and highway improvements have both led and lagged the development process within the 24-county Twin Cities study area will contribute to a better understanding of Twin Cities Regional Dynamics. Future reports in this series will continue to explore these and related topics.