ABSTRACT

Title of Dissertation: DISCERNING INTRA-METROPOLITAN PATTERNS OF

PRODUCER SERVICE ESTABLISHMENT LOCATION

USING GEOGRAPHIC INFORMATION SYSTEMS

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This research presented in this dissertation explores the spatial distribution of

producer service establishments in the Washington DC area for 1997. Producer

services are a distinct and important segment of the US industrial economy. These

businesses provide the intermediary goods and services that are used as inputs for

many other industrial sectors. Producer service employment and sales have grown

substantially during the 1990s in relation to other portions of the overall US economy,

surpassing growth in most sectors including other types of services.

The majority of producer service research tends to focus on these services at

the national scale or comparative studies of whole metropolitan areas. This work

presents the findings for two complementary producer service research problems

pertinent to intra-metropolitan spatial scale research, the contribution of face-to-face

interaction to the spatial concentration of these services using sales between particular

producer services, and the entropy (or diversity) of services within postal code areas and

how this measure correlates to the presence or absence of particular producer services.

The findings indicate that there is empirical evidence of a relationship between the

strength of intra-sector trade and the degree of spatial concentration of producer service

establishments. This analysis also demonstrates that some producer service sectors known to have weak trade relations to other producer services do locate in areas with a lower diversity of services.

The results of this research add to a growing body of research and theory that centers on interpreting the role of producer services in shaping metropolitan economies. The spatial component of producer service establishment location in research is often neglected entirely or is superficially referenced. This geographic research provides the spatial dimension of producer service activities occurring at very fine scales within a metropolitan spatial economy. The results are only applicable to the study area but the methodology is useful and offers a potential for broader utility in producer service research endeavors.

DISCERNING INTRA-METROPOLITAN PATTERNS OF PRODUCER SERVICE

ESTABLISHMENT LOCATION USING GEOGRAPHIC INFORMATION SYSTEMS

by

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CHAPTER ONE: GEOGRAPHIC RESEARCH OF PRODUCER SERVICES

Introduction

The world is becoming increasingly urban. As people across the globe come to

settle in urban areas, currently well over half of the world's population, research

regarding the structure of urban areas and the importance of urban-based economies

will continue to be of significance in geographic inquiry. The past half century's

development of advanced urban-oriented economies such as those in the United States,

United Kingdom, Canada, Western Europe, Japan, and South Asia, reveal the dynamic

relationship of international, national and metropolitan economies as well as the

reciprocal importance of local economic structures influencing these larger

marketplaces. Understanding the location of and potential changes in urban

employment within these advanced urban economies is a needed component for

understanding future large-scale changes of economies with global reach (Castells and

Hall 1994). Moreover achieving greater insight into the changing nature of urban

employment location may aid in interpreting the importance of interactions between

metropolitan area export-based economics and a myriad of other socioeconomic

questions (Isard 1956).

Viewing the spatial distribution of employment within and across urban areas

makes it possible to critique past and present empirical conceptions of Western,

specifically North American, urban spatial economic structures. Much of the recent

changes in employment within urban areas, such as business location and uneven

growth in specific particular sectors, can be strongly debated to have been brought on by

the macro-economic transition of a manufacturing-based economy. Services have come

to dominate the US economy in both employment and revenue. The rapid growth in services, coinciding with a marked reduction in primary and to a lesser degree manufacturing production, has shifted attention away from these traditional research interests of industrial and economic geographers toward that of service provision at local to international scales. Moreover, exploring service growth within the context of urban spatial economies becomes an even greater priority given the growing competition among regions and metropolitan areas for capturing employment (Illeris and Philippe 1993a; Drennan 1997). It is toward a better understanding of the role of producer service business location as a result of these macro-economic changes that this current research is oriented.

Focus of Dissertation Research

This dissertation presents original urban geographic research of producer service establishment location within the Washington DC metropolitan area. To date there has been a paucity of producer service research that seeks to characterize and model the location of producer service activities at an intra-metropolitan scale. There are a few notable exceptions from past research using a variety of spatially-aware urban geographic approaches (O hUallachain 1992a; Beyers and Lindahl 1995; Coffey 1995b; Harrington and Campbell Jr. 1996).

Producer services are often considered 'intermediate' demand production where the output of a service activity is used to add value to an existing product or another service. Accountancy services provided to banking, for example, is a producer service function where the service provided is intended to enhance, add value, or help facilitate the exchange of the product of the firm (the bank) rather than for a non-business, consumer market. Simply put, producer services are service functions that are inputs to

other productive activities and are not generally intended for final consumption (Martinelli 1991b, 15).

Producer services, as the fastest growing segment of the U.S. service sector in the later portion of the 1990s, are seen to be an engine for continued metropolitan growth and a critical component of contemporary urban economic systems due to the increase in jobs and sales attributed to this sector (Gershuny 1987; O hUallachain 1989; Howland 1991; Glasmeier and Howland 1994; Harrington and Campbell Jr. 1996). An ongoing interest among urban geographers is the suburbanization of economic activities where over the past two decades increasing numbers of producer service firms locate in suburban and non-urban locations (Howland and Lindsay 1998). The creation and location of producer service employment within these rapidly growing areas is a critical element in understanding, for example, the impacts of suburban economic development and long-term economic future for US metropolitan areas.

This geographic-focused research in the Washington DC area examines the location patterns of producer service establishments within a metropolitan area where producer services are found in significant numbers (e.g. firms and jobs) and where their role in the urban economy is of particular consequence (Harrington and Campbell Jr. 1996). Using the efficacy of Geographic Information Systems (GIS) this dissertation research explores and tests two interdependent theoretical concepts for interpreting metropolitan area producer service establishment patterns, namely; 1) the influence of non-routine, face-to-face interaction of producer service firms on specific sector establishment location patterns, and correspondingly, 2) the role played by access and proximity to markets for producer service goods and services in shaping establishment spatial patterns within a metropolitan area.

The principal question addressed in this dissertation is how spatial patterns of economic organization in metropolitan areas are influenced by the nature of the activities performed within specific industrial sectors. In this research the producer service sector is the focus. Testing these concepts using a case study investigation adds to a growing knowledge base for understanding and potentially modeling the spatial characteristics of producer service activities. Past research efforts focused on the location of producer services are at spatial scales that often mask the intra-urban complexity of establishment patterns. The spatial clustering or dispersion of producer service establishments at the metropolitan scale can be revealed using appropriate geo-referenced data and analysis techniques. This research effort helps couple past perceptions of industrial location to empirical evidence provided through this case study investigation.

This research makes use of several data sources intended for commercial as well as federal, state and metropolitan area government uses. These data include necessary economic information of producer service firms along with the geo-spatial information needed for the GIS analyses tools[1]. The analysis techniques employed reveal the spatial characteristics of producer services firms across all the producer service sub-sector categories within the study area and with the needed geo-location spatial precision (establishment-level versus region). The output derived from the GIS analysis are compared to the a priori concepts of producer service firm location orientation that test the basis of these research problems. When examined the findings drawn from the research questions proposed here will help to improve the understanding of the location of economic activity at the metropolitan scale and provides some

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[1] The methodology used in this work does not include primary data collection methods such as those used in questionnaires or firm interviews.

evidence for the macro-economic impact of the producer service sector to some urban areas.

To provide a logical basis for this research, this chapter addresses the fundamental components of producer service research, namely the historical growth and diversification of the US service sector, and the specific factors used to explain the growth of producer services. The intent of this chapter is to frame the research of producer service location examined in this work.

The Growth Experience of US Services

Current economic data indicate that the largest sector of the US economy is services. The shift toward a predominately service-based US economy is the result of many social and technological forces. Research focused on the growth and organization of service activities has evolved beyond initial interpretations of services considered as parasitic extensions of primarily manufacturing production. The gains made in service employment are often described as a key facet of a modern economy where the value added from service functions is often difficult to differentiate from the rest of the physical-goods' production system. The basis for the growth of services is the transformation of both *what* is produced and *how* these goods and services are produced by the US economy (Stanback 1985). To understand the importance of the producer services it is necessary to review the explanations for growth in the overall US service sector.

A 1996 US Department of Commerce study noted: "Indisputably, the U.S. economy today is more service-dominated than it was in 1960 or even 1970. In 1990, service industries supplied about 63% of inflation-adjusted GDP, compared with 57% in 1960 (Department of Commerce 1996, 3)." US national economic census data along with other economic research data confirm the rapid growth in US service employment

(see figure 1.1). What is clear from these historic employment trends is the increasing

dominance of services in the overall US economy. The growth in service employment

dwarfs that of the primary sector and greatly exceeds that of retail and government-

related employment. Between 1958 and 1992, total U.S. employment grew by 100%

(from 66 to 121 million workers) while employment in service industries grew at nearly

140%. More recently the US Bureau of Labor Statistics (BLS) finds as of July of 2000,

80.1% of all non-farm employment is in or connected to the service producing sectors

(News BLS, July 2001).

This growth in service employment has had a positive net impact on the US

Gross Domestic Product (GDP). Yuskavage's (1996) analysis of growth and decline in

GDP by industrial groups notes that the increases seen in the share of GDP from the

private services-producing industries stems from an above-average real growth and

above-average growth in prices for services. From 1987 to 1994 finance, insurance, and

real estate (FIRE), share of GDP rose 9.9 percentage points; well above the average for

this period of all industries at 2.6%. Yuskavage notes that the increases are broad-

based, but are particularly noticeable in banking, business services, and health services.

The growth in GDP attributed to services does not come solely from in-country

consumption. The US remains one of the largest exporter of services making up one-

fifth of all exports in 1999 (Patrick and Fantulin 2001). This figure illustrates the degree

of importance services have on the US national economy [2] More recently service

exports from the US appear to continue this growth trend. July 2005 service exports, for

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[2] It is interesting to consider the future of service imports when from "July 2004 to July 2005, services
imports increased $2.0 billion. The largest increases were in other private services, which includes items
such as business, professional, and technical services, insurance services, and financial services ($0.7
billion) ...". Census Bureau, BEA 2005.

example, amounted to $31.1 billion of total exports valued at $106 billion (Census
Bureau, BEA News Release 2005).
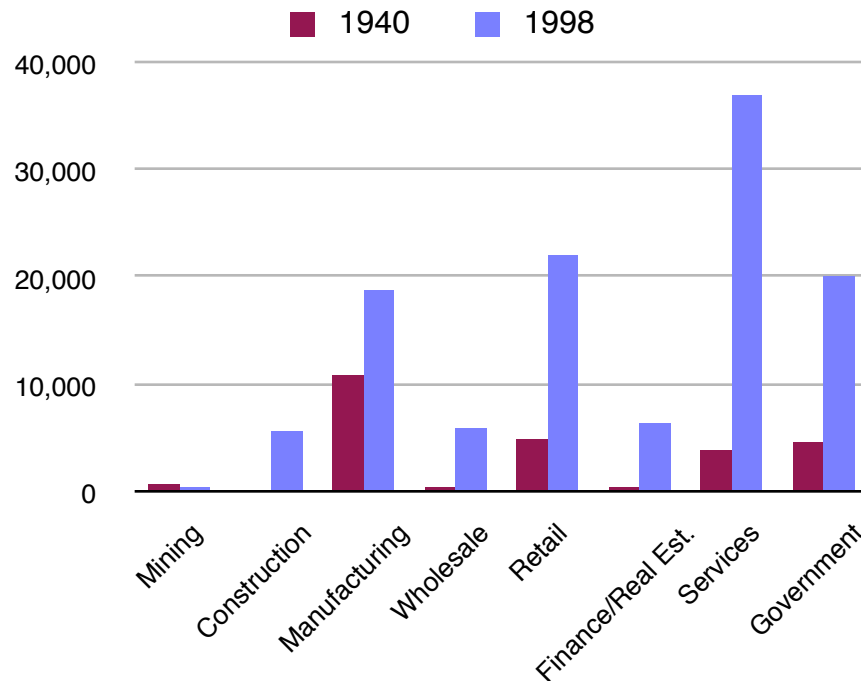
Figure 1.1: A comparison of employment for key sectors of the US national economy from 1940
to 1998 (represented in millions). Source: Statistical Abstract of the United States 1999, 20th
Century Statistics.

The growing importance of services to the overall US economy is evident but not
necessarily unique when viewing similar trends in other advanced national economies.
The overall growth in service exports is also found in several other countries, primarily
European (OECD 1994). Though not wholly unique, the case for the growth of services
within the US economy does have a number of distinctive explanatory characteristics.
These causal factors are central in the growth of services in both employment and
contributions to national GDP.

Changes in US Consumption Patterns

One factor often cited (Know 1994) for the rise in importance of services to the US economy is changes in consumption patterns of Americans (see figure 1.2). The increase in service employment beginning in the post-World War Two era coincides with the growth of the US middle-class. The availability of additional resources created by rising per capita wages fueled greater demand for goods and also services. Glasmeier and Howland note that increased demand for service-based activities can be attributed in part by the increases in personal incomes beginning in the 1950's (1994). In addition leisure and tourism services and have all seen dramatic increases in employment driven by the increased consumer demand. Personal service expenditures have clearly been growing surpassing the consumption of goods by the early 1980s. Expenditures for services tend to be elastic with changes in pricing and have a direct impact on the consumption of services (Daniels 1985, 16-17). Concomitant with these noted changes in consumption are the related demographic trends of the US populace. Principle among these are aging of the US labor force but increases in the competency, education, training of the labor force and the general growth of knowledge are equally as compelling explanatory factors (Department of Commerce 1994).

Government Policy and Regulations

Public policy decisions stemming from government legislation impact how sectors of the US economy develop. Examples of this abound where actions such as deregulation, increases or decreases in spending on defense, public education, and health care can bring about significant changes in how capital is spread across the national economy. For example, deregulation efforts have spurred significant growth in communication, transportation and financial sectors, while lower expenditures in defense

has tended to increase employment in education and research fields (Department of Commerce 1996, 8-9). Federal and state regulations and policies that affect wages are also key to the increase in service output and employment, such as increases to the minimum wage that combine with alterations in personal spending habits.
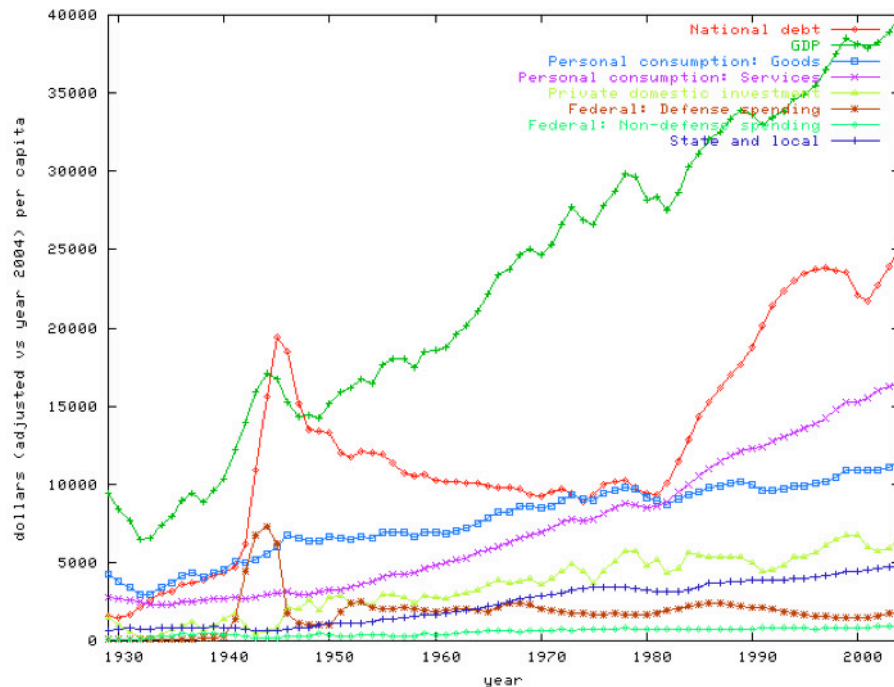
Figure 1.2: A comparison by year for US consumption (in $2004) of goods (blue line) and services (pink line), 1926-2003. Source: Bureau of Public Debt/BEA 2004[3].

Organization and Efficiency of Production

The impacts of the production of goods and services are tightly coupled to the economics of production (Berry, Conkling et al. 1987). In relation to the growth in service employment, Price and Blair (1989) discuss two important aspects of production influences, the increasing productivity of workers, and a broadening of the division of

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[3] Graph courtesy of Die.Net.

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labor. Increasing productivity of workers is a central input to theories of economic

growth or decline. This issue is also vexing for services due to the often amorphous,

elusive, and hard to measure outputs of service production (Sherwood 1994). It does

remain clear, however, that the expanding 'information economy' may dictate the growth

or decline of services (Castells 1989). The broadening specialization of service

employment, especially in the rapidly growing sectors, has broadened the division of

labor and has created new employment opportunities. This diversification in information-

based jobs has also been increased through the contracting out of services especially in

the manufacturing sector (Department of Commerce 1994).

Pervasive Technologies

Technology too has played a role in the development of the service sector

(Peitchinis 1981; Rothwell 1982; Stanback 1985; Glasmeier and Howland 1995).

Technology, a systematic way for accomplishing a particular task, is connected to

innovations where new products or new ways of doing things are created (Harrington

and Warf 1995, 92-93). Regimes of new technologies alter the way goods and services

are created, distributed and purchased by consumers. The past two decades has seen

the rise in the use and development of many technologies based on microelectronics,

digital telecommunications, robotics, and biotechnology and information technologies. It

is these innovations that are thought to play a key role in the surge of the number of new

service jobs (Beede and Montes 1997). As a consequence many of these 'enabling'

technologies have a great an impact on metropolitan economies as did earlier

technological revolutions (Rothwell 1982; Malone 1995).

The ongoing infusion of information technologies into the US economy is creating

new and modifying existing relationships for labor and production methods. These

technologies are seen as reducing constraints of distance on the operation of a variety of business operations (Congress 1995, 108). Future analysis will no doubt better quantify the impact of these technologies on the overall US economy. Information-based service jobs may mean that the location of economic activity becomes less important than the infrastructure, data and hardware that connect labor to the rest of the office and the rest of the work force. These new 'foot-loose' industrial arrangements increase the need for renewed understanding of the impacts of technology on the changing nature of employment (Howland 1992; Howland 1994; Kolko 1999). Information technologies have also rendered many services increasingly tradable. Knowledge-intensive services can now be exchanged often easily through telecommunications networks and have therefore greatly expanded the potential market places for these products (Daniels 1991; 1995).

Classification of Services

The classification of services often used in urban and economic research is drawn from the Standard Industrial Classification (SIC) system produced by the United States Office of Management and Budget (OMB), 1987. This system is useful for differentiating activity in the economy based on the primary output of industries but it has been also been criticized as not appropriate for many kinds of diverse service activities (Price and Blair 1989). The United States SIC system, developed over a half-century ago, is intended to provide a framework for comparing statistical data collected on business establishments as well as providing uniformity about these data collected by various government and non-government entities (Office of Management and Budget

1987, 11, 699)[4]. The SIC system divides economic activities into major groups based on a 4-digit scheme. These digits represent the primary activities for each business based on its principal product or group of products produced, distributed, or as services rendered (see table 1.1).

The diversity of services has created debate for the definition and classification of various types of service activities (Glasmeier and Howland 1995, 22-23). Services are difficult to interpret due to the meaning of the word 'service'. Services are often thought of has having no tangible form (Daniels 1975). When reviewing service functions, however, this notion is unsatisfactory because service activities often involve tangible goods or output. Not surprisingly then the diversity of service occupations, activities and outputs has generated many concepts for the classification of services.

Table 1.1: Services as defined by the Standard Industrial Classification system (Office of Management and Budget, 1987).

SIC code	Description of Service
70	Hotels, rooming houses, camps, lodging places
72	Personal services
73	Business services
75	Automotive repair, services, and parking
76	Miscellaneous repair services
78	Motion pictures
79	Amusement and recreation services
80	Health services
81	Legal services
823, 4, 9	Selected educational services
83	Social services
84	Museums, art galleries, and zoological gardens
861, 2, 4, 9	Selected membership organizations
87	Engineering, accounting, research, and management
89	Services, not elsewhere classified

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[4] Though critical to economic analyses, changes to the SIC system have not been well documented. In fact, it is reported that no documentation exists that explains the underpinnings to changes made in the 1987 classification (Department of Commerce 1994, 2-3).

Services are a hybrid of economic activities where tangible products can be combined with intangible knowledge or expertise. Quinn and Gagnon (1986, 95) clarify this relationship where services are: "...all those economic activities in which the primary output is neither a product nor a construction. Value is added to this output by means which cannot be inventoried ... and the output is consumed when produced." Service occupations therefore will also vary widely in terms of skill, education levels, production methods, and wages.

Given this variability, a useful organizational concept for services is the degree of 'sophistication' associated with the types of service production. Singelmann (1978) proposed four subgroups for services in order to identify some of the functions of the service and the relationship the service has with the final demand for that service are: Distributive Services (retail, transportation), Producer Services (insurance, banking, engineering, legal), Social Services (education, medical, welfare, government), and Personal Services (hotel, laundry, entertainment). This scheme allows for services to be functionally differentiated from the *transformative* industries (manufacturing and construction) and the *extractive* industries (agriculture and mining). Daniels (1982) somewhat later proposed the use of a tiered notion of services based on the notion that activities performed within each group can be divided into three distinct levels; Tertiary (transportation and utilities); Quaternary (finance, insurance, trade, real estate); Quinary (education, government, health, research). These levels were later amended by dividing services further into groups based on the end use of services; consumer versus producer services (Daniels 1985). Allen (1988, 18) challenged this dichotomy by introducing a third type of service referred to as 'circulation' services. Circulation services are produced *within* the process of circulation and *for* circulation. Massey

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(1984) in earlier research of labor organization of UK services confirms, however, that there are often no clear-cut differences between consumer and producer services.

These conceptual descriptions are useful for understanding how services may be classified and organized within the whole US economy, though these notions are often not supported by current data collection methods and are research-oriented and not operational. Services are especially prone to obscuring the boundary between some of the SICs "...coarse and cumbersome industrial categories" (Harrington 1995). The service sector can often be distinguished by what services are not rather than what they are (Bailly, Coffey et al. 1992, 9).

Classifying Producer Services

The research literature for producer services, similarly with all services, varies regarding the types of industrial processes classified under the moniker of 'producer services'. Producer service definitions illuminate the internal structure of an industry; the concept of a group of operations that share similar inputs and technologies and a set of operations that share a common market (Harrington 1995, 5-6). Producer services are classified as intermediate-demand services used as a part of producing some good or as inputs in other services. Insurance, banking, and accounting are all examples of producer service functions. Producer services can also be identified as those "... intermediate-demand functions that serve as inputs into the production of goods or other services, enhancing the efficiency of operation and the value of output at various stages in the production process (Coffey 1995a)".

The functional definition for producer services, recognized by most of the relevant research cited in this chapter, are formed from two key Major Group designations of the 1987 US Standard Industrial Classification system: finance,

insurance and real estate (or FIRE) SIC 60 and business services SIC 73 (see table

1.2). This taxonomy reveals that producer services are being identified by the intended

final market for the service rather than the service or product itself. Business services,

as a group, provide services that are most often clearly directed to other businesses

(Martinelli 1991b, 21). The services provided within the FIRE categories are less clear

where commercial banking (SIC 602), life insurance (SIC 631), and legal services (SIC

811) are all good examples of services that are used by both households and

businesses. It is understood by many producer service researchers that the boundaries

of this sector will remain somewhat vague due to the multi-dimensionality of service

consumption (Martinelli 1991b; Bailly, Coffey et al. 1992).

Drennan's research of producer service distribution in major US urban centers,

for example, chooses to include both communications (SIC 48) and motion picture

production (SIC 78) in his definition of producer services (Drennan 1992, 218). Beyers

(1992, 132-33), in contrast to other producer service research classifications, include all

administrative and auxiliary services for each industrial sector including transportation

services in his classification strategy.

To correct some of the past limitations of the SIC system, the US Office of

Management and Budget formed the Economic Classification Policy Committee (ECPC)

to examine the 1987 SIC classification and offer alternatives strategies for a new

industrial classification system. The new system, known as the North American

Industrial Classification System (NAICS), has replaced the SIC system, beginning with

the 1997 economic census. The ECPC has organized "service-like" activities based on

a production (supply) or market (demand)-based classification.

Table 1.2: The producer service sectors of the US Standard Industrial Classification system for 1987. Source: Office of Management and Budget 1987.

SIC	FIRE SERVICES	SIC	BUSINESS SERVICES
60	**Depository Institutions**	**73**	**Business Services**
601	Central Reserve Depository	731	Advertising
602	Commercial Banks	732	Credit Reporting and Collection
603	Savings Institutions	733	Mailing, Reprographic, Stenographic
606	Credit Unions	734	Services to Buildings
608	Foreign Bank & Branches, Agencies	735	Misc. Equipment Rental & Leasing
609	Functions Closely Related Banking	736	Personnel Supply Services
61	**Non-depository Institutions**	737	Computer & Data Process Services
611	Federal & Fed-sponsored Credit	738	Miscellaneous Business Services
614	Personal Credit Institutions	**81**	**Legal Services**
615	Business Credit Institutions	811	
616	Mortgage Bankers and Brokers	**83**	**Social Services**
62	**Security And Commodity Brokers**	833	Job Training and Related Services
621	Security Brokers and Dealers	**86**	**Membership Organizations**
622	Commodity Brokers, Dealers	861	Business Associations
623	Security and Commodity Exchanges	862	Professional Organizations
628	Security and Commodity Services	863	Labor Organizations
63	**Insurance Carriers**	**87**	**Engineering & Management Services**
631	Life Insurance	871	Engineering & Architectural Services
632	Medical Service & Health Insurance	872	Account, Auditing, & Bookkeeping
633	Fire, Marine, & Casualty Insurance	873	Research and Testing Services
635	Surety Insurance	874	Management and Public Relations
636	Title Insurance		
637	Pension, Health, and Welfare Funds		
639	Insurance Carriers, nec.		
64	**Insurance Agents, & Services**		
65	**Real Estate**		
651	Real Estate Operators and Lessors		
653	Real Estate Agents and Managers		
654	Title Abstract Offices		
655	Sub-dividers and Developers		

The logic is straightforward, where the production-oriented concept aggregates businesses according to similarities in activities that produce and deliver goods and services; the market-oriented approach suggests divisions based on how products are used (Department of Commerce 1994, 5-10). The NAICS system identifies and defines 361 industries not previously recognized in the previous classification system. The lion's share of these new categories are within the traditional services category; and the largest share here fall within producer services.

Research of Producer Services

Like services, job growth in producer services also increased noticeably in recent times. Beginning in the 1980s producer employment in services increased at a significantly faster rate than many other service sector categories. Producer services have then attracted attention due to the perceived importance of these services in fostering local and regional economic development (Moulaert and Daniels 1991). Much of the economic and geographic research of producer services suggest a number of factors to explain this growth and the influence of these services on US economic structure. Some of the extraordinary growth in jobs and establishments can be described as artifacts of the overall US economy. Glasmeier and Howland note for example that 40% of the expansion of US producer services between 1972 and 1985 was produced simply from growth of the GDP (1995, 28-29). This observation makes plain that producer service growth is significantly tied to larger economic conditions yet the remaining portion of the growth of these producer service jobs and the creation of new firms requires additional explanation.

Producer service industries offer a fairly broad assortment of research themes being augmented by differing disciplines including geography, planning, economics,

regional science, labor studies, and, sociology. The producer service research literature

examined in preparation of this dissertation discusses some of the key factors believed

to have led in the growth of these services or have made this growth possible. Many of

these factors relate back to the growth of services in general but are seen here to have

an accentuated role in the development of producer services. Brief summaries of this

research is presented here.

US Economic Restructuring

There have been several times in US history where changes in the types of jobs

and the labor markets have culminated into a restructuring of the overall economy. This

has occurred when a manufacturing-based economy overtook the largely agrarian

economy that was the initial basis for the development of the US (Bednarzik 2005). The

rapid growth of producer service employment in recent times reflects what some note as

another period of economic restructuring. The growth in importance of services is one

component of the restructured economy but there are other factors to consider. Knox

(1988) notes that certain large-scale economic elements of this restructuring have

affected some service-oriented components of the US economy. The author cites that

emerging business strategies often pursue economies of scope rather than of scale to

achieve greater diversification of investment. Corporations are concentrating and

centralizing authority often while they are reorganizing corporation structures. While the

organization of productive processes are becoming increasing flexible leveraging

decentralization and internationalization of skills (Knox 1991, 182-3). These changing

conditions tend to favor the growth of jobs in producer service functions.

As noted, several macro-economic factors underlie the larger structural changes

occurring within the US economy and industrial production. These are pertinent too for

understanding the rise in producer services over the past two decades. Beyers, concurs that the rise in producer service employment in Canada and United States metropolitan areas comes from a general restructuring of national economies (Beyers 1992, 133). He finds that the continuing division of labor, the externalization of functions, continued innovation in the types of services offered, and, technological change in the way services are performed has resulted in the growth of producer service employment.

Within the industrial geographic literature the economic restructuring of many national economies has stemmed from the shift away from a 'Fordist-style' economic regime of mass production and mass consumption (Schoenberger 1988). Harvey (1987; 1989) and Schoenberger (1988) have explored the implications of flexibility and the location and nature of American business and industry. From these efforts, Harvey proposed the concept of 'flexible accumulation' to supplant the often indefinite use of post-Fordism. Flexible accumulation refers to the technological basis and organization of production with its corresponding patterns of consumption. Or, as Harvey describes, flexible accumulation confronts the rigidities of Fordism resting "on flexibility with respect to labour processes, labour markets, products and patterns of consumption (Harvey 1987)". "It is characterized by the emergence of entirely new sectors of production, new ways of providing financial services, new markets, and, above all, greatly intensified rates of commercial, technological, and organizational innovation (Harvey 1989, 147)." The growth of intermediate services are a part of this economic restructuring scenario where the flexibility gained from changes in industrial organization has created new types of jobs and markets.

Spatial Reorganization of Production

Research detailing changing methods of industrial organization are a significant theoretical underpinning of the growth in the producer service sector. The organization of production has long been central for describing how industries have evolved and differ between nations (Dicken 1986). The research literature also reveals that the a reorganization of the production process of some economic sectors can potentially create more employment. How some firms have come to organize their production has had an impact on the growth of producer services. There are difficulties in establishing at times these relationships, both qualitative and quantitative, that exist between vertically disintegrated firms and the emerging producer service firms. A major impediment is acquiring the inter and intra-firm data required for establishing the strength of this relationships (Bailly, Coffey et al. 1992, 28). Debate too surrounding the apparent rapid rise in producer service employment has come from the discussion of vertical disintegration, or *externalization* of in-house production activities.

The outsourcing of functions once performed within a firm is seen as a critical determinant to the rise of producer services (Beyers 1992; Harrington 1995). Removal of a firm's production capability to another location or to another firm often signifies an attempt to maximize of the firm's economic resources. Where, for example, a firm with internal accounting and legal services departments discovers that external accounting and legal services firms provide the same service at lower cost (Beyers 1992, 134). This same example can be applied to a host of producer service functions where the vertical disintegration of larger firms has resulted in the increase in new producer service businesses. The externalization of these producer service functions has been used to explain some of the the growth of these firms created within US metropolitan areas. Similar activities are also at work in Federal and State governments where frequently job

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functions are reviewed to appraise which can be delegated to the private sector. This

controversial process, referred to by OMB as A76, has resulted in the growth of

contractor business once performed by Federal workers.

Goe (1990; 1991, 118-121), in his extensive research of this issue, describes five

forces that contribute to the externalization of producer service function process:

* Cost-efficiency factors (profit maximization): the often mentioned rationale for
  generating profits through efficiently leveraging external capabilities.
* Non-financial resource factors: impacts to staff or the production process that
  do not necessarily have a resource component.
* Demand characteristics of clients: need to be tightly coupled to the output
  used by clients.
* Specific characteristics of the producer services functions: a hierarchy of
  tasks that could potentially be conducted by another firm.
* Government regulatory factors and outsourcing: policies that impact the use
  and wages of labor enacted by State or Federal government policies.

Research focused on the externalization of producer service functions cites

several areas of still needed research tasks: a need for expanding the information

regarding producer services within industrial organization; some knowledge of the

historical evolution of producer services, especially how the decline in some industries

lead to an increase in producer services; and, a detailed examination of market

contracting between firms in producer service industries and the firms demanding their

output (Goe 1991). The ability of firms to reorganize the means of production as Goe

and others have explored is a critical piece to the growth of producer services. The

growth of jobs in producer services can be related to this phenomena and has been

suggested that growth in these services simply mask job losses in other portions of the

economy such as manufacturing and retail.

Influence of Information Technologies[5]

A central factor in this list of determinants for producer services is the role that increasing flexibility, brought on by continued technological innovation, has achieved. The development of several technologies are key to interpreting the growth of producer services and have made a number of producer service jobs possible. It appears apparent from the research literature that technology has plays a major role in the explanation for increased trade and employment in producer services (Price and Blair 1989, 122-27). Technology's role in spurring rapid growth in the service sector has stemmed from the new jobs being created by emerging technologies (web-masters, system administration, etc.), new methods of production and exchange of services (digital-based production, enabling communication networks, etc.), and new schemas for the organization and arrangement of production (vertical disintegration, outsourcing, etc.). The producer services sector benefits from the rewards these related technologies have brought on due to the fact that these technologies have increased the flexibility for the means of production (Martinelli 1991b).

The gaining importance and influence of technological innovation on the US economy is a factor of particular consequence to the producer service sector. Specifically the growth in Information Technologies (IT) has made the creation, trade and marketing of producer service functions increasingly easier and cheaper to perform. Numerous examples and case studies are available that help detail the role of these intermediate services. Progress made in the development of more pervasive IT innovations have played a role in bolstering the possibilities for increased employment across all eleven producer service sectors. Knox (1991), for instance, characterizes

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[5] include any and all hardware, software, and data used to create, store, process, and communicate information electronically as well as services to keep these resources current and operational.

improving communications and transportation technologies as allowing firms to exploit a time-space compression. This impact of rapid communications is important for it allows firms to keep pace with a rapidly fragmenting market place, from regional to global scales. The growth in computing capabilities alone continues to create new producer service jobs. This fact is evident from stated changes being made to the US industrial classification system where several categories are being appended to the limited set of traditional technology-related sectors.

The development of new technological capabilities are often tied to other industrial processes such as manufacturing. Competitive forces of profits and markets will drive firms to adopt technologies that improve the capabilities of the firm. The ongoing importance of IT in the US economy has created job opportunities for IT-related firms. Figure 1.3 illustrates the growth in IT employment over the past decade. Based on this data employment in IT specific to services is now surpassing these positions held in manufacturing. This chart also reveals the economic downturn of IT jobs following the marked decline in IT employment at the turn of the millennium. As jobs once again return to the IT sector in growing numbers the trend of greater increases of IT within the services will remain.
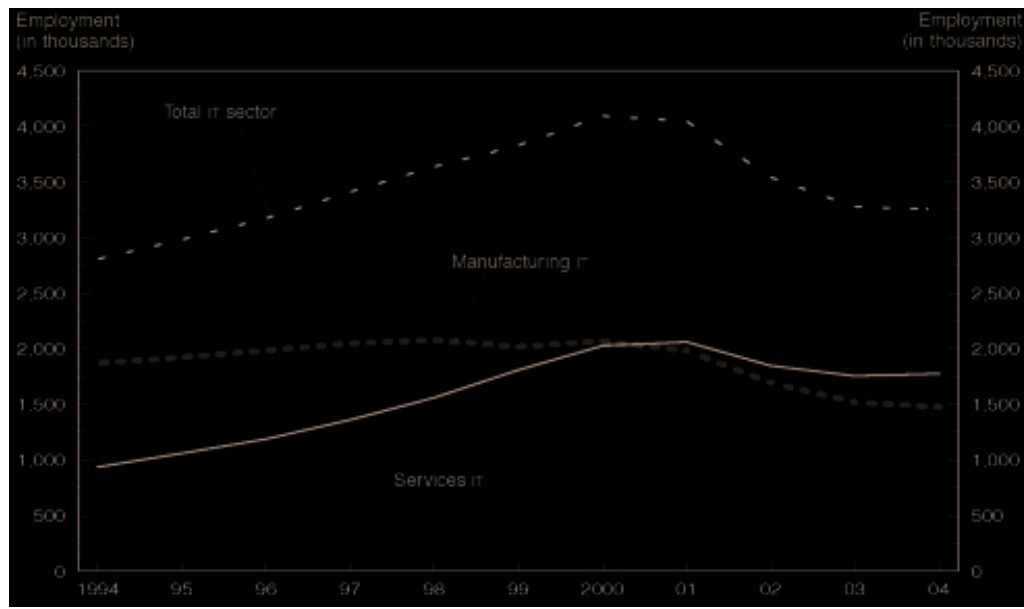
Figure 1.3: The growth in IT employment for the service sector versus jobs in manufacturing.
Source: Bednarzik 2005.

The impact of technology on the growth of producer service continues to be great. The many niches that producer services fill often requires these services to be flexible so that firms are able to react quickly to changes in the needs of client firms. IT technologies have made many processes of producer services more flexible and reconfigurable as needs change. The basis of computing and communications that allow just-in-time alteration and provision of services are essential to today's information-based producer service firms.

The research of producer services conducted since the 1980s has produced some important insights concerning a great variety of topics relevant to this sector and its impact on national economies. Understanding how the confluence of technology, labor and production organization will impact urban areas is critical to the next generation of urban studies and is in and of itself a fundamental question for the whole US economy (Coffey 1995b). Beyond the quantitative measures of rapid growth both in

employment and income, producer services are perhaps an archetype of the future

relationships between traditional goods producing and information-producing industries.

The remaining chapters explore further the role of producer services within the US by

testing the role of non-routine interaction of producer service firm location and the

potential role proximity to markets have on the establishment patterns in the case study

area.

CHAPTER TWO: A SPATIAL ECONOMY OF PRODUCER SERVICES

Introduction

The spatial distribution of industrial employment across the United States are the result of a number of economic-based influences. These influences include the historical antecedents of national and regional economic organization, the role of state and federal government investment in industrial restructuring, and, the competitive advantages of geographic site and situation (Singelmann, 1978; Rothwell, 1982). The numerous combination of these influences has driven the evolution of the national and regional spatial economies of the United States (Berry, Conkling et al. 1987). Knowledge of national and regional industrial activity is also important for understanding the economic organization of producer services at finer geographic scales such as within metropolitan areas.

Examining large geographic areas using economic data from customary aggregation areas, including nations, regions and states, one discovers that economic activities are not homogeneously distributed across these spaces (Knox 1988). Rather, economic activities display location dependencies where the factors noted influence how economic sectors will be geographically distributed. This fact is essential for understanding the spatial distribution of producer service activities within the United States, and in turn the distribution of these services within the nation's leading economic centers.

In this chapter some groundwork is laid to enable the interpretation of metropolitan area producer service business activity within a national and regional spatial context of service employment. From these gross patterns, industrial

characteristics of producer services (e.g. markets, labor, and technology) influence the

distribution of employment and thus the pattern and concentration of the service sector.

The manner in which producer services are distributed within and between urban

centers is indivisible from national patterns of employment and is therefore needed for a

thorough analysis of this economic sector.

National Distribution of Industrial Sectors

Employment trends since the 1970s have lead economists to accept the

importance of services as a source of new businesses and, in turn, new jobs.

Discussion in the first chapter has reinforced that growth in the service sector has had

an enormous impact on the number and types of jobs in the US economy. This growth

has not been homogeneous across the spatial economy of the United States resulting

into what some refer to as "... the way in which the spatial division of labor in the US has

created an uneven topography of production" (Harrington and Warf 1995,74). It is

important to further inform our spatial cognizance of the distribution of US employment

by examining key regional industrial concentrations for regional, state, and metropolitan

areas.

A well-known method for calculating the comparative advantage of cities and

regions in their relative share of various industrial employment is referred to as location

quotient (see figure 2.1). The location quotient (LQ) is a quantitative measure for

discerning the degree that an industrial sector is concentrated in a particular geographic

space[1]. A ratio calculated is between that of a local economy and the economy of some

reference unit. This measure is calculated using the numbers employed within a given

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[1] This ratio is calculated for all industries to determine whether or not the local economy has a greater share
of that industry than expected. If an industry has a greater share than expected of a given industry, then that
"extra" industry employment is assumed to be Basic because those jobs are above what a local economy
should have to serve local needs (FSU, Dept. of Planning, 2005).

industry that are compared to the share of employment within in industrial sectors for a given area or region (Muller 1986; Heilbrun 1991, 143; Harrington and Warf 1995).

$$LQ = \frac{e_i / e}{E_i / E}$$

e_i = state employment in the ith industry
e = total state employment
E_i = national employment in the ith industry
E = total national employment

Figure 2.1: The location quotient measure used to calculate the share of employment in a given industrial sector by state.

Once calculated a LQ score for each region unit (state, county, etc.) will contain a value between 0-1 (or in some calculations between 0-100), where 1 would denote that unit to have employment in the industry of equivalence to all others in the nation. For example, Nevada with a LQ score of > 4 in services reveals the state has four-times an equal share of this economic activity as compared to other states. The LQ measure helps to determine if an area can be viewed as specializing or highly competitive in a particular industrial sector. An often-noted consideration when using the LQ measure is the potential alteration of results that can occur as the size of the unit change (Heilbrun 1991). This is a concern when interpreting results of this calculation using small area geographies (such as urban areas).

Using the LQ a gross view of differences between states in the shares of industrial sectors can be determined. The distribution of employment across the US is not homogeneous and reflects often regional differences in employment. This perspective is useful for visualizing spatial patterns of economic activity. The following figures (2.2 - 2.6) portray the spatial distributions of key industrial sectors in the United States based on their share of employment.

Primary Industries: SIC 01 Agriculture, Forestry and Mining

Location Quotient

- 50-85
- 86-105
- 106-125
- 126-167
- 168-229

Source of data: extracted from the complete US Bureau of the Census Economic Census 1990 Summary Tape Files 1A and 3A, and are based on the Standard Industrial Classification (SIC) system, Office of Management and Budget 1987. Note: The District of Columbia LQ score of 50.

Manufacturing Industries: SIC 20-39

Location Quotient

- 24-51
- 52-82
- 83-101
- 102-116
- 117-137

Source of data: extracted from the complete US Bureau of the Census Economic Census 1990 Summary Tape Files 1A and 3A, and are based on the Standard Industrial Classification (SIC) system, Office of Management and Budget 1987. Note: The District of Columbia LQ score of 24.

Figures 2.2 & 2.3: Location quotient by state for the primary and manufacturing industries for the coterminous United States 1990.

Finance, Insurance and Real Estate: SIC 60-67

Location Quotient

- 64-75
- 76-86
- 87-101
- 102-121
- 122-147

Source of data: extracted from the complete US Bureau of the Census Economic Census 1990 Summary Tape Files 1A and 3A, and are based on the Standard Industrial Classification (SIC) system, Office of Management and Budget 1987. Note: The District of Columbia LQ score of 110.

Public Administration - Government: SIC 91-99

Location Quotient

- 63-75
- 76-91
- 92-116
- 117-147
- 148-277

Source of data: extracted from the complete US Bureau of the Census Economic Census 1990 Summary Tape Files 1A and 3A, and are based on the Standard Industrial Classification (SIC) system, Office of Management and Budget 1987. Note: The District of Columbia LQ score of 277.

Figures 2.4 & 2.5: Location quotient by state for financial and public administration industries for the coterminous United States 1990.

Service Industries: SIC 70-88

Location Quotient
- 67-80
- 81-97
- 98-115
- 116-143
- 144-451

Source of data: extracted from the complete US Bureau of the Census Economic Census 1990 Summary Tape Files 1A and 3A, and are based on the Standard Industrial Classification (SIC) system, Office of Management and Budget 1987. Note: The District of Columbia LQ score of 91.
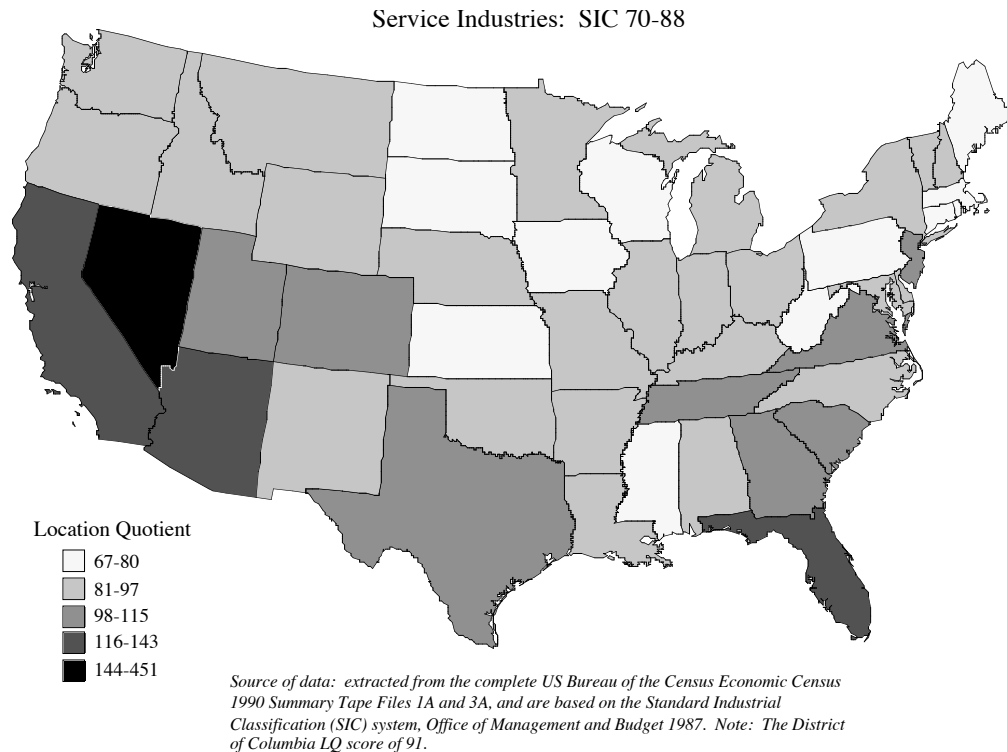
Figure 2.6: Location quotient by state for service industries for the coterminous United States 1990.

Patterns of Industrial Employment

These figures show that regional economies, those composed of multiple clusters of states, will always specialize in one or more sectors of industrial production. The distribution of the industrial sectors displayed, on first glance, look familiar as those formed in earlier decades. Where, for example, primary industries predominate in the Great Plains states while financial services cluster in the Northeastern United States. For some industrial geographers this is not surprising given the often studied series of economic and spatial forces (available resources, physical properties of climate, etc.) that have helped guide where particular industries have located. Some examples include durable manufacturing in the Great lakes region (Pred 1964; Barley and

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Hinschberger 1992), the motion picture industry in southern California, and, the computer industry in Silicon Valley and Route 128 (Saxenian 1985). Over time there has been a number of analyses of US industrial patterns at varying levels of spatial aggregation, and many of these concur on the regional patterns of industrial location we see today. Berry, Conkling et al. 1993 is a good source for an overview of this body industrial location research.

Regional location propensities of industrial sectors can also be determined by using other forms of economic analysis. In his seminal work on the development of the US urban system, Dunn (1980) noted that regional industrial sector specialization is largely borne from a corresponding metropolitan specialization. Where, for example, agriculture, though declining, remains the leading sector in the upper Great Plains states, while durable manufacturing continues to dominate in the Great Lake States. It is of interest to note that this analysis of national industrial location patterns from the early 1980s articulated by Dunn has not altered substantially to the present day. There have been changes to the metropolitan economies that may drive economic and social change to the associated regional economic systems.

The US Service Sector

The number of service workers in the US labor force is, as noted, large and important. When services are combined with finance, insurance and real estate employment these sectors represent over 70% of total national employment. The service sector location quotient by state in figure 2.6 displays the distribution patterns for all US services, SIC 70-88. It is well known in geographic research that many economic phenomena will demonstrate an uneven spatial distribution pattern. The wide range of services gives this sector an inherent heterogeneity that may promote a spatial

heterogeneity (Harrington and Warf 1995, 62). The map shown in figure 2.6 of state-level LQ scores reveals that there are distinct regional patterns of greater shares in services.

An important underlying factor that drives this national spatial distribution of services stems from the division of services into consumer versus producer services. This 'intra-sector' distinction is important for it holds a great deal of spatial distribution explanatory power. Consumer services are intended for the individual consumer as the end market and must therefore be easily accessible to that market. So here we expect that all consumer services (e.g. lodging, automotive repair, motion pictures, amusement and recreation, health services) would correspond spatially with that of the distribution of population. This phenomenon is evident even at the state level where we find low population and high personal services oriented states, such as Nevada, garnering significant shares of service employment. The categorization of the whole service sector (SIC 70-88), based on the SIC system, does not adequately characterize the distribution of producer services at the national level. The relationship between where significant concentrations of service employment are located and the presence of producer services no doubt coincide. Producer service employment data (table 1.2) is required to enable a better analysis of this sector at a national level.

Producer Service National Distribution

The nature of producer services activities preclude using simple population distribution as the template for where employment in these services will be spatially concentrated. The end markets for producer services are other businesses and these include firms in their own and other economic sectors. Producer services differ from other industrial sectors largely by their direct connection to other businesses for the end

market of goods and services provided. This fundamental characteristic must be

considered when interpreting the distribution of producer service employment at a

variety of spatial scales. In addition, the growth in services has not been uniform for

both consumer and producer services. Similar to the broader service sector, portions

within producer services continue to increase at different rates. Some have shown

marked growth while others have kept pace with the overall gains in US employment

since the 1980s. Figure 2.7 is an example of this variance in growth in just a single year

based on receipts by service industry.
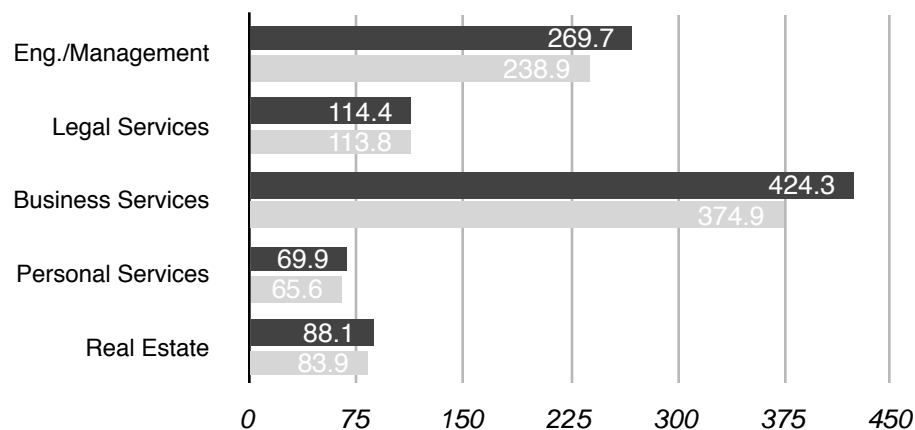
Figure 2.7: A single year growth in receipts for selected US services from 1994 (light bar) and 1995 (dark bar), shown in $ billions. Data source: Current Business Reports BS-95, Service Annual Survey, US Bureau of the Census, 1997.

Figures 2.8 - 2.11 reveal the LQ scores by state for each of the four principal

producer service divisions. The resulting distribution of sectors within producer services

yield differing patterns of sector spatial concentrations. The various engines of

economic growth in the US have created a heterogeneous state-level distribution of

producer services.

Business Services : 1990

Location Quotient

- ☐ 0 -100
- ☐ 101 - 120
- ☐ 121 - 150
- ■ 151 - 180

Source of data: Taken from Harrington and Warf 1995 and derived from US Bureau of the Census Economic Census 1992.

Finance, Insurance and Real Estate Services : 1990

Location Quotient

- ☐ 0 -100
- ☐ 101 - 120
- ☐ 121 - 130
- ■ 131 - 180

Source of data: Taken from Harrington and Warf 1995 and derived from US Bureau of the Census Economic Census 1992.

Figures 2.8 & 2.9: The location quotient by state for business and financial services for 1990.

Data source: US Bureau of the Census, 1992.

Legal Services : 1990

Location Quotient

- ☐ 0 -100
- ☐ 101 - 150
- ▨ 151 - 200
- ■ 201 - 800

Source of data: Taken from Harrington and Warf 1995 and derived from US Bureau of the Census Economic Census 1992. Not visible here, the District of Columbia LQ = 774.

Engineering Services : 1990

Location Quotient

- ☐ 0 -100
- ☐ 101 - 150
- ▨ 151 - 200
- ■ 201 - 300

Source of data: Taken from Harrington and Warf 1995 and derived from US Bureau of the Census Economic Census 1992.

Figures 2.10 & 2.11: The location quotient by state for legal and engineering services for 1990.

Data source: US Bureau of the Census, 1992.

Business services (figure 2.8), as the largest employer of producer services, show specific concentrations in the Washington DC metro area of Maryland and Virginia, and surprisingly, Utah. Other highly urbanized states such as California, Florida, New York, and Texas also show a significant concentration of business services. The location of finance, insurance and real estate (FIRE) services was previously shown, but we have included FIRE (figure 2.9) alongside the other major producer service sectors with the change in the classification scheme. Here the concentration of finance and real estate is quite obviously concentrated in New York State with high LQ percentages in adjoining states and the Washington DC area. Regions showing sparse employment in FIRE services include the inter-mountain states of the west, and a wide swath of states in the Appalachians.

Legal services (figure 2.10) are perhaps the most concentrated showing the clear dominance of the Washington DC area with a LQ nearly eight-times that of most other states. There are, however, sizable proportions of jobs in the legal services distributed other states including Pennsylvania-New Jersey-Connecticut corridor, and, Texas, Arizona, and Illinois. Both the mid-western states and the southeastern states display a noticeable absence in legal services. California too scores an LQ below 100 (equivalent to 1) and may be due in part to the relative high numbers of population employed in other sectors such as agriculture, manufacturing and the military. Engineering and research services (figure 2.11) also display a unambiguous distribution pattern at the state level. The northeast and mid-Atlantic areas score quite high with the Washington DC area ranking at the top. Also, New Mexico score better than two-times an equal share in this sector, perhaps due to lower overall population and an emphasis on attracting new research to the state. The western sun-belt states stretching from California to Texas form a significant concentration of employment in engineering and

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research services. The growth in employment in this section has played a role in the migration of persons from other US states (Crown 1991).

Metropolitan Area Producer Service Distribution

Producer services are identified as the types of industrial activities that require both agglomeration and urbanization economies of larger urban areas. US metropolitan areas are critical centers of employment, and, as the producer services maps have indicated, the majority of producer service employment resides in the states with these large urban populations. Examining then the distribution of these services at the metropolitan level appears a logical next step.

The macro economy of the United States is intimately tied to the combined economies of the metropolitan areas (Frey and Alden 1988; O'Sullivan 1993). As the United States evolved from an agricultural and manufacturing economy to one today dominated by information and services, urban areas became the principal sources of jobs and higher wage earning potential. It is at this level of spatial aggregation that the distribution of these varied producer service activities that makes it possible to reveal the importance the growth in producer services has had on the regional and metropolitan areas, but also, ultimately, the national economy of the United States. Finer scale aggregation units afforded by a metropolitan area definition makes it possible to map the location concentrations of producer services. Much of the spatial economic research has tended to focus on the examination of urban specialization and how this impacts jobs, where establishments locate and the potential for future economic growth or decline (Duranton, 2000).

To illustrate this point, using OMB spatial and US Census economic data it is possible to map the distribution of all service establishments in US Metropolitan areas

(see figure 2.12). The mapping of services reveals the heterogeneous distribution of service activities across the US at the metropolitan level. Services are found within all the 261 US metropolitan areas but differ considerably in their numbers. The spatial distribution of services (SIC 70-88) shown here represents a spatially specific distribution of a gross-level economic sector.

Service Establishments in US Metropolitan Areas: 1998

Service Establishments
- 500 - 1,468
- 1,469 - 3,502
- 3,503 - 10,405
- 10,406 - 12,667
- 12,668 - 91,273

Source of economic and map data: U.S. Small Business Administration 1998
http://www.sba.gov/advo/stats/data.html. MSA boundary data provided by The Office of Management and Budget (OMB) defines metropolitan areas (MAs) following the official standards published in the Federal Register (55 FR 12154-12160) on March 30, 1990.

Figure 2.12: Service establishments by Metropolitan Statistical Areas (MSAs) of the United States (coterminous), 1998.

The distribution of service establishments across the US reveals that service employment is critical for most of the larger metropolitan area economies. Urban geographers have long recognized that metropolitan areas are far from uniform in the distribution of social or economic activities (Johnston 1983; Wheeler 1993). It is evident from examining the distribution of economic sectors at the US state level that there are clear regional patterns of concentration in specific sectors. Likewise when examining

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the distribution of economic sectors within US metropolitan areas we find there is also a heterogeneous distribution in producer services. Figure 2.12 reveals the highest numbers of establishments are found in cities throughout the Northeast and other major regional metropolitan areas including Chicago, St. Louis, Los Angeles, Atlanta, Seattle, and Minneapolis. It is important to recognize that the fabric of US urban areas form a national system of cities that are economically competitive. While not a direct proxy for producer services, the mapping of all services forms a reasonable empirical basis for interpreting other data for producer service employment within particular US metropolitan areas.

A critical industrial-economic organizing function of metropolitan areas is the development of "clusters" of service economic activities within US metropolitan areas. US economic industrial clusters are distinguished primarily by the geographic concentration of similar industries in an area, sharing of technical skills, financial and distributional advantage, existence of specialized buyer-supplier relationships and dependencies, and, competitive advantage in the marketplace (DRI/McGraw-Hill 1995). The presence of these metropolitan clusters provides an additional source of pertinent data for discerning the concentration of producer services and allow for comparisons between urban centers (see table 2.1).

Metropolitan Area Analysis

The distribution of business services (SIC 73) across US metropolitan areas reveal illustrative patterns of economic and employment concentration and heterogeneity[2]. Nationally the metropolitan areas along the Atlantic coast contain twice the business services as the west coast, and almost four-times those in the Midwest.

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[2] See DRI/McGraw-Hill, 1995 for the complete metropolitan cluster data.

Table 2.1: The ten leading metropolitan areas for employment in business and financial services for United States MSAs, 1994. Source: DRI/McGraw-Hill, 1995.

Business Service MSAs	Employees (1000's)	Percentage Growth 79-94	Employment Change % 79-94
New York (NY-NJ-CT)	391.0	3.7	163.0
Los Angeles-Orange County	266.3	5.4	145.5
Washington-Baltimore	**234.6**	**5.9**	**135.5**
Chicago-Gary-Kenosha	184.5	5.7	103.7
San Francisco-Oakland	136.6	4.5	66.1
Boston-Worcester	132.6	5.6	73.8
Philadelphia-Wilmington	113.1	5.1	59.1
Houston-Galveston	90.8	5.3	48.8
Detroit-Ann Arbor	87.1	5.3	46.7
Dallas-Fort Worth	79.3	7.3	51.6

Financial Service MSAs	Employees (1000's)	Percentage Growth 79-94	Employment Change % 79-94
New York (NY-NJ-CT)	706.1	1.9	171.6
Los Angeles-Orange County	292.0	1.8	69.2
Chicago-Gary-Kenosha	259.3	2.2	72.1
Boston-Worcester	169.3	2.2	47.3
San Francisco-Oakland	166.4	1.3	29.1
Philadelphia-Wilmington	165.3	2.5	51.6
Washington-Baltimore	**154.1**	**3.5**	**62.7**
Dallas-Fort Worth	116.1	2.9	40.3
Minneapolis, MN	93.0	3.8	39.8
Atlanta, GA	90.0	3.7	38.0

Since the 1980s some Midwest metropolitan areas have been actually gaining in business service employment. Chicago, as a regional center, is growing at a faster rate in business service employment than that of New York City. Nationwide business service concentrations have likewise spread to other major regional economic centers including Denver, Phoenix and Seattle.

The West coast is home to the second largest concentration of business service employment where southern California has almost two-thirds the employment of the greater New York area. San Francisco retains a large number of business service workers, though by 1995 appears to be growing at a slower rate than Los Angeles. Interestingly, the Washington DC area is just below Los Angeles in business service employment even though the overall population of the Washington DC metropolitan areas is substantially lower than Los Angeles.

The metropolitan distribution of financial services (SIC 60-69), displays a different pattern of metropolitan specialization. While business services display a more regionally distributed pattern across the US urban centers, financial service employment is much more specific. It is clear that cities in the east are dominate, with the New York metropolitan area displaying by far the greatest concentration, well over three times greater than any other metropolitan area. This concentration reveals the role of these urban centers, primarily New York, as financial centers for Europe and other parts of the world (Daniels 1991; 1993). Although Washington DC is growing in financial service employment at twice the rate of the New York metropolitan area. Midwestern cities, lead by Chicago but also including Des Moines, Sioux Falls, Minneapolis, and, Columbus, differ in their export focus acting as regional centers for domestic financial services rather than an international market place. The largest gap in the distribution of financial services appears in the inter-mountain west, where no key concentrations of financial

services are found. West coast metropolitan areas of Los Angeles, San Francisco, and,

Portland dominate this regions employment in financial services. In terms of growth in

employment since the 1970s, it appears, conversely, that the mid-sized urban areas are

those metro areas showing the greatest percentage growth in financial service

employment.

The distribution of 'advanced' producer services, including information

technologies (SIC 737, 89), by metropolitan area reveals another distribution pattern.

Technological innovation continues to play a role in the development of the service

spatial economy, and has been especially important to the growth of the producer

service sector (Storper and Harrison 1991). Stanback (1985) notes that changes in

technological development, especially with information intensive industries, drives

metropolitan growth. Table 2.2 provides a list of those metropolitan areas where

specialization in advanced producer services is noted. Of note in these data of LQ

scores is the marked differences in specialization in closely related producer service

functions, such as computer systems and software production. Austin has a significant

concentration of software production (2.8) yet does not match this concentration in data

processing employment (0.7).

Greater levels of employment in advanced or high technology producer services

are of importance to urban areas, as Cortright and Mayer recently noted:

> *"For those metropolitan areas hosting significant concentrations of high*
> *technology industries, the beneficial impacts have been tremendous. Internet*
> *companies, software developers, biotech, computer and electronics companies*
> *pay high wages to programmers, scientists and engineers, and the computer and*
> *electronics companies have provided many opportunities for entry level jobs.*
> *Contrary to common wisdom, high technology varies dramatically from place to*
> *place. Different metropolitan areas tend to specialize in certain technologies and*

have major concentrations of firms and employment in relatively few product

categories (Cortright and Mayer 2001, 2)*."*

Table 2.2: Location quotients for employment in high technology producer services, 1997. Data Source: Economic Census, 1997, Bureau of Economic Analysis.

	Software Production	Data Processing	Computer System Design	Overall High Tech LQ
San Jose, CA	11.3	1.4	3.3	9.2
Austin, TX	2.8	0.7	1.9	3.5
Raleigh-Durham, NC	1.4	0.7	1.9	2.7
Washington, DC	1.8	3.0	5.7	2.2
Boston, MA	4.8	1.6	1.7	2.2

Conclusion

An important piece of information for producer service research is knowing where producer service jobs tended to concentrate, if at all, and which US states and cities have been the most successful in attracting or growing producer service employment. From the data provided in this chapter reliable statements regarding the location tendencies for US producer service industries can be made. At the national scale producer services demonstrate a heterogeneous pattern. When viewing the state level producer services have, similar to other traditional industries, become concentrated in particular regions and particular cities. The point that producer services spatial distributions differ from those of personal services demonstrates that different influences are at work. It is interesting to note that the majority of these key metropolitan areas do not show strong specialization across the producer service categories shown. This

indicates that even within urban areas with high numbers of producer services, there remains a great deal of specialization within the producer service sector.

These data reveal that the most populous US urban centers are dominant in producer service employment. New York and Los Angeles Metropolitan Areas are the greatest employers in business and financial services but many other cities noted also have significant producer service sectors. Mid-sized cities such as Seattle, Washington DC, Atlanta, and, Minneapolis have witnessed significant growth of several producer service sectors. In a few instances the rate of growth in these cities has been greater than that of both New York and Los Angeles. The spatial influences of regional economies continues to play a role in shaping the development of innovative industrial processes, many of those found within producer services (e.g. computer services, data entry, research). The discussion of producer service location data and analyses provides needed information pertinent to the selection of suitable producer service research. The following chapter discusses the selection criteria for this case study analysis based in the Washington DC metropolitan area and the research methods and limitations.

CHAPTER THREE: PRODUCER SERVICES IN THE WASHINGTON DC METROPOLITAN AREA

Introduction

The literature provides several compelling theoretical reasons to anticipate that producer services will be distributed unevenly within large urban areas. Geographic research also notes that the distribution patterns of consumer versus producer services will differ due to the influence of end markets for these services. The objectives of this chapter are then twofold. The first objective is to describe the key research elements needed for further geographic analysis including characteristics of the research study area, sources and preparation of the research data, and the methods used to develop the analytical and spatial analysis outputs. The second objective is to illustrate this outcome and then discuss the location patterns of producer services in the study area using geographic information systems (GIS) output.

Urban-based research over the past decade has made clear that GIS technologies significantly improve our ability to explore and analyze a host of urban-based phenomena (Wong 1996). The use of GIS software tools has become essential in managing, displaying and analyzing the spatial data associated with research of urban areas. However, obtaining detailed, adequately documented, spatial data for examining the location of producer services continues to be a significant impediment for intra-metropolitan business research. This deficit has been noted by other researchers engaged in producer service research at the intra-metropolitan level (Harrington, MacPherson et al. 1991; Beyers 1992; Coffey 1995). The research presented here makes use of a commercial data source that has been modified to allow the spatial

representation of producer services in the Washington DC area for 1997. The location

patterns of metropolitan area producer establishments presented in this chapter are

aggregated using US postal code-based areas.

Study Area Characteristics

The study area chosen for this dissertation research is the Washington DC

metropolitan area. The Washington metropolitan area (herein as the 'Metro area')

includes several independent cities, counties, portions of two states and a federal

district. Totaling in land area some 6,000 square miles (15,500 km) that encompasses

the District of Columbia, Northern Virginia and Suburban Maryland (see figure 3.1)[1]. The

Metro area population by 2003 is significant with over five million residents making it the

fourth most populace U.S metropolitan area. In terms of job growth, the DC metro area

has shown large increases in new employment since the 1990s, adding some 19,900

new jobs in 2003 alone. The DC metro area is also a leader in regional job growth over

past two decades adding over 1.1 million jobs during this period. The scope and scale

of business fiscal development in the metro area is also impressive with a gross regional

product of nearly $288 billion, the fourth largest in the nation, and the largest number of

Inc. 500 companies for the last seven consecutive years (47 by 2003). The strong

growth in employment be in part due to the quality of the regional labor force where 42%

of residents (age 25 and above) hold a bachelor's degree. The median household

income by 2003 is over $70,000 reflects the high salaries available in the area (data

drawn from the Greater Washington Initiative and the US Bureau of the Census).

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[1] The physical extent used in this analysis is but a portion of the complete 1999 consolidated MSA area. In other words the actual extent of the study area does not completely coincide with the OMB definition. The study area for this analysis and the data collected for it is considered contained within the Office of Management and Budget (OMB) and US Bureau of the Census definition for the Washington DC Metropolitan area.

The Washington DC Study Area:
Jurisdictions and Major Transportation
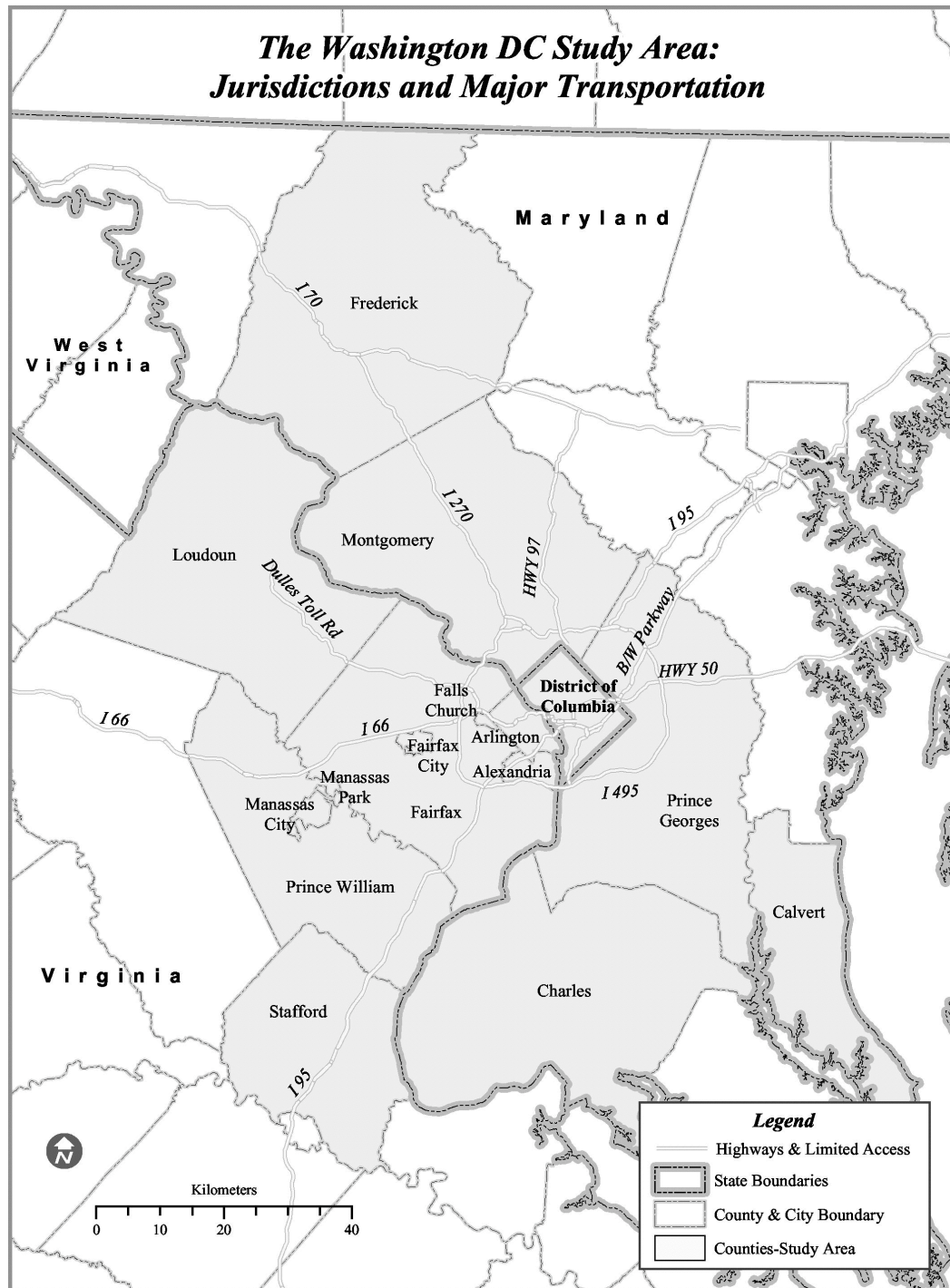
Figure 3.1: The Washington DC metropolitan study area. The counties, cities and Federal District are shown here darkened and comprise the study and data collection area.

The DC metro area is home to the key US agencies and supporting functional offices of the Federal government who have become major consumers of many types of producer services (Office of Technology Assessment, 1995). The presence of the Federal government and its supporting agencies, with a need for producer services, is a critical piece of the regional attraction of these services, the result being that the DC metro area continues to lead all other US urban areas in its share of public administration, a location quotient of 2.7 for example, and producer services (over 140,000 jobs in the District alone by 2003). The out sourcing of jobs from direct US Federal government employment to the private sector is of course an important aspect of regional research examining the actual growth of metro area producer services employment (Goe, 1991).

Employment in information technology (IT) and professional services are found in abundance within the Washington DC region where the metro area is considered an established leader in the growth of the high-tech industry (Mosquera, 2001). The Metro area has increased employment in the professional, technical and scientific services amounting to over 285,000 by 1997; significantly larger than retail employment and other non-producer service employment. The growth of the IT and professional sector employment has had a profound, perhaps unforeseen, impact in the area suburban economies where some metro area counties have seen alarmingly rapid population growth and accompanying land use conversion.

Research Preparation Methods

To create geo spatial-based research output for analysis and display used in location research of producer services within the Metro area, a multistep procedure was developed for preparing and extracting needed spatial data and all associated geo-

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spatial reference data. The following sections provide a brief overview of each critical

component of these methodological procedures.

Business Data

The availability of business information pertinent for understanding spatial

characteristics of these activities *within* metropolitan areas is limited. Federal and state

governments are the principal bodies responsible for collecting business data for

economic forecasting and other uses[2]. Data are often aggregated into single

metropolitan area units or, more often, larger regional aggregates creating a major

impediment for geographic research of businesses within metropolitan areas. Moreover,

the spotty record of data collection by the Federal and state governments, changes in

the type of records, and, differences in collection techniques employed all hamper the

ability to perform basic research.

In response, an increasingly important source of business data comes now from

private sector firms engaged in data collection and preparation. The growth of economic

and planning applications using GIS technologies has created a rapidly growing market

for small area geography business data. The cost, however, of data for individual

businesses from the leading commercial reporting firms remains very high (e.g. ~ $3/

business record). The cost of the most detailed data available for producer service

sector location research has created limitations in the scope of this research.

Robust establishment-level data sets are used here that meet the essential

criteria for spatially identifying producer service establishments at the establishment-

level within the study area. The data set selected for this research was created by the

---

[2] The economic census data provide information for US businesses that includes location of the establishment, numbers of employees grouped into classes and the dollar sum of yearly receipts. State and local governments tend to provide information on economic activities within states using unique and often differing reporting procedures. National, state and regional business organizations, such as Chambers of Commerce and professional societies and associations, publish business data specific to certain geographic areas and types of economic activity, the emerging high-tech sector is one quite current example.

consumer and business data base firm InfoUSA[3] (see http://www.infousa.com). The

company supports over three million customers using its proprietary databases to

generate value-added products such as direct mailings, market research, and other

business planning functions. InfoUSA's America Direct Phone data is used in this

research to locate producer service firms in the Metro area. These business data sets

are assembled using several public record sources, including:

* 5,200 Yellow Page and Business White Page directories
* Federal, State, City and County business records
* Phone records to verify the information (four times/year)
* New business registration and incorporation
* 10K's and other securities filings
* Annual business reports
* Business magazines, newspapers, company newsletters
* Bankruptcy records and legal filings
* National Change of Address.

The public source inputs used by InfoUSA come from a sufficiently wide variety of

sources to assure confidence in the adequacy of data collected for research purposes.

This data set does offer a spatially rich source of business information discerning very

specific industrial types (up to six SIC digits) across all US metropolitan areas to the

street level and are not based on sampling.

To construct the producer service database used for the Metro area it was

necessary to manually export ASCII business records for each establishment and then

collate these single records into two, three and four-digit SIC groupings. The extraction

of business records from the InfoUSA data base resulted in a total of 73,404 producer

service business records within to the Metro area[4]. The process used to extract these

data also resulted in the duplication of some establishment records. Duplication of data

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[3] Additional information about InfoUSA data collection methodologies are at http://www.infousa.com.

[4] Producer service establishment records were defined using the SIC groups most often attributed to this sector discussed. The specific SICs used are listed in both Tables 1.2 and 3.1.

stem from records that repeat same firm/same address for a single establishment (i.e.

physical location). These duplicates are found primarily with banking and insurance

firms where many establishments are found to have a single address but many phone

numbers. Most, but not all, of these duplicate records were removed (some 900+ data

records) helping correct a negligible skewing of some establishment count statistics.

The numerical distribution of these establishment producer service records across the

major sectors is shown in Figure 3.2. The largest numbers of producer service

establishments for 2/3 of all within the Metro area come from just three sectors,

engineering and management, business services, and legal services. A more detailed

view of these data are found in Table 3.1 that provides the statistical summary for the

whole data set.
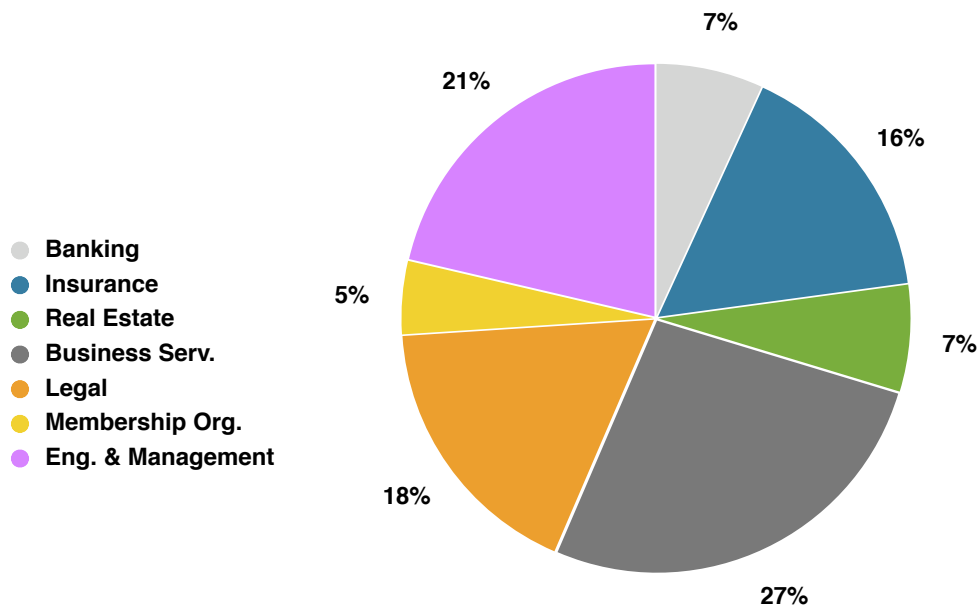
Figure 3.2: The relative percentage of all producer service establishments for the DC Metro area, based on 2-digit SIC groups using the 73,000 records from InfoUSA data base for 1997.

Table 3.1: The statistical summary of the extracted producer service data base. The summary includes the establishment count, percentage of 2-digit SIC group, percentage of all producer services, and the rank of all producer services.

SIC	Producer Service Type	Count	2 Digit	All PS	Rank
60	**Depository Institutions**	**1,851**		**2.52%**	
602	Commercial Banks	1,334	72.07%	1.82%	14
603	Savings Institutions	136	7.35%	0.19%	29
606	Credit Unions	175	13.12%	0.24%	26
609	Functions Closely Related Banking	206	11.13%	0.28%	25
61	**Nondepository Institutions**	**2,185**		**2.98%**	
611	Federal & Federal-sponsored Credit	61	2.79%	0.08%	35
614	Personal Credit Institutions	747	34.19%	1.02%	18
615	Business Credit Institutions	159	7.28%	0.22%	27
616	Mortgage Bankers and Brokers	1,218	55.74%	1.66%	15
62	**Security And Commodity Brokers**	**1,411**		**1.92%**	
621	Security Brokers and Dealers	534	37.85%	0.73%	21
622	Commodity Brokers, Dealers	33	2.34%	0.04%	36
623	Security and Commodity Exchanges	2	0.14%	0.00%	40
628	Security and Commodity Services	842	59.67%	1.15%	17
63	**Insurance Carriers**	**281**		**0.38%**	
631	Life Insurance	2	0.71%	0.00%	41
632	Medical Service & Health Insurance	62	22.06%	0.08%	34
633	Fire, Marine, & Casualty Insurance	7	2.49%	0.01%	38
635	Surety Insurance	84	29.89%	0.11%	33
636	Title Insurance	8	2.85%	0.01%	37
637	Pension, Health, and Welfare Funds	114	40.57%	0.16%	31
639	Insurance Carriers, NEC	4	1.42%	0.01%	39
64	**Insurance Agents, Brokers and Services**				
641	Insurance Agents, Brokers and Services	5,057	100.00%	6.89%	6
65	**Real Estate**	**7,502**		**10.22%**	
651	Real Estate Operators and Lessors	340	4.53%	0.46%	23
653	Real Estate Agents and Managers	6,014	80.17%	8.19%	4
654	Title Abstract Offices	529	7.05%	0.72%	22
655	Subdividers and Developers	619	8.25%	0.84%	20
73	**Business Services**	**21,019**		**28.63%**	
731	Advertising	860	4.09%	1.17%	16
732	Credit Reporting and Collection	156	0.74%	0.21%	28
733	Mailing, Reproduction, Stenographic	3,363	16.00%	4.58%	8
734	Services to Buildings	2,408	11.46%	3.28%	11
735	Equipment Rental and Leasing	711	3.38%	0.97%	19
736	Personnel Supply Services	1,465	6.97%	2.00%	13
737	Computer & Data Process Services	5,142	24.46%	7.01%	5
738	Miscellaneous Business Services	6,914	32.89%	9.42%	3
81	**Legal Services**	**13,703**	**100.00%**	**18.67%**	**1**
83	**Social Services**				
833	Job Training and Related Services	109	100.00%	0.15%	32
86	**Membership Organizations**	**3,647**		**4.97%**	
861	Business Associations	3,259	89.36%	4.44%	10
862	Professional Organizations	125	3.43%	0.17%	30
863	Labor Organizations	263	7.21%	0.36%	24
87	**Engineering and Management Services**	**16,748**		**22.82%**	
871	Eng. & Architectural Services	3,295	19.67%	4.49%	9
872	Account, Auditing, and Bookkeeping	3,578	21.36%	4.87%	7
873	Research and Testing Services	1,749	10.44%	2.38%	12
874	Management & Public Rel.	8,126	48.52%	11.07%	2

Temporal Selection

The data chosen for this producer service geographic research was collected in 1997. The selection of a single year was a deliberate action based on the requirements of the analysis performed in this research. The examination of producer service location here is connected to the regional technological advancements and processes. This time frame reference captures a period of relative economic 'stasis' where rapid or disjunctive changes in urban employment are minimal.

This period in the late 1990s is representative of the technological economy being born in the mid-decade with its climb from the inception of the massive growth in IT-based economic functions to the collapse of the Internet 'bubble' of the turn of the millennium. 1997 was a growth year for producer service activities based on the economic growth data of sales and establishment creation. In addition, this particular year is distinct enabling a bridge between heritage economic data using SIC to the NAICS system where services are significantly expanded in their characterization. This bridge period represents the latest period from which SIC-based data can be used with a minimum of forward translation into the NAICS. Lastly, to adequately mix data sets gathered for varying purposes and across time spans it is essential to match temporally the geo-spatial baseline data sets (e.g. population, jurisdictions, roads, etc.) with the establishment business data used.

Geo-Spatial Data

An additional data set is required to locate producer service establishments in the Metro area. This data set portrays spatial area using US postal codes, a very common aggregation unit for economic and demographic data analysis and is used by the Federal and state governments among a myriad of other users. The commonality of the

postal code, or ZIP (Zone Improvement Plan) code has arisen from the daily use of these zones for conducting matters of commerce and exchange of many kinds[5]. The Washington DC study area contains 450 discrete ZIP codes. A large number of these ZIP codes are, however, assigned for speciality purposes such as large federal buildings, military and other special cases and are not illustrative of commercial activity. The research methodology plan uses a subset of the total zip code data comprising the ~265 units that have spatial extent (see figure 3.3).

The data set chosen for the spatial representation of ZIP code areas was developed by the US Census Bureau whose spatial units are known as ZIP Code Tabulation Areas (ZCTAs). Several ZIP code area data sets from non-government providers were reviewed but each was not able to meet the match rate as the Census Bureau data. ZCTAs are used as the spatial geography within the Metro area to link statistical data of producer services (e.g. InfoUSA data) to geographic areas. An important quality of this data layer is one of spatial accuracy, the geographic area (shape) representation of the ZCTA, and numerically (code), where the ZCTA is consistent with the spatial areas denoted. These units are analogous to and their origins from those used by the US Postal Service but differ in some instances where the spatial characterization of area boundaries vary. The spatial representation is more than adequate for the analysis of producer services at this spatial scale. If street-level geo-coding is used an evaluation of these data's spatial accuracy would need to be addressed.

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[5] Use caution in associating postal code areas with areas demarcated as neighborhoods or some other social or economic cohort area. Postal codes are used primarily for the orderly and systematic mail delivery to residences and businesses and attempts to maximize on available mail handling resources and delivery times. The creation of or changes to existing postal code boundaries is what is best described as an 'organic process' where an individual post office must petition the office of the US Post Master General to obtain final permission. The aim of the postal service does not always comply neatly with the needs of producer service economic research.

The Washington DC Study Area:
ZIP Code Boundaries

Legend
Highways & Limited Access
State Boundaries
County & City Boundaries
Counties-Study Area
ZIP Code Areas
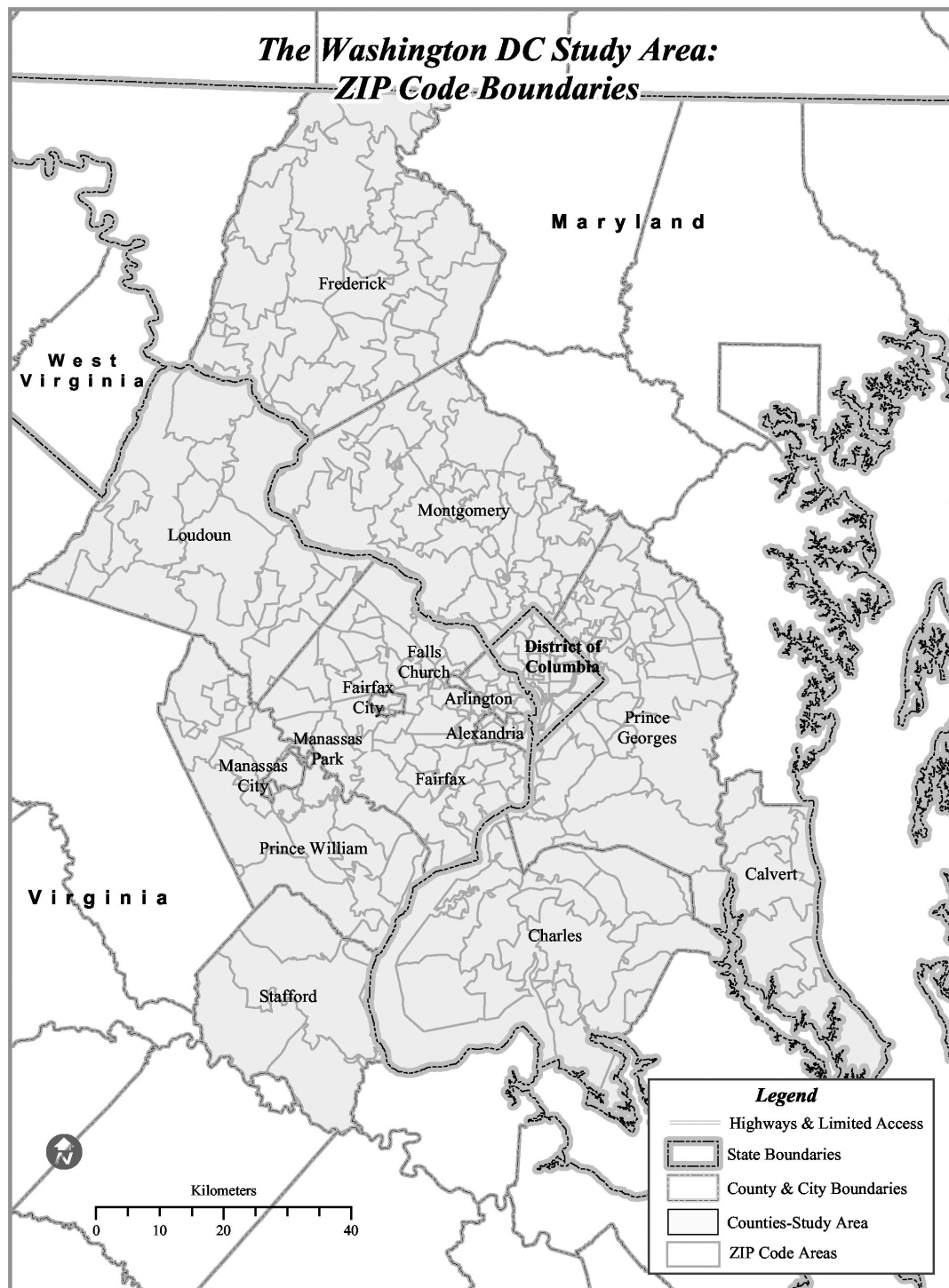
Figure 3.3: The 265 Zip Code Tabulation Areas (ZCTAs) of the Washington DC study area. Data source boundary data from the US Bureau of the Census, 5-Digit ZIP code boundary files, 2001.
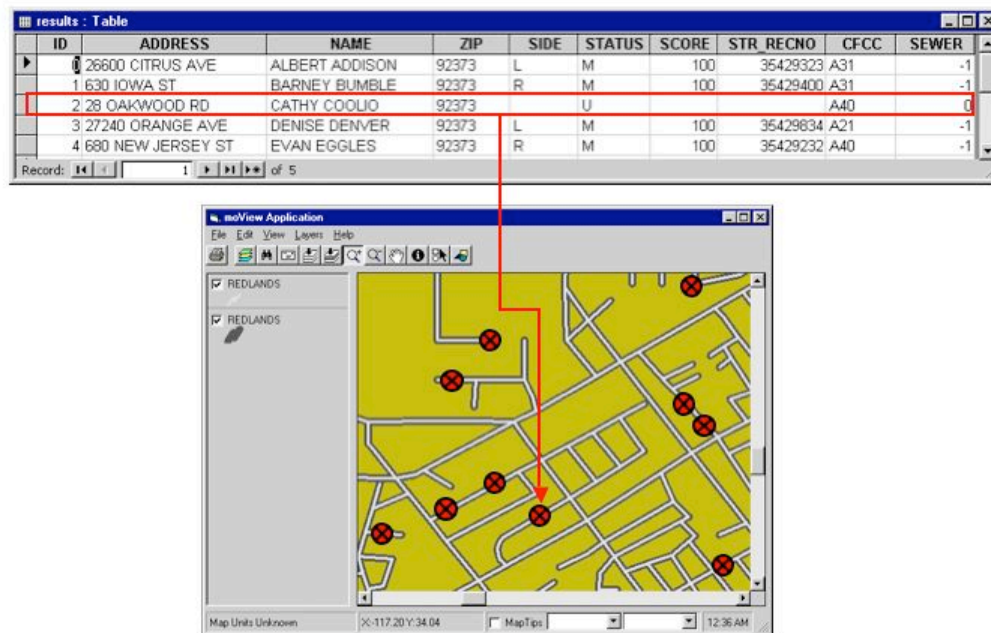
Figure 3.4: A visual representation of geocoding using ArcGIS software demonstrating single data base records are matched to geographic areas (points).

Geocoding

Geocoding is the process where geo-spatial coordinates (e.g. lat./long.) of a location are linked to any phenomena of interest. These coordinates are then used by computer software to graphically represent geographic points, lines, or areas and then provide the method for linking characteristics of these spatial objects to information held in a data base (see figure 3.4). In short, geocoding is an information analysis tool to connect two or more databases, one containing geo-referenced spatial information, such as street addresses, with others containing attribute data.

To perform the geocoding of producer service establishment data, tools from Environmental Science Resource Institute's (ESRI) ArcGIS 8.1 software are employed. This software GIS package is used throughout this document to geocode business

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information as well as to create the outputs for visual and analytical inspection. Once a phenomenon has been geocoded it creates data base links from those specific locations (point) or regions (area) to where the phenomenon's attributes can be associated. Geocoding provides a geographic means for viewing data attributes spatially and with a great degree of accuracy for the geographic arrangement of these attributes (Daniel 1995).

The geocoding procedure employed here is commonly referred to as *address matching*. The self descriptive term denotes the use of address data in place of other forms of geographic location, such as coordinate systems. The infoUSA data of producer services provides street-level address information and thus makes it feasible to use this address information for geocoding establishments. Matching to distinct individual addresses for establishments, while common, can be highly problematic. The central issue is the address record and the diversity of how the records syntax is constructed. Small discrepancies can have large impacts in the ability to match records to points (e.g. road versus rd., misspellings, wrong numbers, etc.). For this reason the address matching performed here uses ZCTA aggregates (polygons) rather than street level establishments (points). The benefit of this are immediately apparent statistically where using address data the match rate for establishments rarely rose above 60-70% of all data records. Using the five digit ZIP code records the match rate improved dramatically where a very small proportion, .01% of all records remained unmatched to a ZCTA. Given the low impact these unmatched records there is robust correspondence between our ZIP code boundary data and the producer service business records.

Producer Service Establishment Distribution

The methodology presented provides the basis for the output of the address matching procedures of the producer service establishment data. To visualize the intra-metropolitan location patterns of the producer service establishments in the Metro area a series of maps are presented in the coming section. These cartographic outputs provide a graphic display of the spatial patterns for the selected producer service industrial groups. One provision of the InfoUSA data set is the lack of employment data attributed to each producer service establishment. An establishment can employ a few to many thousands of workers that are attributed to a specific location. It is noted that the establishment-level data used here cannot directly correspond to employment, so the count data of establishments is used as an approximation of producer service activity within each ZCTA. Figure 3.5 provides an overview Metro area density of all producer service establishments by ZCTA.

The patterns of producer service establishment density in the Metro area are immediate and striking. Rather than map establishment count data, the density map normalizes for the area of the ZCTA so that it is possible to visually and statistically compare smaller, more central, ZCTAs to those in the outer reaches of the Metro area. A initial inspection reveals a clear density pattern of these services concentrating in a few noted areas: the central city (DC), along the I-270 corridor in Montgomery County, Maryland, outer Fairfax county, Arlington, and Greenbelt, Maryland adjacent to the Capital Beltway. This density map represents, however, all producer service types. Given the known heterogeneous nature of the range of services provided within the producer service sector, it is expected that this regional pattern of all producer services will vary greatly once specific portions of the producer service sector are subsequently mapped.

Density of Producer Service Establishments 1997

Legend

County Boundary

ZIP Code Boundary

Establishment Count Density

190.4 - 8804

8805 - 38240

38250 - 144400

144500 - 338100

338200 - 56120000

Null or No Data

210 2 4 6 8 Miles
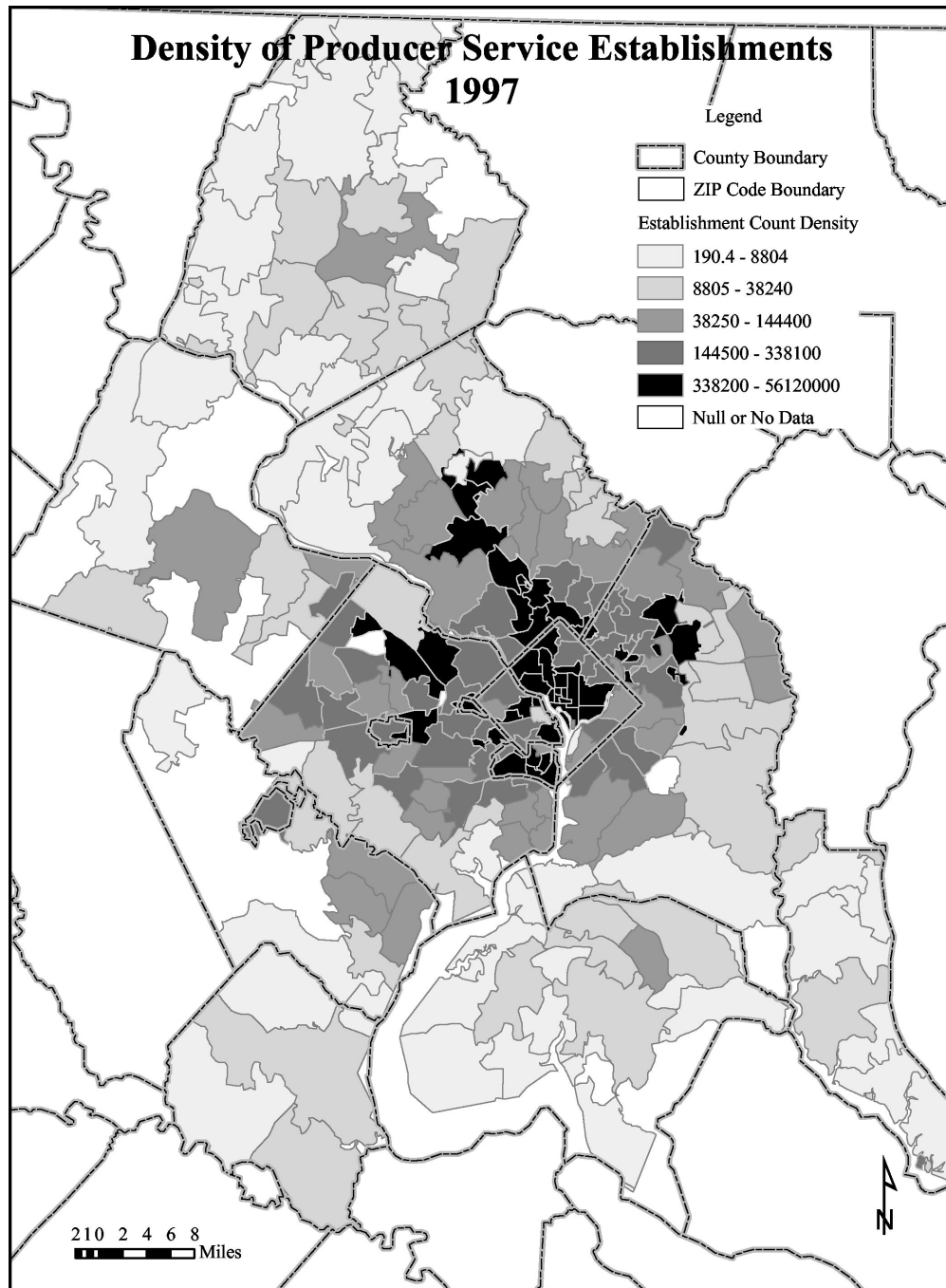
Figure 3.5: The spatial density of producer service establishments by ZCTA for all producer service sectors (SIC 60 – 87) in the Washington DC study area, 1997. Density is calculated per meter squared by total ZCTA area.

For the research and evaluation of the spatial proclivities of producers services a series of maps have been created from the addressed matched ZIP code records of the producer service data. These maps focus on several key producers services that form the majority of the producer service firms within the Metro area. These ten out a total of possible 42 three-digit SIC groups represent 80% of the total number of all establishments (see table 3.2). The resulting spatial distributions mapped for these services represent the most critical, in terms of total establishments, producer service activities within the Metro study area for 1997.

The Location Quotient (LQ) calculation, first discussed in chapter two, is a useful economic base analysis measure for research across all scales. The calculation compares the local economy (those under investigation) to that of another 'reference economy'. To use this measure for the Metro area the base calculation has been modified to incorporate the use of SIC groupings of data. In other words, instead of mapping producer service density by three-digit groups, the data matched to the ZCTAs is the LQ measure for each of the ten sectors. In this analysis the LQ is calculated using the following equation:

$$\frac{\text{3 Digit SIC in ZCTA}}{\text{3 Digit SIC in Metro area}} \bigg/ \frac{\text{All Producer Services in ZCTA}}{\text{All Producer Services in Metro area}}$$

The LQ measure is the ratio between the local economy and the economy of the reference region. The calculation for each ZCTA and for each of the three-digit SIC sectors enables comparisons there for to be made in reference to the statistically relative shares of importance for each the producer service types by area.

Table 3.2: The rank order by establishment count of the top ten producer service 3 digit SIC groups for the Metro area. The groups listed here comprise 80% of all establishments in the infoUSA data set.

SIC	Service Description	Number of Establishments	% of all PS
811	Legal Services	13,703	18.67
874	Management and Public Relations	8,126	11.07
738	Miscellaneous Business Services	6,914	9.42
653	Real Estate Agents and Managers	6,014	8.19
737	Computer & Data Process Services	5,142	7.01
641	Insurance Agents, Brokers and Services	5,057	6.89
872	Account, Auditing, and Bookkeeping	3,578	4.87
733	Mailing, Reproduction, Stenographic	3,363	4.58
871	Eng. & Architectural Services	3,295	4.49
861	Business Associations	3,259	4.44

Producer Service Location Quotients

The goal of this chapter is to provide a through geographic portrayal of producer service establishment activity within the DC Metro area. The final segment of this chapter presents the culmination of the data and methodological steps described to develop meaningful GIS-based output for location analysis of producer services. All 42 sectors have not been separately mapped, but rather a significant subset of these comprising the lion share of all producer service establishments in the Metro area. This initial output from the address matching methods provides a means for discerning the true spatial differences in distribution patterns of discrete producer service sectors at significantly finer scales. These data of the key ZCTAs where the 'relative shares' of producer service establishments are known provides a spatial layer with which the

propensity for this type of service activity can be judged as greater or lesser to other Metro areas.

The following series of maps (figures 3.6 - 3.10) reveal the distribution patterns of the top ten leading producer service sectors in the Metro area. The LQ score attributed to each ZCTA is then subsequently divided to allow for inter-comparisons across producer service sectors. Each sector's LQ score breaks at +/- 1 denoting either a deficit or surplus share in the producer service sector mapped. In addition, the upper scores of LQ where the relative supply of these services is twice or greater are shown up to their full extent. All ZCTAs contain at least some producer service activity, with the exception of those areas for which no verifiable ZIP code can be determined or equally no data is available.
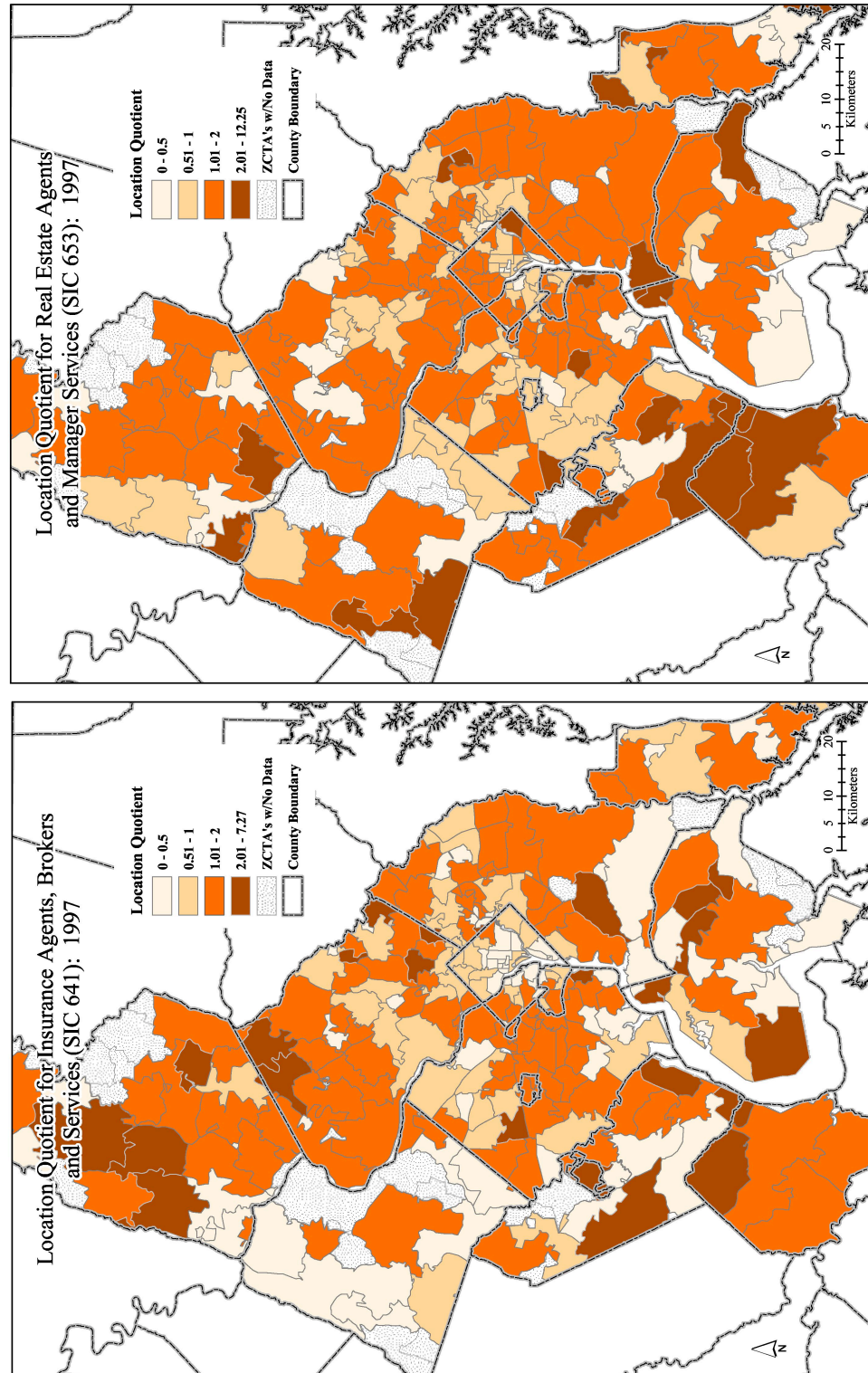
Figure 3.6: The location quotient by ZCTA for SIC 641 Insurance Agents and Brokers (5,057 establishments, 6.89% of all producer services) and SIC 653 Real Agents and Mangers (6,014 establishments, 8.19% of all producer services).

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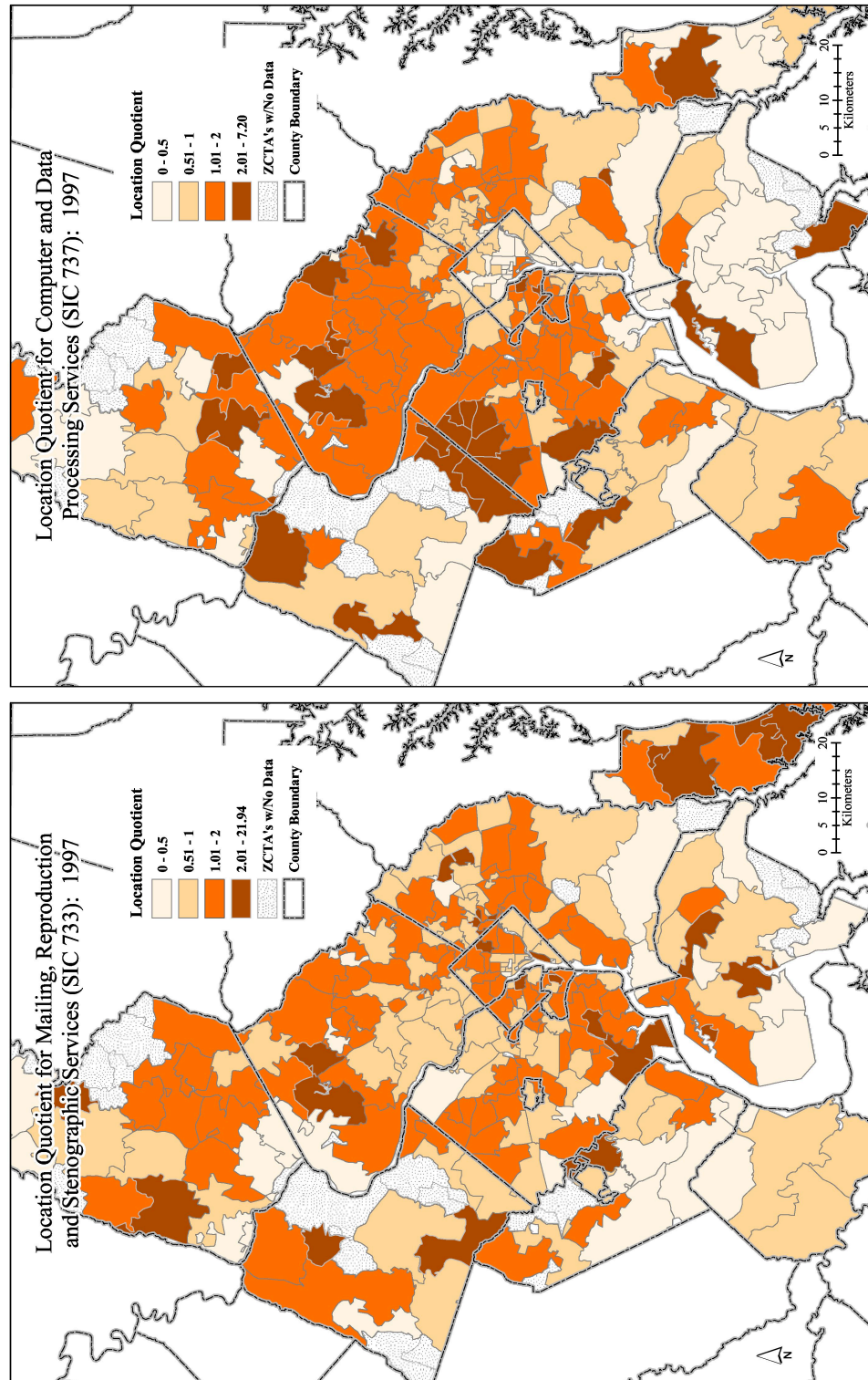
Figure 3.7: The location quotient by ZCTA for SIC 733 Mailing and Reproduction (3,363 establishments, 4.58% of all producer services) and SIC 737 Computer and Data Processing Services (5,142 establishments, 7.01% of all producer services.
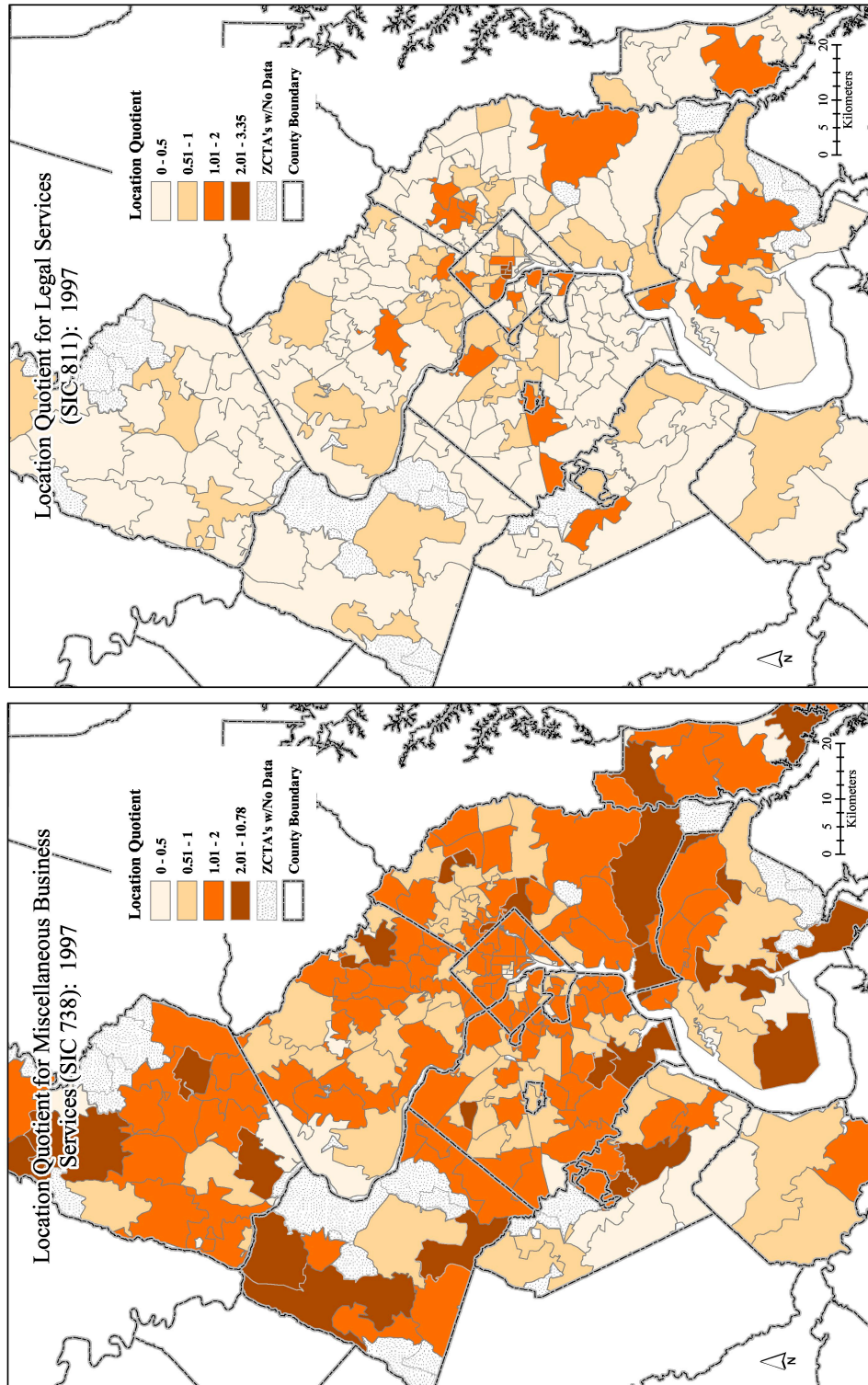
Figure 3.8: The location quotient by ZCTA for SIC 738 Miscellaneous Business Services (9,914 establishments, 9.42% of all producer services) and SIC 811 Legal Services (13,703 establishments, 18.67% of all producer services).
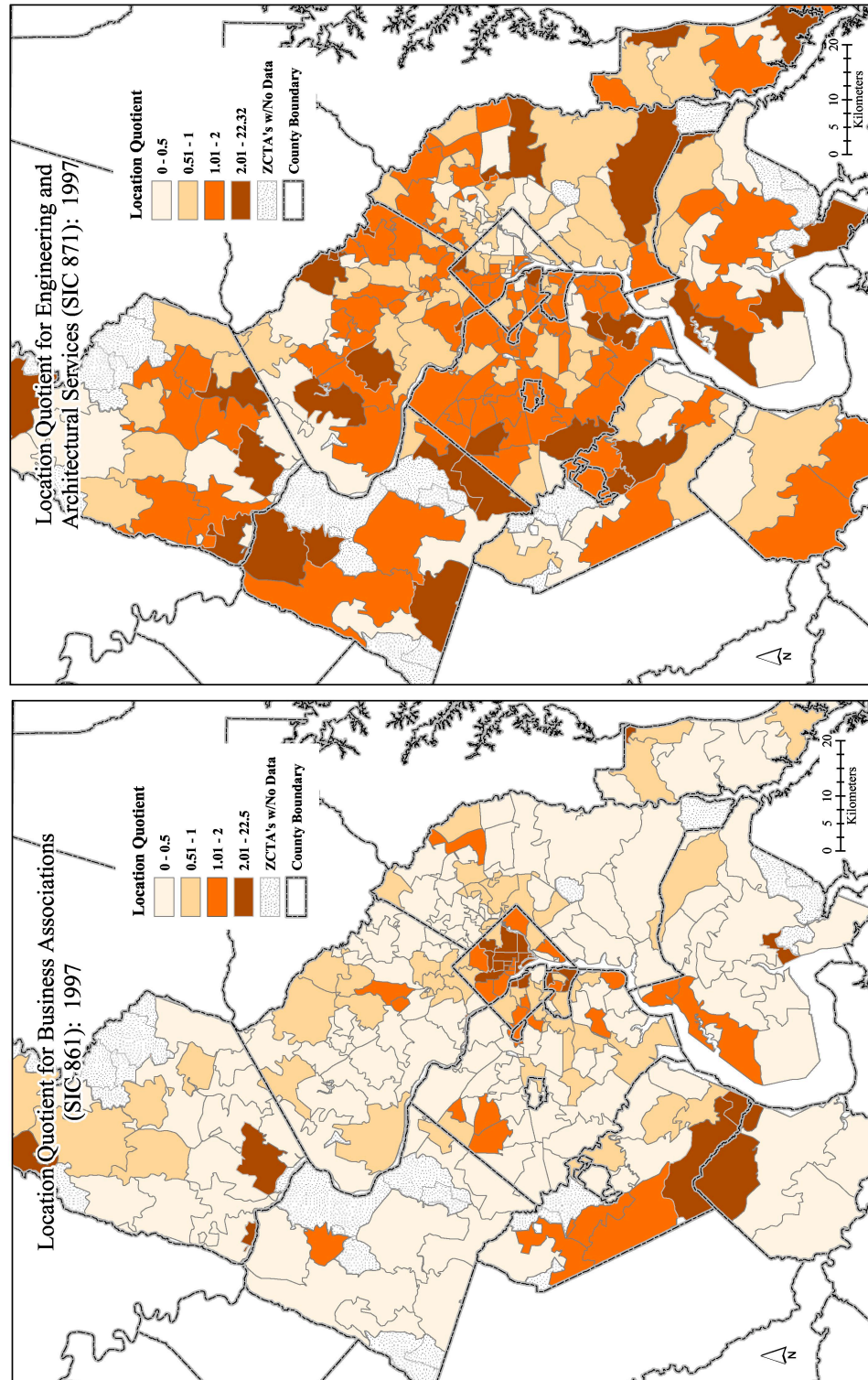
Figure 3.9: The location quotient by ZCTA for SIC 861 Business Associations (3,259 establishments, 4.44% of all producer services) and SIC 871 Engineering and Architectural Services (3,295 establishments, 4.49% of all producer services).

67
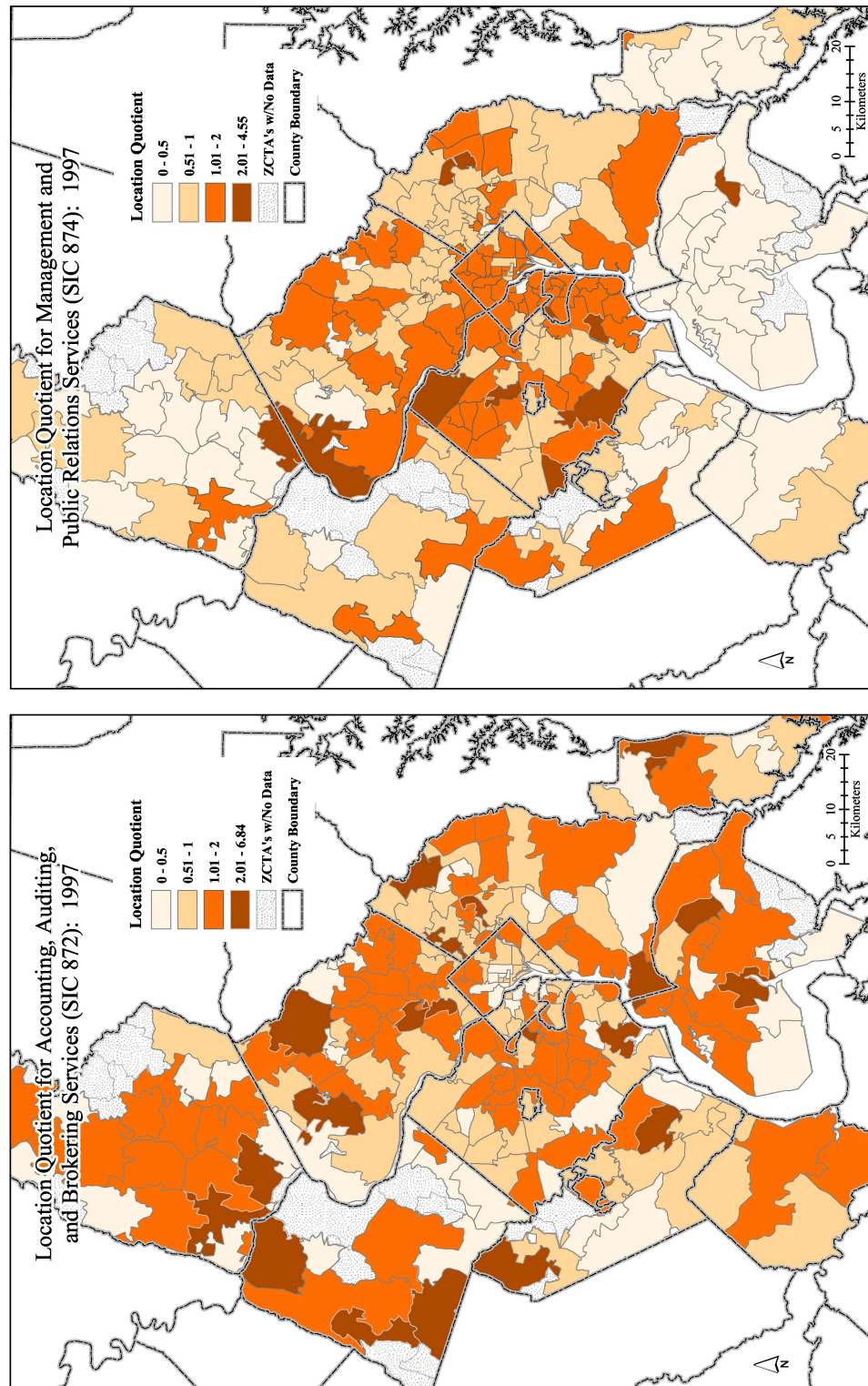
Figure 3.10: The location quotient by ZCTA for SIC 872 Accounting, Auditing and Bookkeeping (3,578 establishments, 4.87% of all producer services) and SIC 874 Management and Public Relation Services (8,126 establishments, 11.07% of all producer services).

Location Analysis

These ten maps reveal the distribution of the key producer service
establishments in the Metro area. As predicted the distribution patterns vary, and in
some instance greatly vary, between three-digit SIC groups. Moreover, the patterns of
LQ scores for each ZCTA shows the level of producer service sector establishment
activity within that area. Where some ZCTAs are found to not have a proportionate
share of a particular sector versus others that have an equal, and in some cases, a
share far in excess of a homogeneous distribution pattern. It is this differentiation in the
geography of producer service concentration across the Metro area that is discussed
here. There are relationships between the sectors in terms of production and market
characteristics. These similarities are used here to form some logical groups for
discussion of the location patterns of establishments. The ten leading producer service
sectors mapped are discussed in four groups; finance, insurance and real estate
(FIRE), legal services and business associations, business services, and, advanced
services including engineering, management and public relations.

Finance, Insurance and Real Estate (FIRE)

An important and well recognized sector of producer services is those relating to
finance, insurance and real estate functions. SIC 641, insurance agents, and SIC 653,
real estate agents and management, comprise the FIRE category. Visual inspection of
figures 3.5 and 3.6 reveal a dispersed pattern of LQ concentrations where these
services tend to concentrate often well outside the central city area. In other words,
these services have a strong location tendency for suburban areas.

Another interesting aspect of these services, which also have among all the rest
the most likely to follow a consumer as well as a business market, is a tendency to be
ubiquitous in ZCTA distribution. Where a very large number of the ZCTA areas (264) are

at or approach an equal share of these services. This denotes that these functions need

to be collocated with their markets, no doubt due to the type of service being rendered.

The result appears to be a fairly homogeneous spread with the exception of the central

city area. Some ZCTAs in the far extremes of the Metro area have some very high LQ

scores which were thought to be anomalies of some error in the data. Examination of

these data reveal overall few establishments per ZCTA but equally very low counts in

other producer service establishments, thus creating the appearance of significant

concentrations.

Legal Services and Professional Business Associations

Legal services, SIC 811, and business associations, SIC 861, are here discussed

given their expected clustering within or near to the Metro area central city. The

Washington DC study area attracts these type of services largely, if not entirely, due to

the close association these establishments may have with government function, policy

formation, lobbying activities and to be physically near the seat of judicial decision

making. Unsurprisingly many of the Metro area legal establishments are highly

clustered in the downtown area near to the Federal government and its agencies. This

spatial pattern of these services helps reinforces research conducted in other

metropolitan areas showing similar spatial patterns (O hUallachain and Reid 1991).

While both sectors are largely concentrated in the central city, their patterns do

vary (see figure 3.11). In this figure that compares the LQ distribution in the central city

of legal establishments and business associations, legal services remain clustered in

principally five ZCTAs while business associations are far more distributed throughout

the whole city. This raises many interesting location strategies such as the continuing

need of legal firms to be physically in close contact with one another, the value of legal

versus business association revenues and the ability to bid for prime real estate, or,

business association must be central but also accessible to suburban interests and associates.
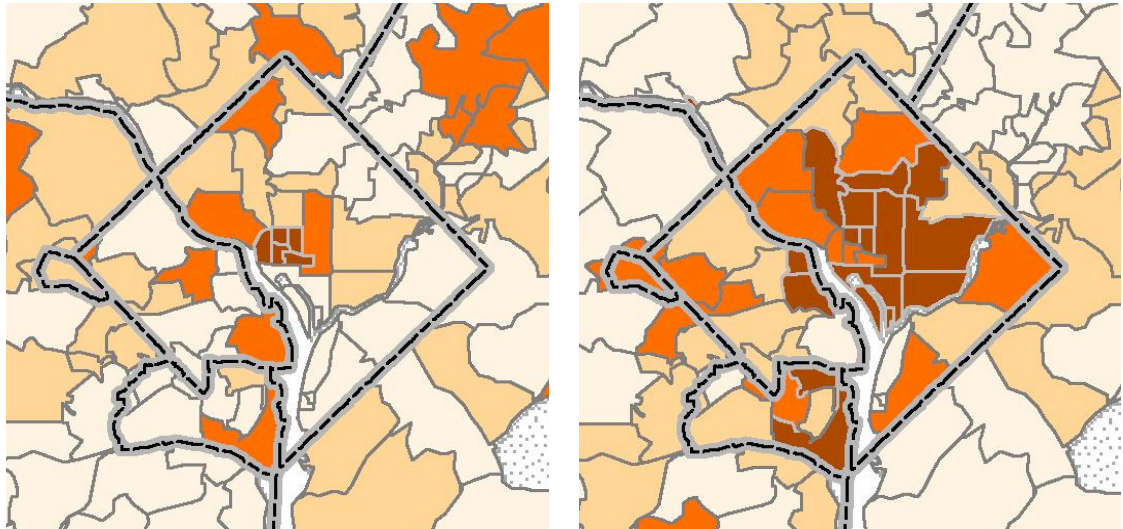
Figure 3.11: A central city detail view of the LQ for ZCTAs of SIC 811, legal services (left side), and SIC 861, business associations (right side). The concentration patterns suggest differing needs for proximity and markets.

Another location dimension to these services can also be seen in the suburban and rural distribution patterns noted in the LQ maps. Unlike other producer services noted, SIC 811 and 861 are not as wide spread beyond the central city, though there are some clear exceptions. For legal services there are a number of ZCTAs beyond central DC where a equal to slightly higher share of legal establishment are found. These appear in each county and a few independent cities in Northern Virginia. These outliers correspond clearly with the presence of suburban office and municipal center areas such as Greenbelt, Silver Spring and Rockville, Maryland, and in Virginia, Fairfax City and Falls Church. Business associations, as noted, are not as concentrated as legal services but also have a stilted suburban distribution. Some ZCTAs in each Maryland and Virginia show a similar connection with suburban centers of municipal and business

area activity, but also noted are a number of these association located in the furthest reaches of Prince William and Stafford Counties. This distribution draws more distinctly the types of consumption for these services.

Business Services

Business services is a very diverse sector of producer services. This diversity within the sector is in part why the NAICS industrial classification system was developed for the US industrial sector. Using the SIC this sector includes three principal pieces relevant to producer services, SIC 733, mailing and reproduction, SIC 737, computer and data processing, and SIC 738, miscellaneous business services. Business services are aptly named in their role is to support and supply needed services to other businesses. The types of services rendered vary markedly, from those requiring high skills to services that are commonly outsourced to other firms, security, building services, etc. Interpretation of establishment location patterns become difficult with this sector given this internal diversity [6].

Patterns of Metro area distributions of business service establishments can be interpreted using the LQ ZCTA maps. SIC 733, mailing and reproduction services, establishments are concentrated within areas of known business activity, suggesting an ongoing requirement for proximity of these services to other businesses. Although, based on the LQ score, several more distant suburban ZCTAs across the Metro area have garnered better than double an equal share of these services (e.g. northern Montgomery and Calvert County, Maryland, and, Loudoun County, Virginia. Despite the

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[6] Miscellaneous business services are primarily engaged in providing detective, guard, and armored car services, fingerprint service, polygraph service, rental of dogs for protective service, monitoring and maintaining security systems devices, provide news, pictures, features, and news reporting services to newspapers and periodicals, developing film and photographic prints and enlargements for retail outlets, and other business services, not elsewhere classified, auctioneers' establishments, drafting service, independent lecture bureaus, inspection service, printing brokers, notaries public, and shop window decoration (from 1997 Economic Census).

growth of many form of electronic publishing and advertising the need for these service within accessible proximity of business remains reasonably fixed for the Metro area.

Computer programming and data processing service (SIC 737) establishment pattern reveals marked differences with its sister business service activities. This is not surprising given the significantly different forms of services provided including higher skill level software development to more traditional business service support of computer equipment rentals. Despite a broad reach within the three-digit group, a clear pattern of suburban over central city establishment concentration becomes apparent (see figure 3.7). The most notable LQ significant concentrations of establishments appear in Montgomery County, Maryland, and Fairfax and Loudoun Counties, Virginia. It is clear from the producer service data set that SIC 737 establishments (and thus firms) choose suburban versus more central city-based locations. This spatial confirmation aligns with other research showing the importance of an increasingly technology-based economy and the growth of suburban office parks and 'Edge Cities' (Garreau 1992).

Engineering, Management and Public Relations (Advanced Services)

The final series of LQ maps denote the spatial distributions of engineering and architectural services, SIC 871, accounting and brokering, SIC 872, and SIC 874, management and public relation services. These portions of the producer service sector are often times referred to as 'advanced services' or those that are the visage of higher order services where technology, expertise and information sharing culminate in the new industrial economy. The mapping of the LQ scores of these services also display variance in the location patterns within the Metro area. As with the other producer services sectors noted in this final section, the advanced services are also diverse in the types of services performed and thus the market for the service.

This variance does not allow for a 'one size fits all' approach to an appraisal of the distribution patterns in the Metro area of advanced services. Where for example, engineering and architectural services (SIC 871), large numbers of establishments are found within Fairfax County and its independent cities, and several areas in Montgomery and Prince George's County, Maryland. These services by ZCTA tend to favor the western portion of the Metro area, but, have representation across the whole area. SIC 872, accounting and auditing, favor the suburban areas more so than the central city. This is no doubt due to the ability of this service production to be physically removed from the location where the information provided is required. As noted in the description of this sector, the advent of computer-based data entry and storage is the defining factor of the sector.

Management and public relations services, SIC 874, display LQ establishment concentrations of greater than an equal share per ZCTA are found in northern Virginia with some notable exceptions in Montgomery County, Maryland. This is a curious 'advanced service' sector where a need for close proximity is essential for client/ producer relations given the type of services provided[7]. These services truly rely on information and the ability to effectively network amongst other information sources pertinent to the client. These requirements appear to coincide with the distribution of LQ scores for ZCTAs showing significant shares of this service. The DC central city hosts a sizable proportion of these services along with coterminous areas of adjacent jurisdictions. The maps reveal non-central city areas where these services have chosen to locate. These outer suburban areas may also be focal points for clusters of firms that

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[7] Establishments primarily engaged in furnishing general or specialized management services on a day to day basis and on a contract or fee basis. These establishments generally perform a variety of activities, such as strategic and organizational planning; financial planning and budgeting; marketing objectives and policies planning; information systems planning, evaluation, and selection; human resources policies and practices planning; and production scheduling and control planning.

have equal or ready access to knowledge and trends that are vital to effective business

management information and the more ephemeris knowledge of public relations.

CHAPTER FOUR: PRODUCER SERVICE LOCATION AND THE ROLE OF MARKETS

Introduction

Patterns of business location provide a glimpse of probable factors for the organization of industrial production and the provision of services in a metropolitan area. The importance of metropolitan-level producer service location research remains crucial given its duly noted under-representation in current producer service research literature (Coffey 2000). Producer service location patterns are not random but are influenced to varying degrees by underlying business rationale and economic optimization processes (Knox 1988). Location pattern interpretation is an important component of urban economies that enables a greater understanding of some key influences over producer service location within the Metro area and other metropolitan areas where there are significant numbers of producer services.

This chapter explores producer service end markets and their theorized influence in fashioning establishment location patterns. In the context of urban economic geography we have learned of some fundamental concepts (e.g. Harrington 1994, Johnston 1983, and others) that provide rationale for producer service business location theories including: *urban agglomeration* where producer services establishments will be located in areas with a high density of business activity, *industrial agglomeration* where producer services will locate near one another to take advantage of common resources such as needed physical infrastructure, labor or aspects of intellectual capital, and, *market agglomeration* where sales to buyers play an essential role in the arrangement and location of businesses within urban areas. It is this last influencing factor that specific attention is focused here due to the spatial importance of markets.

Despite significant amounts of geographic research, mainly Harrington (1995) there remain significant gaps in our knowledge of producer service location patterns in US urban areas. Discussions of producer service location patterns often mention simple associations of producer services within central city locations or suburban office complexes. There are of course notable exceptions to the more generic studies of producer service in metropolitan areas of the United States and Canada (O hUallachain and Reid 1992; Howland 1993; Coffey 1995b; Harrington and Campbell Jr. 1996). The differing degrees of location cohesion of producer service establishments helps inform some interesting and dynamic aspects of urban agglomeration economies, including the importance of market sales and the need for spatial proximity, the changing economic landscape in metropolitan areas where a variety of locations, both central and suburban, can effectively concentrate economic activities, and the interdependence of some types of producer services.

Research Question

The first of the two producer service research problems explored in this dissertation concerns the influence of non-routine, face-to-face interaction of producer service firms on specific sector establishment location patterns in the DC Metro area. Non-routine, face-to-face interaction in the context of this research refers to the process of trade or exchange between firms that involves 1) trade between firms occurring on a as needed basis as opposed to very regular, routine purchase or transaction, and 2) where trade between firms often require close interaction between client and producer[1].

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[1] Producer services with higher need for face-to-face interaction include real estate (SIC 653), legal services (SIC 811), and management/public Relations (SIC 874). Those with lower needs include computer and data Processing (SIC 737), professional business organizations (SIC 861), and engineering and architectural services (SIC 871).

The economic circumstances of these trade forces make it likely some producer service firms will have need to be physically closer, tightly coupled using information technologies, while others will be unfettered from the need for these close associations.

One basis for this spatial relationship comes from a fundamental notion that increasing physical spatial distance between establishments denotes progressively weakening bonds of exchange. Tobler (1979) offered the axiom that, "... everything is related but things closer together are more related", broadly emphasizing the importance of spatial propinquity. Physical proximity can be argued to remain even today a key manifestation of the economic linkages between producer service establishments in urban areas. The influence of information and communication technologies, where physical distance can be rendered superfluous, must be an additional element in the interpretation of establishment location. The ongoing tension of the friction of distance in spatial economics is a central theme within producer service studies given the natural role these services play within today's information and technology-based economy. The premise of clustering and dispersion of producer services is explored here by discerning the degree of economic exchange between firms in this sector and that of others.

Research Methods

To address the research problem posed, knowledge of producer services sales must be known and a means to measure the degree of establishment spatial concentration. To address this first research problem, therefore, some additional research preparation steps are required. This methodological discussion succinctly covers the use of economic trade analysis and data that reveals the use of inputs from producer services by similar and other industrial sectors, and the specific details of geo-

statistical methods applied toward arriving at analysis outputs of this research problem posed.

Producer Service Input-Output Data

A key piece of economic information, vital to many aspects of economic planning and forecasting in the United States, are the Input-Output Accounts (I/O) calculated by the Bureau of Economic Analysis (BEA)[2]. The power of I/O accounts is their ability to quantify how all US industries interact; specifically, they show how industries provide input to, and use of output from, each other to creating the US national Gross Domestic Product. These data provide comprehensive information on the exchange of the goods and services that make up the production process of all industries. To achieve this the I/O accounts are divided into a set of four master tables, Use, Make, Direct Requirements and Total Requirements (Guo, Lawson et al. 2002). Here defined as:

✻ **Use:** shows the inputs to industry production and the commodities that are consumed by final users.
✻ **Make:** shows the commodities that are produced by each industry.
✻ **Requirements:** are derived from the Use and Make tables.
✻ **Direct Requirements:** shows the amount of a commodity that is required by an industry to produce a dollar of the industry's output.

The contemporary make-use (UV) system was devised to better accommodate the ever increasing diversity of industrial production in the US economy (figure 4.1). By removing an assumption of one-to-one relationships between commodities and industries, this dual-matrix approach allows, and can characterize industries as able to

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[2] The Industry Economics Division (IED) prepares benchmark input-output (I-O) accounts for years ending in 2 and 7, which are based on detailed data from the quinquennial economic censuses that are conducted by the Bureau of the Census (See http://www.bea.gov/bea/dn2.htm).

produce more than a single good or service. The use matrix (U) carries the dimensions of the commodities-by-industries, while the make (V) matrix carries the dimensions of the industries-by-commodities, which implies that they are not necessarily square.

	Commodities	Industries	Final Demand	Total Output
	1 2 ....m	1 2 ....n	1 2 ....k	
Commodities 1 2 : m		Use Table U	E_C	q
Industries 1 2 : n	Make Table V			g
Value Added		W_I		
Total Input	q˚	g˚		

Figure 4.1: The schema for the BEA's use-make matrix approach to calculating US industrial inputs and outputs.

Using the output from these I/O tables we are able to accurately assess the relative strength of exchange between industries and therefore how much (in terms of dollars) output from one industry goes into the production of commodities in another. This relationship also extends to our area of interest for this research in exploring the potential spatial impacts of the intra-industrial sector exchange and intermediate inputs within producer services.

The most current and most easy to modify queries for I/O data comes from the Internet-accessible BEA data records (BEA 2003). This online database of industrial activity is a significant improvement over the static, analog print versions and even the more arcane DOS-based software access tools offered by the data producers. The online tools allow for users to crosscut the I/O data by various industry groups (and

levels of industrial-type aggregation) and produce 'custom' data sets based on the query parameters.

For this analysis the relative shares of intra-industrial sector sales for the six producer service types were selected (see table 4.1). The use rank is calculated using the sum of intermediate goods and services used by the NAICS-based industry. Using these data a rank order for the six producer service group was created based on the share of sales to the same industrial sector. The ranking of intra-industrial sector sales provides a quantitative method for reviewing establishment location strategies as being influenced by the degree of this economic linkage to like services.

Table 4.1: An equivalency table for SIC codes and the NAICS-based codes used in the 1997 BEA Input-Output use and make tables.

SIC	Description	BEA I/O	
653	Real estate and manager services	531000	
737	Computer and data processing services	5415	514200
811	Legal services	541100	
861	Business and professional services	561400	
871	Engineering and architectural services	541300	
874	Management and public relation services	541610	5416A0

These I/O data must also be interpreted in light of a few caveats that are embedded in producer service functions: 1) producer services do not exclusively sell only to other businesses, 2) producer services will then vary widely in the relative amount of business versus consumer sales, and 3) producer services will also vary in the percentage of total sales made to other producer service firms performing the same industrial function. An integral component for the research problem statement is that

intra-sector sales between producer services will have an uneven or differential influence

on firm location-making strategies. It is not an illogical assumption that producer service

firms relying in some measurable way (e.g. sales to other businesses) on other like-firms

will be in a close physical association with them.

Geo-Statistical Analysis Using Variograms

The second component of these additional methods is the need for a geo-

statistical measure to aid in the interpretation of resulting spatial patterns of producer

service establishments. Geostatistics are essential for they are inherently concerned

with spatial data. Here, each data value is associated with a location in space and there

is at least an implied connection between the location and the data value[3]. In these

measures, location can be a point in space or an area where values are aggregated or

averaged. Within geostatistics there are several types of measures each with a variable

attributed to space or location. Given the added complexity of spatial reference,

calculating geostatistics, even with the aid of a computer, can be challenging.

Measures of spatial autocorrelation coefficients determines how clustered or

dispersed phenomena (points) are in a given area using the value of the attribute(s) of

each (Davis 1986). One measure for the distinction of local area spatial autocorrelation

is the G-statistic (Lee and Wong 2001). The forms of the G-statistic (General Statistic)

have variations and enhancements that reveal the distribution of the data with reference

to the local area variability and resulting spatial autocorrelation of phenomena. These

measures are, however, of less utility to us here in that the output is often not readily

'mappable' due to a single statistic being calculated for the whole area of investigation.

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[3] Donald Myers, University of Arizona.

A geostatistic that provides mappable result data is a semivariogram. A semivariogram is the difference-squared of the values between each pair of points at different distances, where semivariance distance for all point pairs is calculated as:

Equation 4.1:
$$d_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

The basis of the semivariogram measure centers on the pure difference calculation of the distances between all point pairs of point-based phenomena. Given the need here for using centroid-based data (a point to represent multiple points) so that our establishment match rate will be significantly high, we are able to take advantage of the ability to weight these points based on the relative values of data associated with these ZCTA centroids. In spatial autocorrelation, the basis for a semivariogram measure, the underlying base assumption is that things that are close to one another are more alike than things further away. This concept is common in geographic study and is used primarily in ecologic and physical geographic research and analysis.

This measure is a function that relates semi-variance (or dissimilarity) of data points to the distance that separates them. The research and analysis utility of this measure is its graphical representation that can be employed to provide a spatial view (a surface) of the correlation for each data point with all neighboring points. The semivariogram measurement applicability here is to allow the examination of distance-based spatial relationships of data to test in another context the importance of an economic function of producer services. These geostatistical capabilities are available within the ArcGIS 8.1 software used in this analysis.

Semivariogram Interpretation

The output from the geostatistical toolkit in ArcGIS for the semivariogram contains several elements that require some discussion. The output plots are presented in the next section. The discussion here is on the meaning of the elements within the graphical output from semivariogram calculation. It should be mentioned that using this particular geo-statistical procedure this research moves into a rather unexplored territory given that the use of this measure has not been used extensively for examining economic urban phenomena.

The semivariogram values of all point pair distances, which is the difference squared between the distances of each pair of locations, is plotted on a y-axis relative to the distance separating each pair appearing on an x-axis. Each point in the semivariogram point-pair cloud represents a pair distance measure of locations (a weighted average of point pairs based on ZCTA values of producer service establishments). Phenomena closer together should be more alike, the semivariogram determines the 'close' locations (left on the x-axis) will have lower semivariogram values (low y-axis). As the distance between the pairs of locations increases (moving toward the right on the x-axis), the semivariogram values will also increase (moving up on the y-axis). When a particular distance (i.e. a stochastic threshold value) is reached, the point cloud then flattens out, indicating that the relationship between the pairs of locations beyond this distance can be interpreted as no longer correlated. In other words, there are likely few relationships (spatially-based) that can be discerned for these outlying data point-pair values (see figure 4.2). In this figure, gamma (γ) denotes the correlation (dij) based on the physical distance (h) weighted by the point values (establishment number).
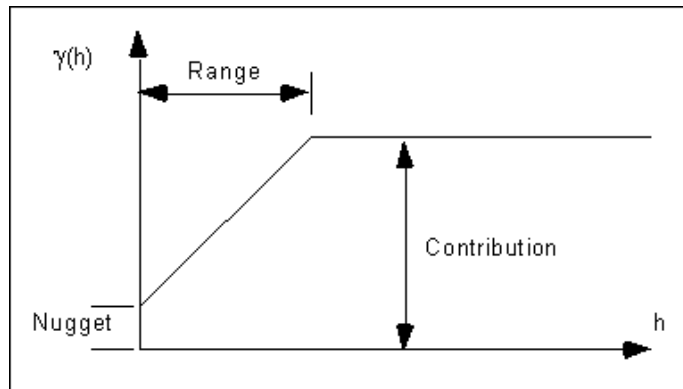
Figure 4.2: The plot area for the semivariogram measure. The nugget represents a minimum variance. The contribution is sometimes called the "sill" and represents the average variance of points at such a distance away from the point in question that there is no correlation between the points. The range represents the distance at which there is no longer a correlation between the points.

The clouds of data pairs can be interpreted such that surfaces created from the similarity of data values of these points can be displayed. These value surfaces are not 'maps' per se but rather representational diagrams where spatial distance is the parameter for affording associations of high to low correlation of establishment values.

Lastly, an important parameter in the calculation is the lag size, shown as the y-axis of the semivariogram plot, is the portion of a distance class into which pairs of locations are grouped (see figure 4.3). This step of data preprocessing is needed in order to reduce the potentially very large number of possible combinations. Reducing the lag size means that you are in essence changing the spatial resolution of the data revealing the details of very 'local' variations between neighboring sample points up to variations across the whole data set. For purposes in our examination we wished to use a lag that allows us a view to the entire set of points within the study area, though the techniques does allow us to move to a finer level of spatial resolution (sub-ZCTA areas).

The x-axis on the left of the semivariogram plot is the value of the point pair at that lag

distance. The scale used here for our outputs flow from blue tones meaning less

correlated to the red tones of high correlation.
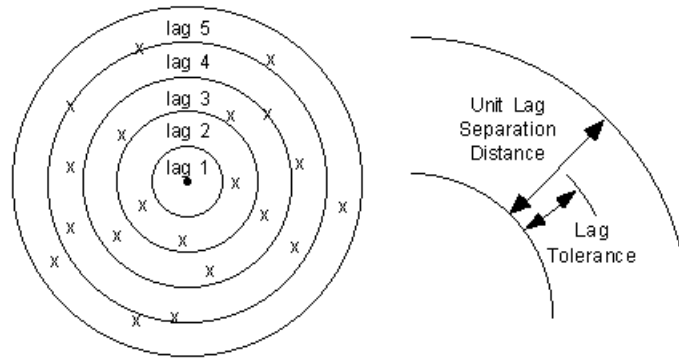
Figure 4.3: The relationship between the spatial lag of data points and the tolerance for
establishing the lag.

Analysis Outputs

Using these added data and geo-statistical methods, analysis outputs were

created to address the problem statement. In the preparation for this analysis data from

the Use tables of the 1997 BEA I/O for the six producer service industrial groups,

identified initially in table 4.1, was extracted and organized. The following table 4.2

provides the outcome of this collection where each of the six producer services types are

ranked in their level of sales to similar firms. As a general tendency producer services

overall market is to sell their goods and services to other businesses, this is by way the

common component of the definition of producer services. Exploring the actual

purchases of goods and service by firms for use as a intermediate product we learn that

the producer services under investigation vary markedly. An additional table 4.3 reveals

some of this heterogeneity of producer service sales.

Table 4.2: Use data derived from BEA's Input/Output accounts. Ranking is based on sales to same SIC coded firms. All producer service types are shown in bolded.

Use Rank	Real Estate [531000]	% Selected
1	**Real estate**	**13.34%**
2	Retail trade	12.60%
3	Hospitals	5.59%
4	Wholesale trade	5.16%
5	Food services and drinking places	3.53%
6	**Management of companies and enterprises**	**3.48%**
7	Colleges, universities, and junior colleges	2.89%
8	**Monetary authorities and depository credit intermediation**	**2.86%**
9	Offices of physicians, dentists, and other health practioners	2.79%
10	Owner-occupied dwellings	2.74%
11	**Legal services**	**2.48%**
12	**Insurance carriers**	**1.67%**
13	Religious organizations	1.60%
14	**Securities, commodity contracts, investments**	**1.59%**
15	Nursing and residential care facilities	1.56%
16	**Civic, social, professional and similar organizations**	**1.32%**
17	Grain farming	1.14%
18	Cattle ranching and farming	1.12%
19	Elementary and secondary schools	1.01%
20	Other ambulatory health care services	1.00%
		69.47%

Use Rank	Legal Services [541100]	% Selected
1	**Management of companies and enterprises**	**9.57%**
2	**Securities, commodity contracts, investments**	**7.08%**
3	**Legal services**	**5.64%**
4	Owner-occupied dwellings	5.32%
5	**Real estate**	**5.15%**
6	Hospitals	4.86%
7	**Monetary authorities and depository credit intermediation**	**4.29%**
8	Wholesale trade	4.09%
9	Offices of physicians, dentists, and other health practioners	4.04%
10	Power generation and supply	3.64%
11	Retail trade	2.58%
12	Other ambulatory health care services	2.07%
13	**Nondepository credit intermediation and related activities**	**1.85%**
14	Air transportation	1.78%
15	Sightseeing transportation and support activities for trans.	1.71%
16	New residential 1-unit structures, nonfarm	1.57%
17	Telecommunications	1.29%
18	**Insurance carriers**	**1.21%**
19	**Scientific research and development services**	**1.07%**
		68.79%

Use Rank	Architectural and Engineering Services [541300]	% Selected
1	Commercial and institutional buildings	15.61%
2	Telecommunications	7.64%
3	Other new construction	7.14%
4	**Real estate**	**6.85%**
5	**Architectural and engineering services**	**5.54%**
6	New residential 1-unit structures, nonfarm	5.48%
7	Other State and local government enterprises	4.95%
8	Highway, street, bridge, and tunnel construction	2.09%
9	Maintenance and repair of nonresidential buildings	1.98%
10	Manufacturing and industrial buildings	1.53%
11	Motor vehicle parts manufacturing	1.50%
12	Water, sewer, and pipeline construction	1.50%
13	Power generation and supply	1.48%
14	Other basic organic chemical manufacturing	1.46%
15	New residential additions and alterations, nonfarm	1.41%
16	New multifamily housing structures, nonfarm	1.40%
17	State and local government passenger transit	1.27%
18	Maintenance and repair of highways, streets, bridges, tunnels	1.08%
		69.91%

Use Rank	Management Consulting Services [541610]	% Selected
1	Wholesale trade	12.00%
2	Retail trade	8.49%
3	**Real estate**	**5.90%**
4	**Architectural and engineering services**	**5.63%**
5	Hospitals	4.75%
6	**Legal services**	**4.01%**
7	**Monetary authorities and depository credit intermediation**	**3.10%**
8	**Securities, commodity contracts, investments**	**2.87%**
9	Pipeline transportation	2.84%
10	**Nondepository credit intermediation and related activities**	**2.21%**
11	**Accounting and bookkeeping services**	**1.64%**
12	**Management consulting services**	**1.63%**
13	Truck transportation	1.61%
14	Funds, trusts, and other financial vehicles	1.60%
15	Offices of physicians, dentists, and other health practioners	1.47%
16	Office administrative services	1.31%
17	Food services and drinking places	1.29%
18	All other miscellaneous professional and technical services	1.22%
19	Other State and local government enterprises	1.21%
20	Telecommunications	1.18%
21	Power generation and supply	1.09%
		67.03%

Use Rank	Data Processing Services [541200]	% Selected
1	**Management of companies and enterprises**	**10.79%**
2	Retail trade	10.25%
3	Wholesale trade	6.39%
4	**Securities, commodity contracts, investments**	**5.27%**
5	**Insurance agencies, brokerages, and related**	**3.98%**
6	**Monetary authorities and depository credit intermediation**	**2.14%**
7	Hospitals	2.03%
8	Scenic transportation, support activities for transportation	1.79%
9	**Legal services**	**1.67%**
10	Food services and drinking places	1.63%
11	Motor vehicle parts manufacturing	1.52%
12	Telecommunications	1.45%
13	**Architectural and engineering services**	**1.43%**
14	Offices of physicians, dentists, and other health practioners	1.34%
15	Travel arrangement and reservation services	1.28%
16	**Computer systems design services**	**1.24%**
17	**Data processing services**	**1.16%**
18	**Nondepository credit intermediation and related activities**	**1.07%**
		56.46%

| Use Rank	Business Support Services [561400]	% Selected
1	Wholesale trade	12.41%
2	Retail trade	10.17%
3	**Legal services**	**5.43%**
4	**Monetary authorities and depository credit intermediation**	**4.70%**
5	Hospitals	4.16%
6	**Nondepository credit intermediation and related activities**	**4.08%**
7	Telecommunications	3.36%
8	**Securities, commodity contracts, investments**	**3.32%**
9	Offices of physicians, dentists, and other health practioners	2.66%
10	Grantmaking and giving and social advocacy organizations	2.54%
11	Analytical laboratory instrument manufacturing	2.41%
12	**Civic, social, professional and similar organizations**	**2.33%**
13	**Real estate**	**1.97%**
14	Magnetic and optical recording media manufacturing	1.76%
15	**Management consulting services**	**1.69%**
16	Social assistance, except child day care services	1.62%
17	Colleges, universities, and junior colleges	1.58%
18	Industrial process variable instruments	1.38%
19	Other ambulatory health care services	1.38%
20	**Insurance carriers**	**1.25%**
		70.21%

The level of intra-sector economic interaction can be seen, through an examination of these data tables, to vary between the producer services industries studied here. The data provided by these tables is further examined in the last section of this chapter. In a cursory manner it is evident that the intra-sector sales variation across the six producer service sectors in the Metro area have spatial ramifications. This initial view reveals from the I-O account data offer views that are analogous with presumed spatial and trade relationships. While others confound these general premises and note areas where further problem statement examination is required. With these rankings we have established an economic proxy that will inform the interpretation of producer service locations within the study area. As expressed at the outset we testing the degree to which these intra-industrial sales will have on location patterns, either resulting in clustering of like firms or showing signs of no influence.

The six industrial groups aid in understanding the role of intermediate market sales on the location of producer services. The logic of location for these firms can be linked to their sales when the timeliness of getting goods and services into the market place is a critical aspect of the role in the urban economy that these firms play. The problem statement suggests producer services that are trading with similar industrial establishments should also have a highly correlated spatial pattern. The empirical semivariogram surfaces created here affirm some general assumptions for each of the industrial sectors shown. The following figures 4.4 and 4.5 display the output from the semivariogram measure calculated for each of these service sectors.

SIC 653 Real Estate [NAICS 531000]
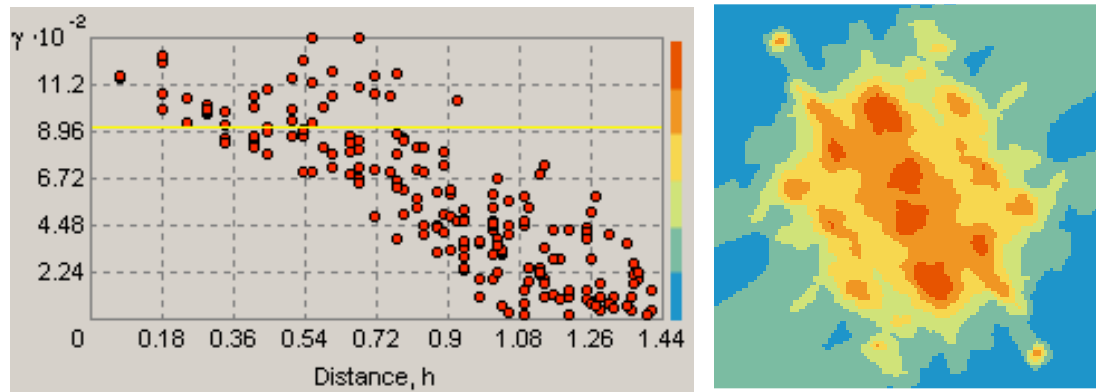
SIC 811 Legal Services [NAICS 541100]
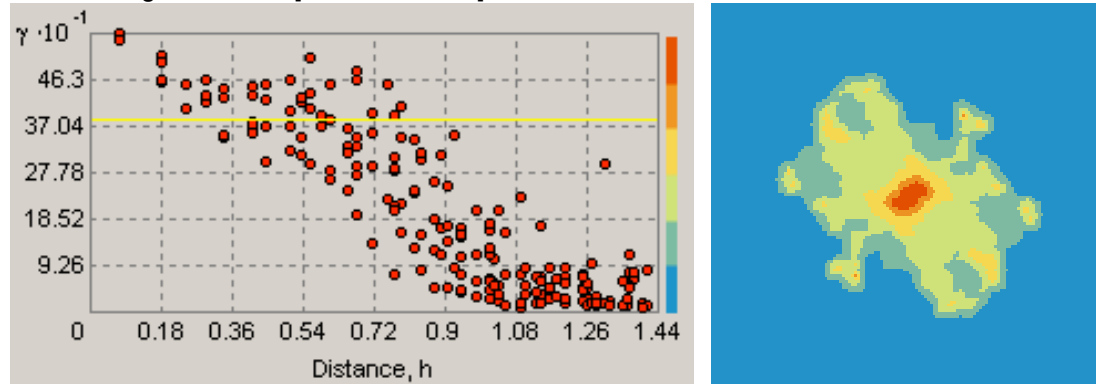
SIC 871 Architecture and Engineering [NAICS 541300]
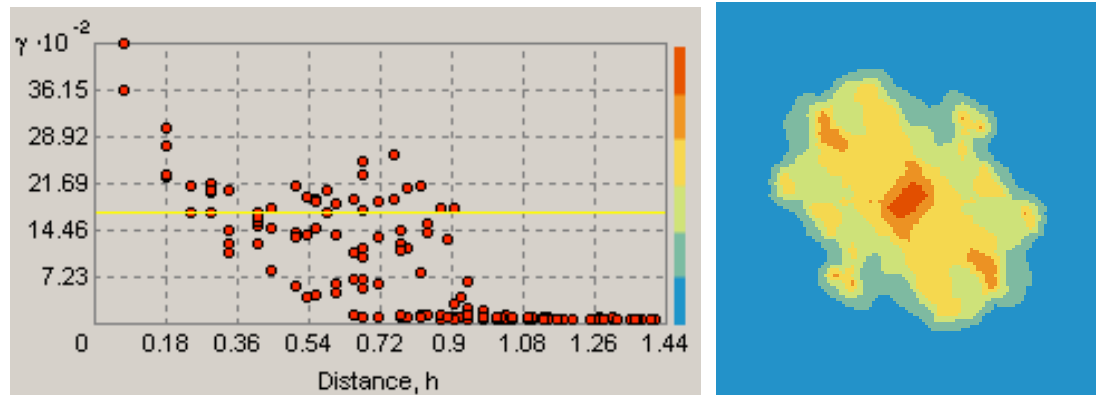
Figure 4.4: The results of the semivariogram analysis output for Real Estate, Legal Services and Architecture and Engineering establishments (see figure 4.2 for value definition).

SIC 874 Management and Consulting [NAICS 541610]
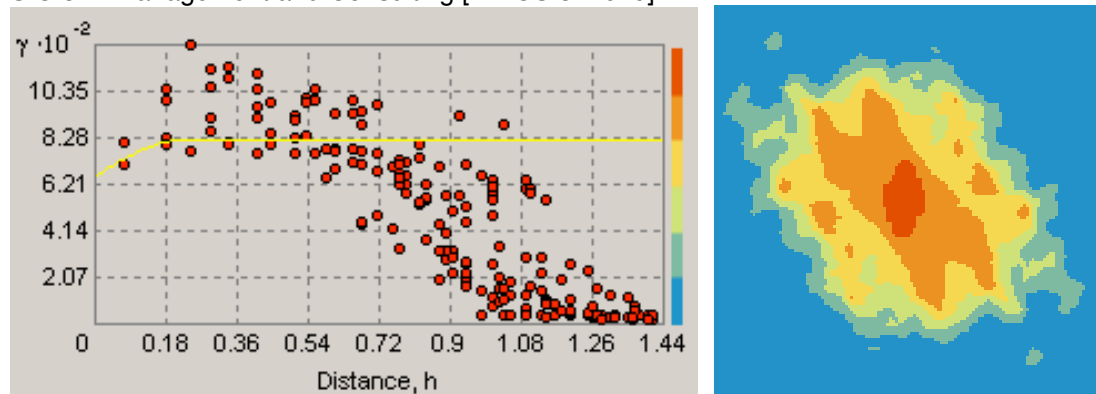
SIC 737 Data Processing [NAICS 541200]
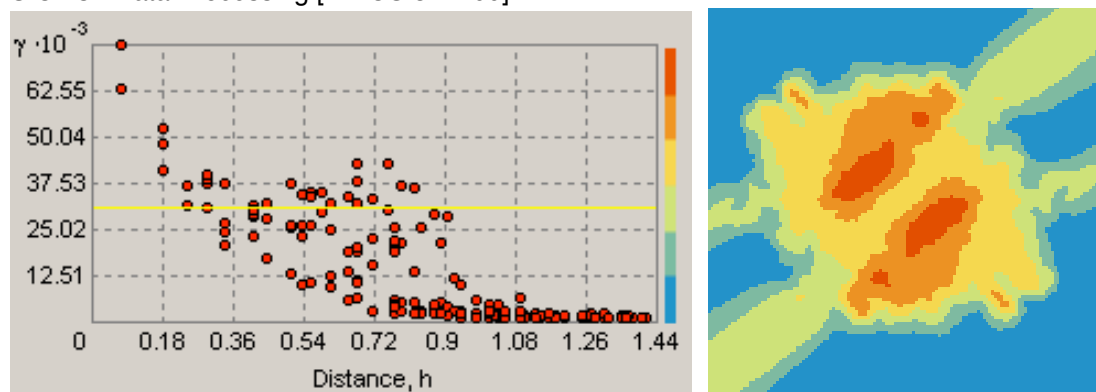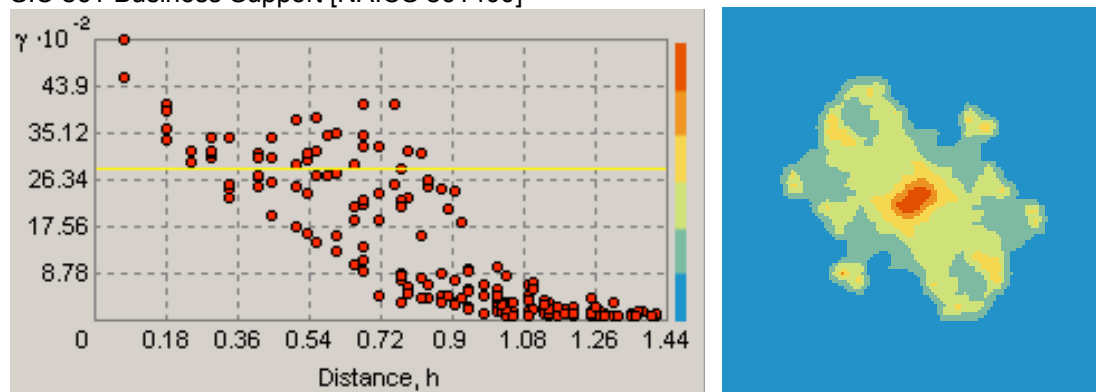

SIC 861 Business Support [NAICS 561400]

Figure 4.5: The results of the semivariogram analysis output for Management and Consulting, Data Processing, and Business Support services.

Analysis Discussion

This analysis addresses the research problem statement presented in this chapter by exploring the relationships between intra-sector trade relationships and the patterns of establishment location in the Metro area. To understand the nature of trade relationships between the differing producer service economic sectors, BEA I-O data were used. These data make it possible to quantify the potential for trading relationships of goods and services between producer services, and important here, the trading between like producer services. With a sufficient insight of these potential trading relationships, a semivariogram measure for each producer sector was then calculated using the weighted (by establishment count) ZCTA centroids. These geo-spatial data are a type of multivariate data where there may be only one variable of interest (the dependent variable) but whose values are related to position (independent variables of location or time). Semivariograms created here relate the variance in the difference of an attribute value (establishment count) for pairs of points (weighted ZCTA centroids) to the separation distance.

The analysis outputs (both tabular and graphical) provide the means to test the theorized impact of intra-sector trade on producer service establishment location. Given the breadth of producer service types expectation of differences in location patterns and the underlying factors that stimulate these differences is assumed. For the tabular data from the I-O accounts table 4.3 provides a summary of the critical information. Across the sectors examined here differences in the trading of goods and services by these firms can be determined. The primary metric used in this chapter is the degree to which a producer service from a specific SIC sector purchased goods and services from the same sector. In this category across the six types studied three groups emerge, real estate, the leading intra-sector purchaser at over 13% of all sales. Two other groups can

be offered, legal and architecture/engineering services. These sectors have a moderate

amount of sales to like-firms, ~5%[4]. Lastly, the lowest group for intra-sector purchases

of goods and services, data processing services and business associations and support

services examined make use of like producer service inputs at 1% or lower.

Table 4.3: Summary use statistics for the six producer service sectors.

Sector	% Intra-Sector Use	% Use by Producer Services	Total Industries Served (all)*	Total of Producer Services*
Real Estate	13.34	26.74	20	7
Legal Services	5.64	35.86	19	8
Architecture/Engineering	5.54	12.39	18	2
Management/Consulting	1.63	26.99	21	8
Data Processing	1.16	28.75	18	9
Business Support	0.09	24.77	20	8

* Data here is based on the industrial sectors that have a greater than 1% use of that
specific sector.

The portion of sales to similar establishments is a part of a larger picture of

industrial trade for producer services. The summary table provides other views of trade

between these services that are of interest here. The I-O tables (table 4.2) also denote

the amount of sales to all other producer services. The differences between sales to

other producer services of all types to the six service sectors here show a more

homogeneous pattern with the exception of architecture and engineering (at 12%, half

the sales as all the others). Likewise, the remaining summary categories also show a

degree of similarity where the total industry sales used by other industries and the

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[4] It should be considered that while 5% of total sales may not appear to be significant, however, the
overwhelming majority of use by other all other industrial sectors remains very low (<.001%).

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subset of all other producer services above the 1% level. The significant exception in the number of sales to all other producer services again comes from architecture and engineering services, where only two producer service sectors make any use of these services in their production.

Using these I-O trade accounts as a probable baseline for producer service trade relationships, the semivariograms then provide the spatial manifestations of establishment location and potential for the exchange of services. The semivariogram outputs are a means for mapping (tying data to space) of the location of producer services establishments. In a broad interpretation the semivariograms the expected patterns of concentration versus dispersion appear to hold true with the baseline assumptions of the importance of intra-sector sales. The following sections present brief overview analyses of the spatial patterns discerned and the output from the semivariogram measures. These sector vignettes are discussed in the order of their relative ranking of highest to the lowest sales to same SIC group producer services.

SIC 653 Real Estate
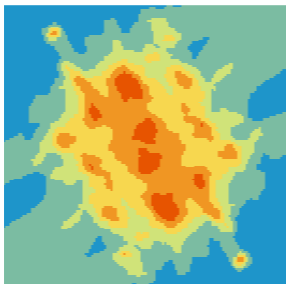
The producer service sector with the highest intra-sector sales is this study is real estate (SIC 653). Real estate establishment locations reveal a mixed result. Although sales to other real estate firms represents 13% of all sales, the semivariogram surface shows that establishment clustering is spread across the surface. The covariance result, though ranked low, provides one insight into the correlation of real estate locations. These firms seem to be widely dispersed across the whole study area yet reveal a clustering in local areas. This helps to explain a high level

of trade among real estate firms when these groups maintain a high degree of inter-firm interactions to meet local demands by end purchasing markets (Gurd 1990). The pull of a non-producer service end market must play a role in this distribution patterns despite the high degree of intra-sector sales. The problem statement notes a spatial pattern where distance between these firms will be less. The results for real estate confirm this notion although not for the whole Metro area but rather a series of more local concentrations.

SIC 811 Legal Services
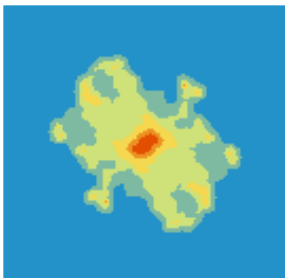
Legal services were expected to demonstrate a high degree of both intra-sector trade relationships and to have a high degree of spatial concentration. For legal services a relatively large proportion of sales are exchanged between legal service establishments (>5%). As a result both the mapping of establishments and the covariance testing demonstrate the significant clustering of establishments and employment in the center of the study area. Some past research shows that this result is not too surprising given the importance of these firms in the functions of the downtown Washington DC area (Warf and Wije 1991). While this point is important it still does not refute that these economic interactions between firms also are a critical factor (e.g. legal services dispersed yet concentrated areas where legal services function in suburban market areas). These results match the expected distribution pattern of establishments and then adds evidence for the hypothesis tested in this chapter. The research literature of the higher-order functions within producer services, legal services in this case, has noted the need for close associations with

competing firms (O hUallachain 1989; 1992). This research analysis provides a

measure to reveal the degree of which a close association can be associated with

locational decision making.

### SIC 871 Architectural and Engineering Services
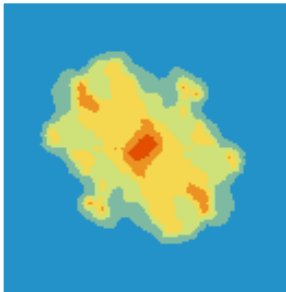
Engineering and architectural services represents a broad

sector that includes the most applied application of the

advanced producer services[5]. In terms of trade with other

producer services, this sector ranks as the lowest of the six

examined (only two other producer service sectors make use of

SIC 871 services). These services do buy and sell a significant percentage among each

other (>5%). This relative high degree of intra-sector exchange can be perceived

spatially using the semivariogram surface show here. The central computation node for

these variograms is roughly the central city of the Metro area. Therefore, the feature in

the center denotes a significant proportion of these establishments are highly correlated

spatially more in the center of the city than in suburban areas. The surface is not as

centralized as that found for legal services.

The circular pattern that rings the central area may be the artifact caused by the

important urban area organizing feature created by the Capitol beltway. Again, the

surface is not a map based on specific coordinates, but the areas where these producer

service establishments become more correlated spatially then a feature is created. So

similar to those dispersed concentrations of real estate establishments, a few areas,

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[5] While the whole sector comprises many related types of services engineering and architecture services make up the majority of employment in this sector.

beyond the central city area, are also centers where the exchange of SIC 871 goods and services become critical.

SIC 874 Management, Public Relations and Consulting
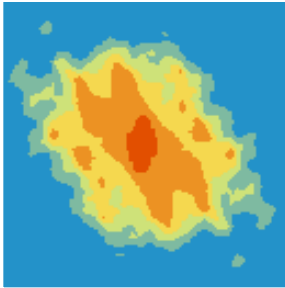
The 874 SIC producer service sector is the broadest in terms of industrial production activities of the six sectors used in this research. This diversity within the sector in terms of the types of production included is not completely in sync with the low level of intra-sector trade that occurs (~1.5%). The diversity of the types of firms in this sector leads, perhaps falsely, to the notion that this breadth of job function would increase the likelihood of use by other SIC 874 firms. The shear number of employment types would make a strong case for greater means for the buying and selling within this single producer service sector quite high.

The spatial pattern of establishment correlation from the semivariogram reveals an interesting outcome. The bifurcation of the central city by a swath of lesser correlated establishments, for example. The dispersion across the surface where a high degree of spatial correlation continues beyond the central area helps confirm the research problem statement. The relative low levels of intra-sector trading suggests, in this research, that the level of spatial correlation will be less clustered (correlated) and more homogeneous across the study area. The result of the semivariogram measure demonstrates this outcome. A large highly correlated area appears in the central area that is surrounded by progressively less correlated producer service establishment locations. This distribution pattern of correlation is largely commensurate with the distribution of business areas within the Metro area. The range of services within this sector in relation

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to the output of the semivariogram lends strong evidence that trade relationships can help geographers discern location patterns based on the likely economic relationships like firms may share.
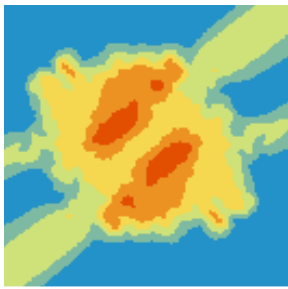

SIC 737 Computer and Data Processing Services

Computer services are a key sector of the high-technology sector activities included within producer services. This sector combines both the high-tech sector (programming, software development) along with those services which are for more lower skill operational types of service support (data processing, information retrieval, etc.). These services based on I-O accounts show significantly lower intra-sector trade (~1%) than all of the previously mentioned services. If the problem statement holds true this will result in a lesser need for these types of services to be spatially correlated. As the semivariogram surface reveals, this general assumption based on the trading accounts reveals a diffuse pattern of correlation of SIC 737 establishment locations. This sector is the only group to show a marked low correlation at the center of the study area. Moreover, the areas of high correlation appear in the adjacent areas to the center city (using the center of the semivariogram surface as the approximate center frame for the study area).

The spatial pattern derived from the noted semivariogram correlation confirms in part the problem statement conjecture of the need for higher intra-sector sales to contribute to the spatial tendency of service establishment clustering. In this case, computer and data processing services reveal a location pattern that is namely drawn to non-central city locations and is also posed to serve other service and non-service

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sectors. It is interesting to note that, like real estate, these services have concentrations across the study area where by these distributed centers are perhaps better able to access the market places for their services. Unlike some other advanced producer services, a good deal of the activities within this sector require physical active exchange of information that would require close contact with the customer. These distributed locations suggest that a good deal of the market place foe SIC 737 is beyond the central city.
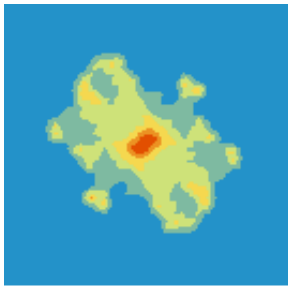
SIC 861 Business Association and Support Services

Along with legal services business association services are the most spatially concentrated in the Metro area. Their business trading statistics also have some striking commonalties with the significant exceptions of intra and inter-sector sales. Legal services as shown are much higher in both sales to similar firms and to all other trading with producer services (5.6% and 35.8% respectively). Business association and related services are considerably lower with virtually no intra-sector sales, thus no real exchange, and roughly a quarter of all other exchange total going to other types of producer services.

These services, it is evident, are unique in this collection gathered for the research analysis. Business associations are professional groups that serve constituencies. These services are focused more so on the provision of the needs for the larger business organizations represented, such as professional advancement, securing beneficial labor and contactual agreements, and most importantly, political presence. It is the later of these principal services that the concentration of

establishments for the central city area is noted. The need of central city locality for these groups is an obvious criteria for establishment location within the Metro area. A few suburban areas, primarily in Northern Virginia, have garnered some of these services. The establishment data reveal these firms as more supportive in function rather than functions needed for close proximity to the central city.

In summary, do non-routine, face-to-face interactions influence producer service establishment location? The evidence from the analysis demonstrates the role of these interactions on location and confirms a relationship. The influence however is highly variable and cannot be evenly applied to all producer services. Reasons for this variability stem from the type of the services provided. Legal services, and management and public relation establishments with greater needs for client interaction are concentrated within central city. Data processing, and engineering and architectural services with lower face-to-face interaction are more dispersed throughout the study area. While the outliers, professional organizations and real estate, denote where the influence of these interactions was is counter to the expected influence.

CHAPTER FIVE: METRO AREA COMPOSITION OF PRODUCER SERVICES

Introduction

The distribution of producer service establishments within the DC Metro area is controlled by a number of factors that include the need for face-to-face communications by some service firms and the nature of trade both within and beyond the particular sector. It has been shown in this work that producer services that have a tendency for higher degrees of face-to-face relations will also have a tendency to be spatially adjacent, supporting the notion that despite the rapid growth in information technologies, trade between producer services may influence location decision making of firms. This sector-specific aspect of geography is of obvious interest but lacks in part the broader inter-sector trading spatial relationships that producer service firms share. This chapter focuses then on to the second of the two problem statements introduced in chapter one with an examination of the diversity of producer service establishments within Metro area ZCTAs. The concept of 'service diversity' developed here denotes the spatial relations of producer service establishments within defined geographic areas. The concept born from social geographic practice is applied here to help interpret the spatial relationships of producer services and to reveal the mixture of business types varies across the study area.

A spatial entropy measure is used to identify the mix (or diversity) of the key producer services within non-jurisdictional units of the metropolitan study area. Entropy measures, broadly defined, have proven useful tools in a wide array of social and environmental science research endeavors, most notably to examine and quantify the

mix of ethnic groups (typically using census area geography) and numerous analyses of the composition of ecosystems (Morrill 1995; Wong 1996). The use of the entropy measure in this analysis quantifies the degree to which the collection of producer service types are locating in either heterogeneous or homogeneous ZCTAs. The entropy measure further demonstrates for our sample set of producer services that factors shaping agglomeration economies at the metropolitan scale are not equivalent for all producer service industries.

Research Question

The second major research question in this dissertation examines the potential role played by access and proximity to markets for producer service goods and services in shaping establishment spatial patterns within the Metro area. The spatial concept is producer services that have limited trade relationships and a greater need for face-to-face interactions with other producer service firms will locate in areas that are less diverse in producer service sectors. In other words the concentration of particular producer services may serve to create areas where high levels of homogeneity of establishments may be found. The literature discusses agglomeration economies develop among some producer service industries to leverage concentrations of suppliers, knowledgeable labor forces, infrastructure, and other 'shared' resources. The results here demonstrate how producer service establishments may chose locations where theses services can benefit from the spatial proximity of needed trade relations be these with like firms or with a combination of complementary producer services.

Economic Centers in the Study Area

The distribution of all businesses, while varying across the Metro area, also conform to a regional macro-structure formed from transportation patterns, zoning, the location of housing, accessibility, property values, and a myriad of other factors. Any examination of business location must be viewed within this the framework of existing economic centers to understand how employment is distributed. At a regional level, employment within the Metro area for 1998 study period varies spatially. Nearly one-quarter (24%) of all jobs are found within the District of Columbia, another 26% are located in the inner suburban area (adjacent to the Capitol Beltway), and the remaining 50% of all jobs are in the outer suburbs (Brookings 2000).

An important interpretive dimension of urban employment distribution is the location of concentrations of economic activities. These centers of economic versus residential activity are the places where a lion share of employment will be found. Often these centers can be viewed as competitors. Each center collectively attempts to draw new businesses, employment, and consumers from the other competing areas of the region. The push and pull factors of the location of firms within these zones become heightened as these areas are spread across and between numerous political jurisdictions of the Metro area. Figure 5.1 reveals the location for twenty significant business centers identified by the Washington Metropolitan Council of Governments (COG).
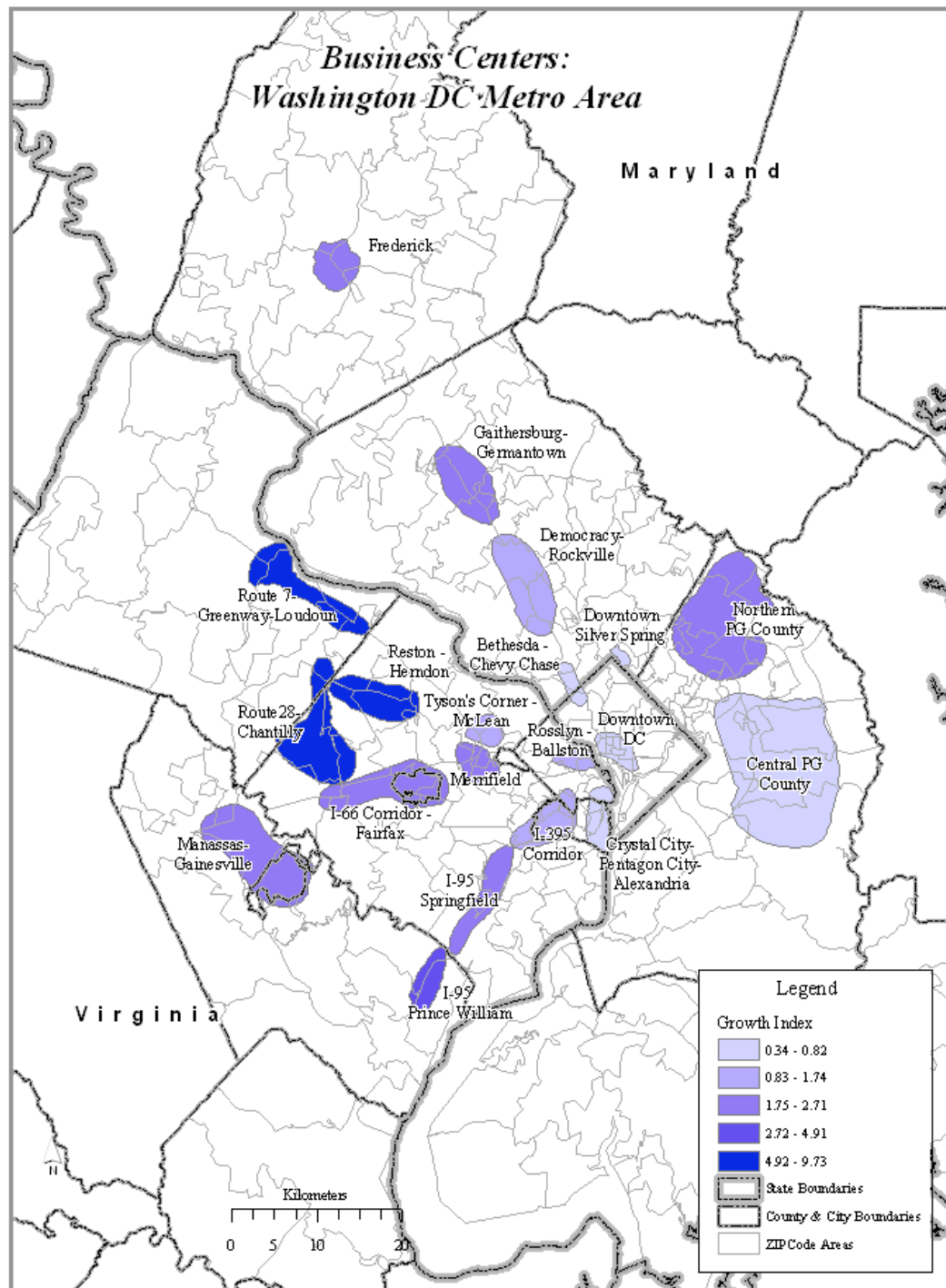
Figure 5.1: The location of 20 Metro area business centers. A growth value of >1.0 is increasing employment at a slower rate. The spatial extent shown is based on map data interpreted from the Brookings Institute, 2000.

These regional centers do not comprise all business employment but rather denote areas in the study area where employment in producer services is likely. An additional aspect added from COG data is the growth index calculated for each of the centers for 1998. Here, the western outer suburban areas of Virginia show a significant increase in the growth index while the District of Columbia and the adjoining eastern suburban counties of Maryland were anticipated to decline in these center's employment generation capacities.

Producer Service Diversity

The concept of industrial diversity within various geographic areas and at various geographic scales has been discussed in the research literature. Reviewing literature concerning the location of producer services reveals gaps in an interesting and often overlooked aspect of interactions between producer service firms. Over time the literature remains scant in the discussion of firm morphology derived from location patterns instead focusing largely on non-spatial econometric models of producer services. Nevertheless, the spatial aspects of industrial diversity of producer services processes is an invaluable component of understanding business location within cities and their surrounding suburbs.

Industrial diversity is often considered when comparing the relative levels of employment in particular industrial sectors within metropolitan areas. This aspect of industrial urban research was presented previously in this work using location quotient measures. The use of industrial diversity in the context of this chapter, however, refers to the complement of differing producer service types within small area geographies of the Metro area. The mixtures of these producer service establishments quantified within

these small areas enables the second research problem statement to be explored and thus explained. The benchmark for the predicted extremes in the distribution of producer services is represented in figure 5.2. This figure demonstrates likely scenarios of an aggregate-area distribution where in the left-hand panel displays a uniform (e.g. representation of all the producer service types) mix of the producer service types (all being ~ equal in the number of establishments). The right panel reveals a situation where we arrive at a majority of establishments coming from a single producer service industrial sector and is therefore dominant in that local area.
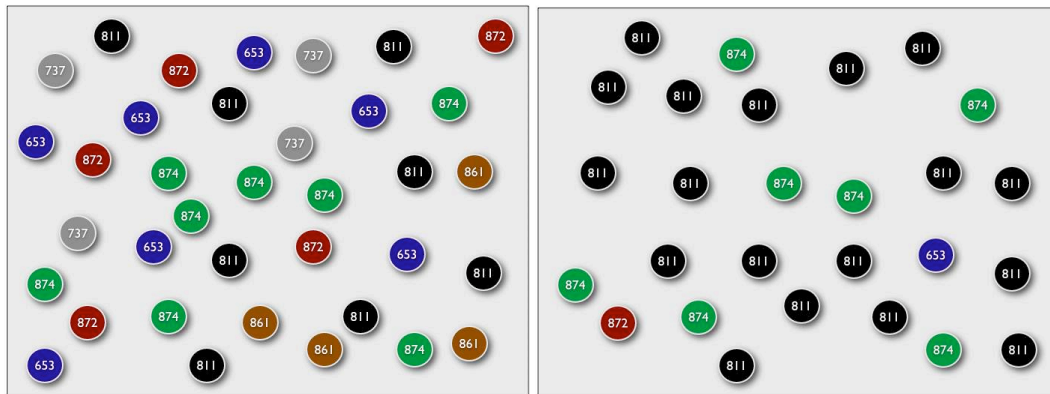
Figure 5.2: The potential composition of producer service types within aggregation areas (ZCTAs) as represented by bounding rectangles. The left panel denotes a consistent (heterogeneous) mix of producer service types and the right panel illustrates where a single producer service type has a disproportionate share of like establishments (homogeneous).

The Metro area is markedly heterogeneous in the distribution of particular producer service industries at gross levels of spatial aggregation. These patterns of spatial differences have been revealed in previous chapters. Using industrial classification systems necessary to describe the types of producer service functions will also result in the bundling of differing, and at types extremely differing, industrial processes and thus lose the detail available at finer levels of industrial classification (e.g.

specific functions such as stenographic service firms remain concealed within

miscellaneous business services).

Research Methodology

The following sections discuss the methods used to measure the degree of

diversity of producer services within the ~260 ZCTAs of the Metro area. Central to the

methodology is the use of an entropy measure to establish a quantitative basis for ZCTA

characterization of diversity. The previous chapter provides some insight of intra-sector

sales of the six producer service categories examined. Based on these findings it is

possible to speculate on where higher numbers of producer service establishment may

locate. Figure 5.3 offers one view of the likely relationships between the intra-sector

sales of these firms and the theorized location tendencies. The underlying logic for the

placement of these services is the role that industrial agglomeration has on the

relationship of these producer services firms to other adjacent business types. Real

estate (SIC 653), for example, was shown to have a high degree of intra-sector sales yet

these firms are also distributed more widely across the study area as opposed to legal

services (SIC 811).

Entropy Measures

In this research we use entropy measure to understand the diversity of producer

services. Herein the use of the term 'diversity' refers to the relative level of producer

service 'entropy [1]' found across the Metro area. To assess then the the mix of producer

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[1] A measure of the disorder or randomness in a closed system. In geostatistics, spatial entropy has been
defined as a measure of spatial disorder (Journel and Deutsch 1993).

service activities spread across the metropolitan area it becomes necessary to employ

some spatial statistical operations as a part of this overall methodology. There are some

important factors to measuring geographic diversity that relate to the methodology

employed here including appropriateness of the measure employed and the use of

postal zones as aggregation areas.

There are two primary types of measure that allow us to measure the spatial

segregation of phenomena within and between aggregation units.   The index of

dissimilarity and the measure of entropy are two such techniques, though, as has been

noted, there are other related measures (Morrill 1995, 35). Among these spatial

statistical methods that can be employed potentially for economic data is the measure of

segregation, as first employed in Duncan and Duncan's index of dissimilarity (Duncan

and Duncan 1955) and the diversity measure. This measure of segregation is calculated

using the following expression[2]:

$$D = 0.5 * \sum_i \left| \frac{b_i}{B} - \frac{w_i}{W} \right|$$

The measure can be interpreted as the percentage of these groups that is required to

move to achieve the same distribution patterns in the two groups. The index of

dissimilarity measure ranges from zero, indicating no segregation at all, to one, a

perfectly segregated situation (Wong 1996, 100).

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[2] Where bi and wi denote two different populations in the spatial unit i, and B and W represent the total populations across the study area. D is regarded as the total difference in how the two groups are distributed among all units in the entire study area.
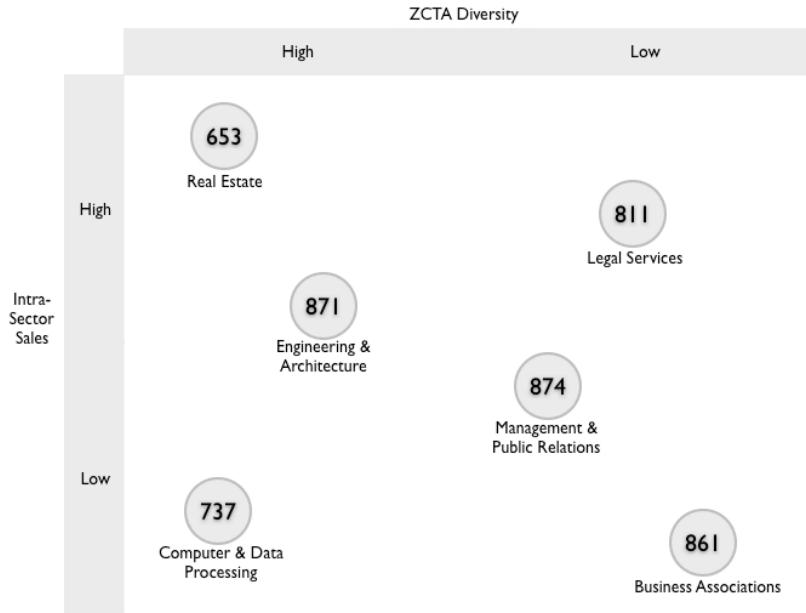
Figure 5.3: Predicted relationships of the entropy (diversity) measure for the aggregate areas (ZCTAs) and the breadth of sales to industrial sectors by the six producer service industrial types.

In typical cases the index of similarity has been used to examine demographic facets of society, such as the classic cases of residential segregation (Boal and Johnson 1971; Morrill 1995; Wong 1996). This calculation requires units, in which data are aggregated, these can be enumeration areas such as census tract or blocks. While useful for comparing two populations, this measure is not well suited for our purposes here. In addition, and most importantly, the result is a global value for an area so that it is not possible to map the outcome of the measure beyond the single value. In other words users will not be able to reveal the spatial pattern of the degree of internal homogeneity within the enumeration units (Wong 1997, 100-101,105).

To understand better how the diversity of producer service establishments are distributed within small areas within the Metro study site a specific diversity measure was selected. The 'diversity index', or more appropriately here termed, an entropy

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measure (White, 1986) differs from the index of dissimilarity in that the proportion of the

phenomena within each unit can be discerned and is therefore 'mappable' (Morrill 1995).

The entropy measure is calculated here using the following expression[3]:

$$E = \sum \left(\frac{N_{ij}}{N_i} * \log\left(\frac{N_{ij}}{N_i} \right) \right)$$

If the proportions of the different groups in the study area are similar then the

entropy measure will be a high value, whereas if one group dominates that unit the

entropy measure will be low (Wong 1998, 14). Moreover, the entropy measure used is

able to compare more than simply two groupings of phenomena. This characteristic

makes the entropy measure particularly well suited for examining the multifarious

classifications of the industrial data sets; this analysis looks across six producer service

industrial types. The measurement output value is therefore not bounded between zero

(the unit being completely dominated by one class) and one (the unit is evenly split

between the two classes) but rather is open-ended relative to the number of groups

measured.

Entropy Measure Preparation

There are several statistical measures for assessing entropy and thus a measure

of diversity of producer service establishments within the Metro area. A necessary step

to achieve this objective is to represent the entropy equation within an operable software

environment where the calculation can be made. Calculations of an entropy measure, or

other diversity measures are not, however, readily available in current GIS software

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[3] Where Nij/Ni, Nij is the population of the group under study, such as an ethnic group, in area unit i, while Ni
represents the total number of the population.

packages. GIS software remains deficient in some functions allowing for the

visualization of spatial statistical analyses, though much progress has been made in the

last few years. Spatial statistic functions including kriging, multivariate analysis,

surfaces, and others are being developed (ESRI, 2003).

While there remain limitations to the types of spatial analyses that can be

performed 'out of the box', many GIS software packages allow scripting or linking to

external computer code or other software packages. The entropy calculation was

initially coded using the scripting language "Avenue" in ESRI's ArcView 3.2 software.

The script was developed as an element larger GIS software suite urban analysis[4].

Given the existing dependencies of the full software suite, the code used to perform the

entropy calculation was modified creating a stand alone function capable of being run

within the ESRI software. Once the Avenue script is incorporated into an ArcView

project file the entropy calculation function is made available. To keep all analysis tools

available in a single GIS package, the output from the entropy measure performed in

ArcView was imported into the substantially more robust ESRI ArcGIS 9.

The Census Bureau Zip Code Tabulation Areas (ZCTAs) were used as the

aggregation units to which the entropy equation was calculated and a resulting diversity

value was attributed to each of the 265 areas. The data inputs for the measure use the

producer service establishment counts for each of the six sectors examined. As stated

the diversity output values for each unit (ZCTA) of this measure are normalized to cover

a range between 0 and 1. The base values for each unit will, however, generally

become higher as the number of elements (discrete producer service industrial classes)

are used in the entropy calculation. When these values are mapped the range of values

from low diversity to high diversity reveal a spatial of producer service diversity for the

ZCTAs.

Analysis Tools

The crucial utility of the entropy measure for geographers is the ability to map the

results. The spatial patterns that form enable the analysis of diversity of producer

services within small area geographies of the Metro area (census tracts, blocks, etc.). In

addition, these cartographic outputs allow for the testing of some assumed explanatory

variables for the location of producer service firms. In this instance the second research

problem explores the connections that may exist between the diversity (entropy) of

producer service industrial sectors and the ultimate concentration of these service

establishments. Figure 5.4 reveals the mapping of diversity values by ZCTA for the set
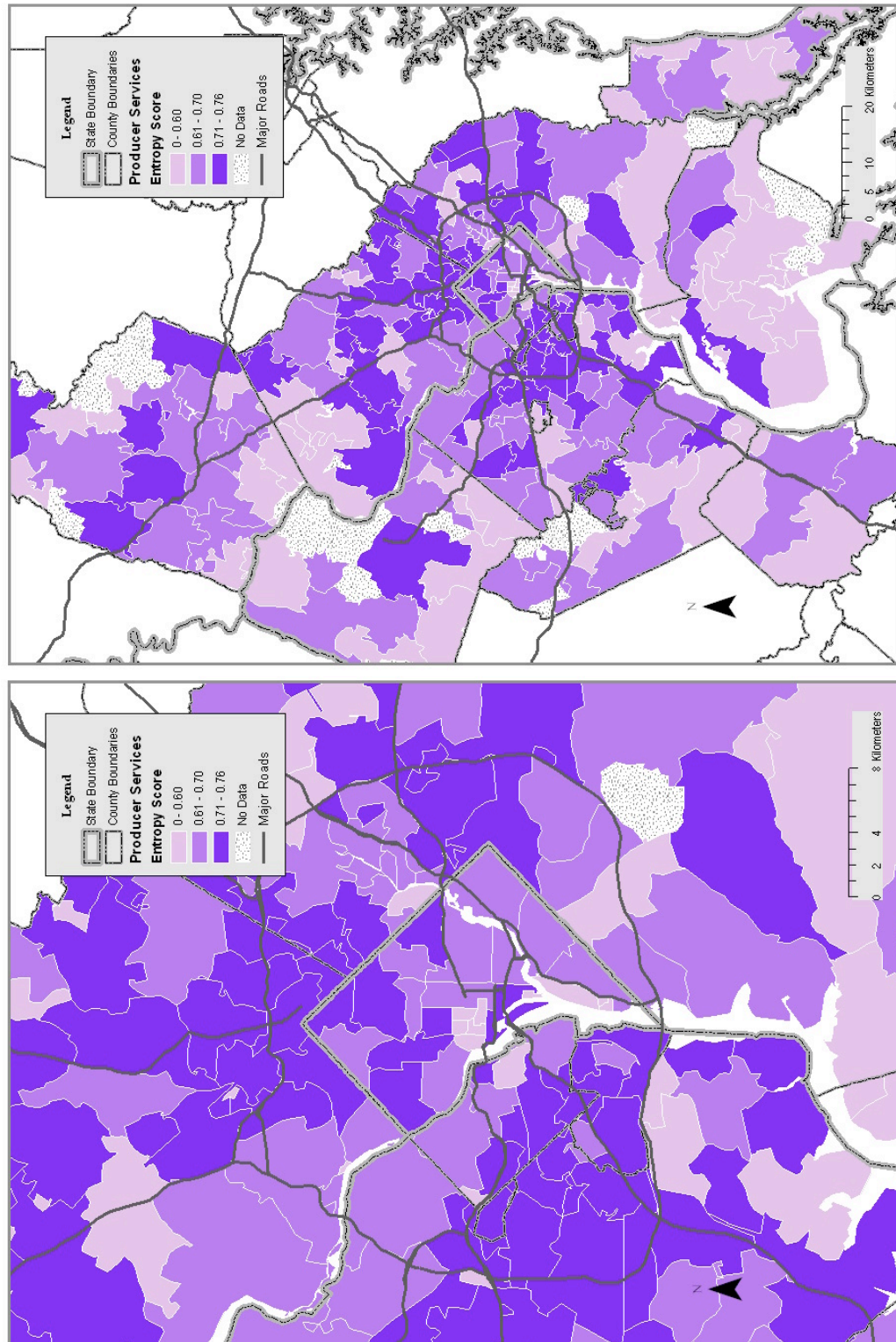
of six industrial producer service sectors.

Figure 5.4: The diversity values by ZCTA for the Metro area. The values are based on the entropy measure applied to a collection of six producer service types. The map on the left hand side is a close-up of the central city area.

Figure 5.3 shows the spatial distribution of the diversity of producer services for the Metro area down to the ZCTA level. The diversity value is displayed as low (<0.6), moderate (0.61-0.7) or high diversity (>7.1). Based on these values it is evident that the diversity of producer services is spatially variable across the Metro area. These general patterns displayed using a few divisions mark those ZCTAs where the mixtures of the six producer service types are greater or lesser. In this case higher diversity denotes that each of the six industrial types is present thus a mixture of establishment types is present. Low diversity is roughly equivalent to a more homogenous distribution so that one or two of these producer service types dominate the total number of establishments in that ZCTA. What is of interest in this research and analysis is revealing these mixtures of producer service activities within areas of the metropolis at a fine spatial scale.

There are some interesting spatial components to this first producer service diversity map. As expected the very heart of the central city reveals several ZCTAs where the diversity of producer service establishments is low. Areas within the Metro portion of Northern Virginia and the Silver Spring-Rockville corridor in Maryland rank high. There are, however, unexpected areas in the rural portions of the Metro area where some ZCTAs also rank high in diversity. These apparent anomalies where expected low diversity actually ranks high are not errors but ZCTAs where there is a high diversity of producer service establishments but a low establishment count[5]. To address this factor the next series of diversity maps use both the diversity values and our initial data sets of producer service establishment counts (figures 5.5-5.7).

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[5] For example, a ZCTA could have a single establishment in each of the six classes producing a high entropy score.
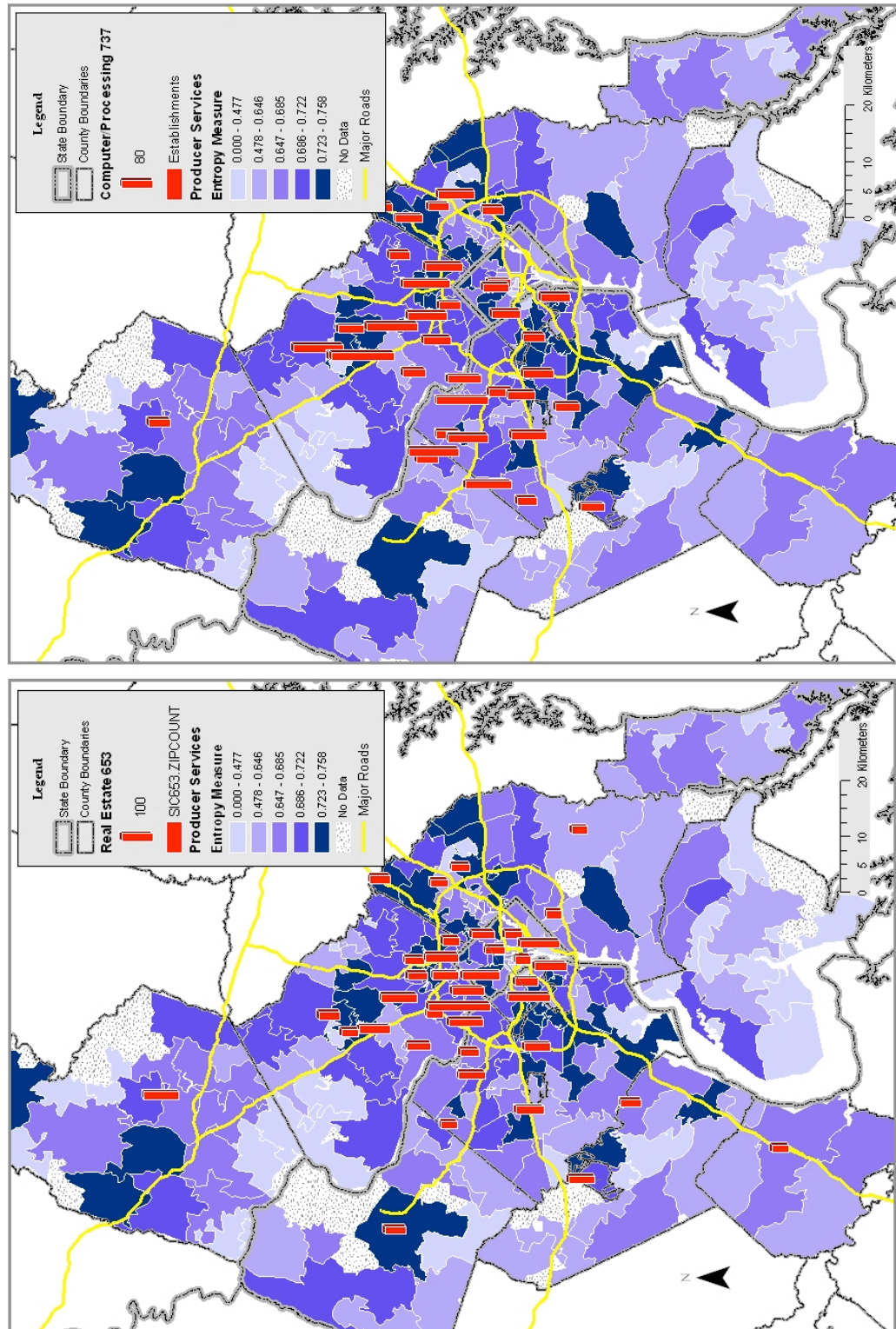
Figure 5.5: The distribution of real estate (SIC 653) and computer and data processing (SIC 737) services by ZCTA with 50 or greater establishments. ZCTAs are ranked based on entropy measure value.
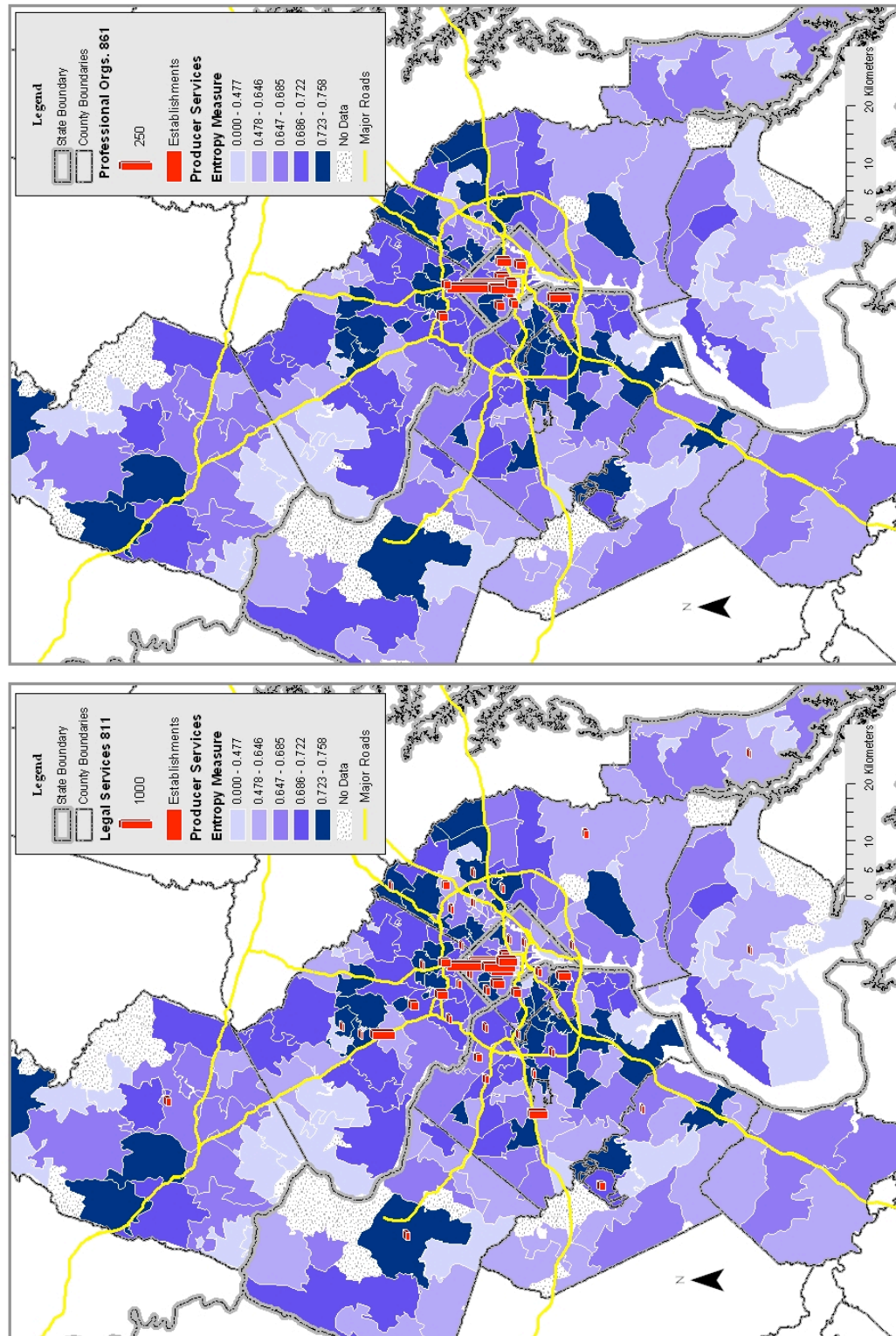
Figure 5.6: The distribution of legal services (SIC 811) and professional organizations (SIC 861) services by ZCTA with 50 or greater establishments. ZCTAs are ranked based on entropy measure value.

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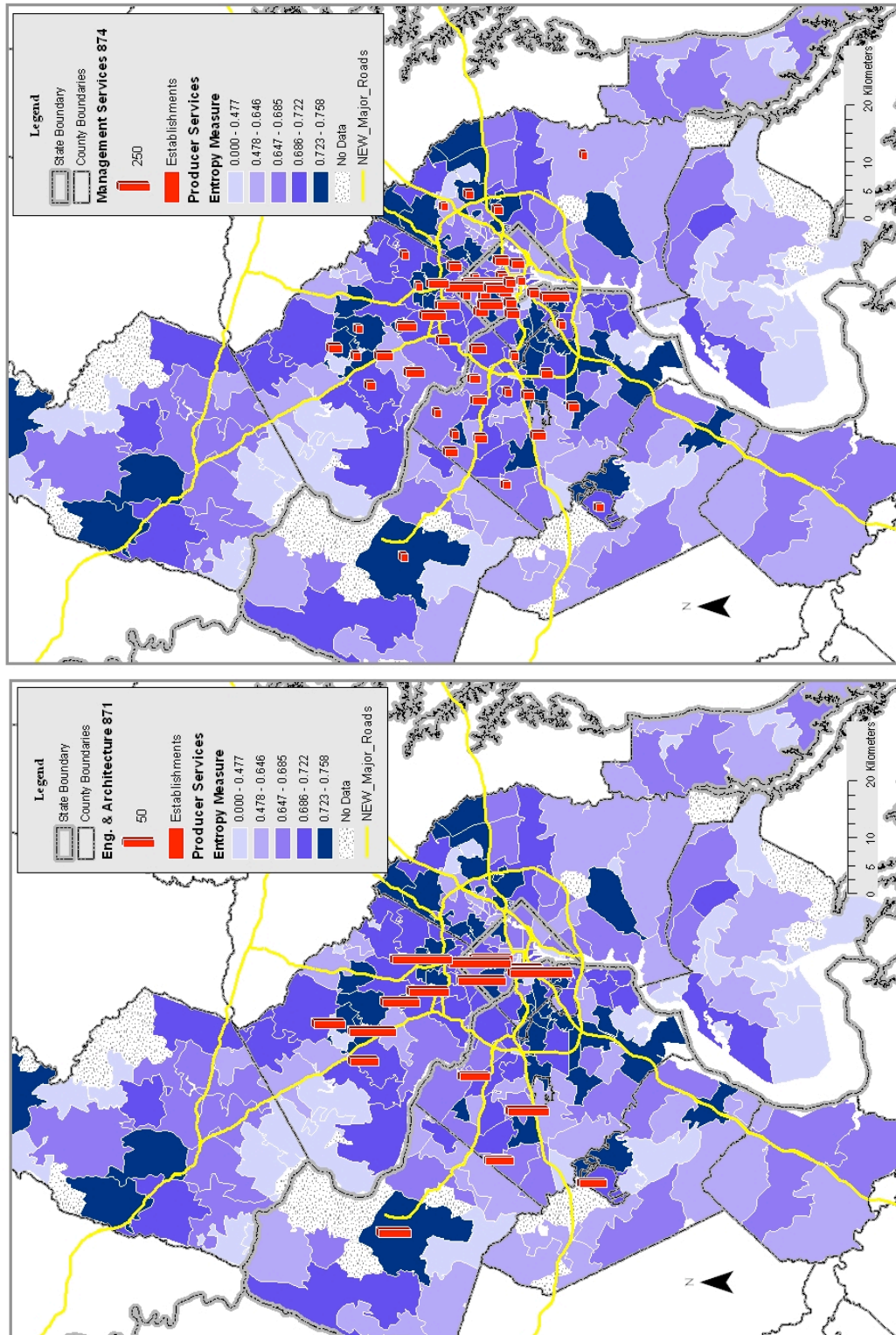
Figure 5.7: The distribution of engineering and architecture (SIC 871) and management and public relations (SIC 874) services by ZCTA with 50 or greater establishments. ZCTAs are ranked based on entropy measure value.

These maps culminate the collected information from which the basis for the second problem statement is addressed. The maps display diversity values for ZCTAs as used in the previous figure 5.3 but do using the value recalculated to quintiles[6] so that finer differences between ZCTAs are discerned. Added to this base-layer information is the establishment count for each of the 265 ZCTAs for which greater than 50 producer service establishments for any of the six industrial classes are present. At this point cartographic representation becomes more challenging as the size of ZCTAs vary considerably from inner city to outer suburbs. Symbols using relative sized bars (i.e. height), in part, aids in revealing the spatial concentration of significant numbers of producer service establishments in relation to ZCTAs with greater or lesser diversity[7]. The bars denote the number of establishments for each ZCTA, however, as the size of the ZCTA decreases so to the spatial accuracy of the bar's location. However imperfect, the relationships between the ZCTA diversity value and the proportion of producer service establishments are revealed.

Analysis Discussion

The series of GIS/cartographic analysis output is presented in order to discern some suitable conjectures for the research problem posed. Despite the caveats made regarding the production of these analysis tools, their use in the interpretation of the location propensities of producer service establishments is of course useful. This final portion of this chapter briefly reviews these materials and the relevancy of producer service diversity to the location of these services within the Metro area.

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[6] Quintiles organize the data into fifths, dividing the data at each 20th percentile.

[7] See Tufte, Edward, The Visual Display of Quantitative Information, Graphics Press, Cheshire, CT (1983).

A general overview of the spatial data reveals much of the differences between the producers service sectors. At a glance the differences of producer service concentration within ZCTAs with particular diversity values vary between the six industrial groups. Figure 5.8 provides an overview of the GIS-based results by capturing the statistical differences of the mapped values for each of the six industrial sectors.
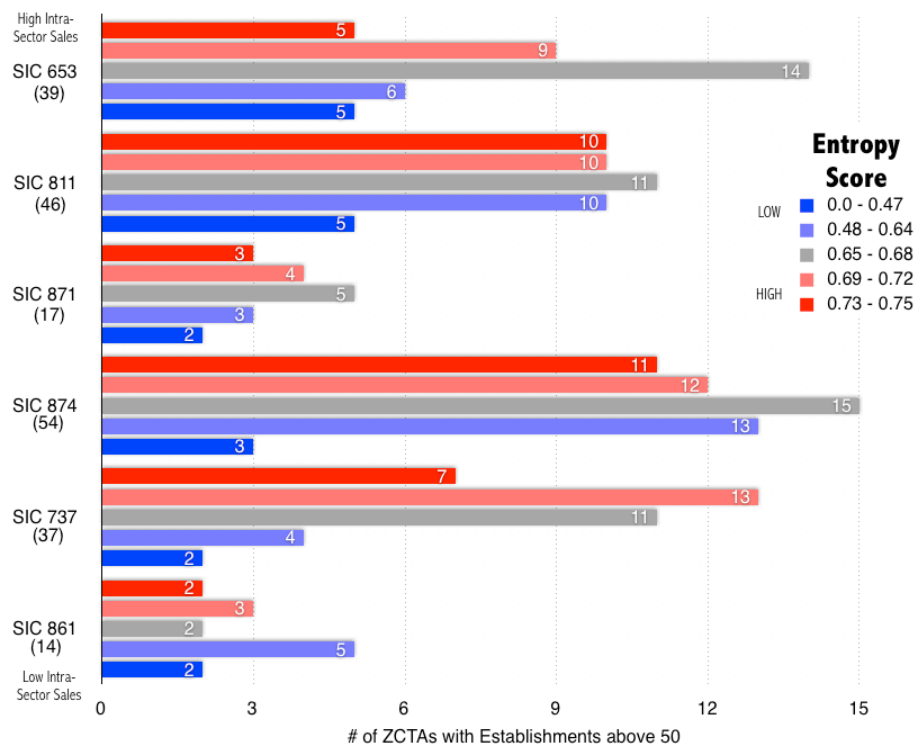
Figure 5.8: The distribution of producer services by ranked ZCTAs based on the entropy measure. The total number of ZCTAs are shown below each SIC class (those ZCTAs with 50 or more establishments), while the bars are individually numbered. Ordering of SIC groups is based on high to low intra-sector sales.

Clear differences between the six sectors with the ZCTAs that contain 50 or more establishments is evident when viewing the statistical and spatial data. The filtering

threshold of establishment count is applied so that the analysis focuses on areas where producer services are found in meaningful abundance versus those ZCTAs in the Metro area where retail or other economic functions are dominant.

The producer service sector dominating the spatial spread by ZCTA is SIC 874 management and public relation services. These services are found in over 20% of all Metro area ZCTAs, and in collections of 50 or more establishments. The Metro area spatial distribution pattern is displayed in figure 5.6 where the spread of SIC 874 firms can be seen to be quite widespread across primarily the inner suburbs of the Metro area with a sizable number within the central city. At the other end of this continuum are business and professional organization SIC 861. These highly specialized service are only found in abundance within fourteen ZCTAs, representing just 5% of total ZCTAs and only one-quarter of SIC 874. These services, as noted, are exclusively focused on central city locations with but a few suburban exceptions. The location propensities of these services do not, however, appear to single out areas where the diversity of other producer services are either high or low. Table 5.1 provides additional summary information of the ZCTA establishment count and the percentage of these ZCTAs having very high (0.73-0.75) or very low (0.0-0.47) entropy scores. The percentage scores for SIC 861 services shows an even balance between ZCTAs with high and low level of diversity (14%). This is an additional indicator of the spatial differences of these two producer services where one in five management and public relations service establishments locate in ZCTAs with very high diversity and only one in twenty for low diversity areas.

Legal service (SIC 811) establishments also have an even distribution of ZCTAs balanced between the very high and very low in diversity, 21% for each. From these data legal services are the most evenly distributed across the range of ZCTA diversity in

producer services. This finding counters earlier conceptions of legal services clustering

in significant numbers only in areas where their high numbers of other legal services, or

places with limited types of producer services. It is expected that the lion's share of SIC

811 establishments are found within a few central city ZCTAs, nevertheless the

remainder of these service establishments also locate in suburban ZCTAs that vary

across all five levels of diversity.

Table 5.1: A summary of percentages for the number of ZCTAs for each producer service type falling within the highest and lowest entropy scores.

SIC	% High Entropy	% Low Entropy
Real Estate	.12	.12
Legal	.21	.21
Eng. & Arch.	.17	.11
Manage & Pub.	.20	.05
Comp & Data Proc.	.18	.05
Professional Orgs.	.14	.14

SIC 653 ranked the highest in its sales to other real estate firms in the last

chapter. When examining the location of real estate establishments in the Metro area

the data distribution pattern of ZCTA diversity is nearly normal. Therefore, of all the

services examined SIC 653 establishments appear to be distributed in areas largely

independent of the presence or absence of other producer services. The distribution

suggests a mixture of relative dominance or weakness in the numbers of producer

service establishments within each ZCTA. The high middle entropy score in relation to

lesser very high and very low scores may be related to this lack of firm relationships

(trading or spatial agglomeration) for real estate. It is interesting to note, however, that the majority of the more rural ZCTAs that contain 50 or greater real estate establishments all ranked quite high in diversity. This may well describe the assortment of businesses that will occupy less dense economic areas of the urban fringe.

Computer and data processing services (SIC 737) is an eclectic mix of industrial service processes most of which are quite central to understanding the growth and development of the information economy in the 1990s. This sector's ZCTA distribution is noticeably skewed toward those areas with higher diversity of producer service firms. Examining the spatial distribution (see figure 5.4), one can also note a clear distribution pattern within the Metro area where the focus of SIC 737 establishment location is outer Beltway and split between the Dulles and I-270 technology corridors. Despite a very low degree of sales between like firms, it is apparent that these services are sensitive to the location of other potential consumers of SIC 737 services. Based on the sector sales data presented in table 4.2, these computer services do have extensive sales to a number of other producer services.

The idea of industrial and economic agglomeration has been suggested to explain why businesses locate where they do and describe the advantages of coincident location strategies. The entropy measure makes it possible to view the spatial relationships of producer establishments with other producer services. The output generated from the GIS analysis provides a means to address this research problem. What this measure and subsequent analysis confirms is that there are relationships between the spatial manifestations of producer service location and the mix of other services adjacent to a target producer service sector. These "diversity relationships" across this group of six are not equivalent but rather each tells a different story of the role of industrial agglomeration.

CHAPTER SIX: FINDINGS FROM GEOGRAPHIC RESEARCH OF PRODUCER

SERVICES

Introduction

This final dissertation chapter provides an overview of the research findings

regarding the influences to producer service location within the study area. The scope of

this research has varied across spatial scales, data sets, and industrial sectors, to

explore some novel ways for revealing and interpreting the spatial arrangements of

producer services at a metropolitan scale. The intent of this work has been to further the

knowledge base of the spatial characteristics of producer service activities within

metropolitan areas principally in the United States. A case study approach was used so

that location details can be shown for a specific metropolitan area. Past research has

tended to use a nation-wide characterization of producer services. The results

stemming from the exploration of the two research problems here portray the location

propensities and potential interactions that specific producer service establishments

have in the Washington DC study area for the late 1990s. The central geographic theme

addressed in this work is how spatial patterns of economic organization in metropolitan

areas are influenced by the nature of the activities performed within specific industrial

sectors.

The first portion of this concluding chapter details the findings derived from the

research and analyses of primarily chapters four and five.   Cursory analysis was

provided at the end of each chapter so the discussion here focuses on the blending and

synthesis of the discrete research findings of producer service location patterns. Each

finding is discussed within the context of broader geographic research of producer

services. The second portion looks forward and addresses future research and the extensibility of the research presented in this dissertation. One significant strength of the research methodology is the ability to move from a collection of isolated, or wholly unique, results to the application of the methods to the whole United States.

Research Findings

The location of producer services are highly heterogeneous across the US metropolitan system. This heterogeneity is due in part to the specialized nature of these services. Similarly, the location of producer services at the metropolitan scale also reveals highly variable patterns. Different producer services often have differing spatial patterns at this scale. It has been learned that producer services that require greater interaction with clients, in this study, tended to be more centrally located rather than dispersed. Some interesting exceptions to this, such as real estate, may show the city-like functions of suburban 'edge cities'. The relationship of the entropy of producer services within small areas proved to correlate only in a few cases and will require additional refinement in later studies. The presence or absence of other producer service firms in close proximity therefore may not be an adequate predictor of PS location in all cases. Spatial patterns of producer services are influenced by the type of activities performed by these services.

Role of Non-routine, Face-to-Face Communication

✴ Research Question: Do non-routine, face-to-face interaction of producer service firms influence specific sub-sector establishment location within the study area?

✴ Finding: There is empirical evidence of a relationship between the spatial concentration (clustering of firms) of specific producer service sectors and the importance of non-routine, face-to-face communications for conducting trade.

A first finding for the producer service establishment research coincides with the traditional notion of industrial agglomeration theory. Industrial geographic literature often noted that proximity of firms is one indicator that relationships between firms exist, even if the relationships are not overtly apparent or measurable (e.g. non-tangibles such as quality of life, environment and amenities, etc.). What these analyses indicate, based on the use of trade data and the entropy measure, is that a trend exists where a need by particular producer service sectors (at a 3-digit SIC level) for non-routine interaction and communication to conduct trade with other firms does impact the spatial arrangement of these establishments.

The research study set used here consists of the six most numerous producer service types in the Metro area. This location trend noted does not apply to all these producer service sectors. The increase in spatial concentration of producer service establishments is only apparent once the the highest and lowest 'tails' of the intra-sector sales rankings are removed. This refers both to the real estate (SIC 653) and business and professional organizations (SIC861). These services represent the highest and lowest for intra-sector trade, 13.4% and 0.01% respectively.

The removal of these end states in this analysis appraisal is far from arbitrary. These services, as noted earlier, have characteristics where it might be expected that the spatial concentration will be different from the proposed relationships. Real estate, for example, having a very high intra-sector sales also has a very high proportion of sales to end consumer markets. This may mean the pull of these population-based

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markets helps to explain a far more spatially dispersed patterns of establishments than is apparent with other producer service sectors. At the other end of the producer sales continuum, business and professional associations, while by definition are producer services, are highly singular and would not be expected to have any substantive need for trade. This fact means the SIC 861 distribution pattern of establishments, much like that of real estate, is being shaped primarily by a wholly different driver. For this producer service sector where accessibility to the decision makers is vital, the highly central city concentration is expected. This is counter to the modeled outcome noting a more dispersed pattern of these services.

The remaining sectors, SICs 811, 871, 874, and 737 adhere then to the predicted trend that varying sales to like firms should produce varying spatial concentration patterns based on the strength of these trade relationships. It is with this majority of the initial six SIC groups where the influence of trade relationships on producer service establishment location is best demonstrated. The strength of sales between the producer service sectors is summarized in figure 6.1, where the percentage of use (or sales) is represented by the first blue bar.

The four producer services sectors where the strength or weakness of sales may be an influencing factor on the degree of spatial concentration are themselves divided into two groups. Legal, architecture and engineering services form a group that have relatively high intra-sector sales (over 5%) and have shown (see figure 4.4) to be spatially highly concentrated. These firms often rely on the the close proximity of clients given the highly individualized nature of the product traded. The second group, management and consulting, and data processing services, have half or less the intra-sector sales as SICs 811 and 871, and reveal a much more diffuse distribution of establishments across the study area (see figure 4.5). This initial finding based on the

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results of the spatial analysis performed indicates that there is a relationship between trade in producer services and how these services come to spatially organize in the study area. This insight into a dimension of the role of markets in producer service production is one additional piece of information that addresses the core questions of producer services location raised in the chapter one (see page 24).

Diversity of Firms and Proximity to Markets

✶   Research Question: Does access and proximity to markets for producer service goods and services help to shape establishment spatial patterns within the metropolitan area?

✶   Finding: There is evidence indicating that some types of producer service establishments known to have weak trade relations to other producer services do locate is areas with lower diversity of services.

The answer to the second research question is more uncertain[1]. Nevertheless, the mixture of end results do not entirely refute this relationship or bear enough evidence to counter the general notion. The spatial distribution for diversity of producer service establishments, aggregated to ZCTAs (Zip Code Tabulation Areas), reveals a distinct pattern in the Metro area (see figure 5.3). Variation of the diversity of producer service establishments by ZCTA is not simple where more diverse areas coincides with all economic centers of the study area. Rather the patterns of high and low diversity appear to relate to specific areas where producer services firms are more likely to be located. For example, the ZCTAs where there is a high entropy tend to locate in the mixed business area of Montgomery County, and in western Fairfax County.

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[1] Significant refers to the ability to use these results as a means for prediction of spatial behavior of particular types of producer services.

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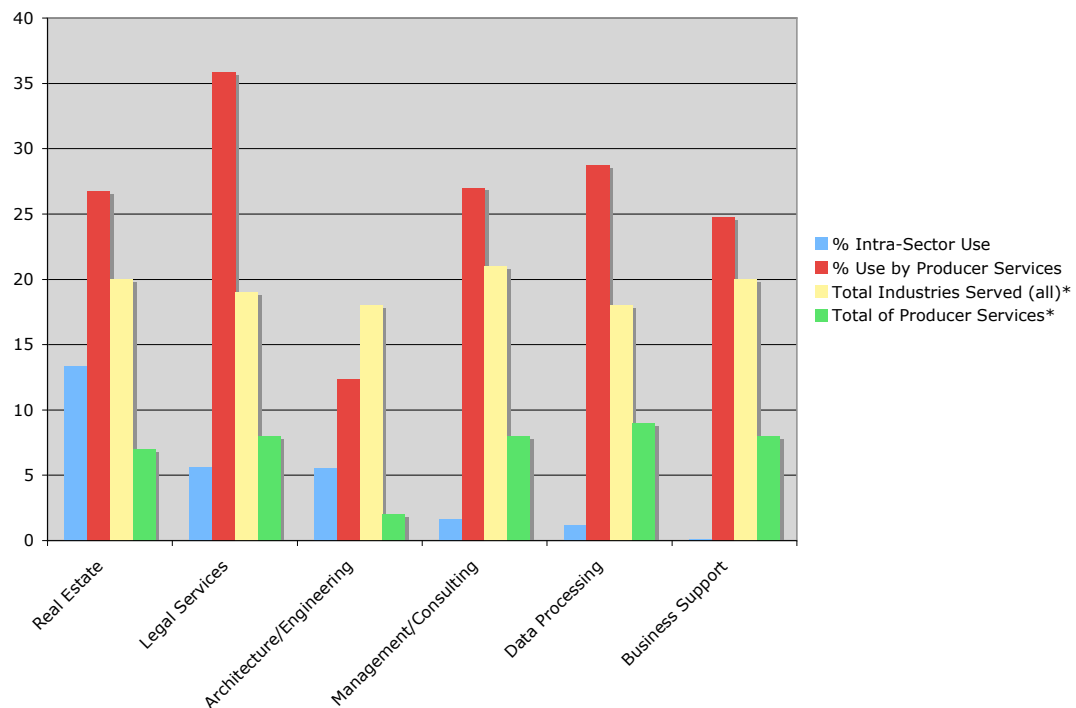
Figure 6.1: A summary of the statistics for trade relationships of the producer service establishments.

The intent of the analysis using the entropy measure is to correlate the diversity of producer services by ZCTA to the presence or absence of particular producer services. It has been shown that producer services, despite a common definition, do not all share the same functional requirements for production inputs or the end markets for goods and services. The resulting GIS analysis confirms this heterogeneity in the patterns of ZCTAs with high numbers of producer services, based on the industrial sector. The added layer of information is the relationship of the underlying diversity of the ZCTA with the presence or absence of these services. Legal services, for example, appear in greater numbers in the low entropy ZCTAs of the central city area (see figure 5.5). However, when the total numbers of ZCTAs for each producer service type are

calculated (see figure 5.7) the distribution of legal services is far more mixed across the diversity of ZCTAs.

Based on the data analyzed for this research problem, two producer service sectors data processing and management and public relation show a clear tendency to locate where diversity of other producer services is greater. This is a general reinforcement of results from the analysis of producer service markets. These services both have extensive distributions across the Metro area with data and computer processing services tending to have large numbers of firms outside the central city area. The colocation of large numbers of these two specific service sectors and the presence of a mixture of other producer service types in their ZCTAs reveals a location tendency. It is the purpose of the research here to work toward developing these type of diagnostic tools to aid in the prediction of where producer services will ultimately locate. There is a need, however, to better differentiate the other producer service sectors' relationship of establishment location and the presence of a greater or lesser mix of adjacent producer services.

Research Extensibility

As stated the results produced and discussed in this final chapter are intended to explain the location of producer service establishments within the study area of the greater Washington DC metropolitan region. Nevertheless, it is a contribution to note the areas where this research and methodologies can be applied to geographies and topics beyond the limited scope presented in this work. The methodology developed here was in part conceived with an idea that the data and tools could well be used in other urban areas. Again, this is not to suggest the results and findings here can be applied to

another metropolitan area rather the framework for the same type of research could be performed.

The data sets used in this analysis are available for all urban areas within the United States. This alone is a key to creating a research environment where results can be compared. The economic data used, for example, from the BEA is collected nationally as is the business data from InfoUSA (and other commercial vendors of these forms of geo-referenced data), and all the geo-spatial data from the US Census Bureau. This suite of useful data for producer service research represents a capability to study unique urban phenomena, such as the mix location and markets of producer services, at the sub-metropolitan scale but inclusive of potentially all US urban areas. This offers the advantage of reproducing studies across differing metro area and regions. The commonality of approach and data would make results, in many instances, comparable.

Study Area Distinctiveness

A critical piece of the economic landscape for the Metro area is the presence of the US Federal government. Clearly this creates conditions that are unique for the area. Federal employment is found through cites and states across the United States but the highly centralized function of the Federal government in the region makes it a tall pole in supplying to overall regional employment and resulting economic activity. The research discussed in this document has not broken out specific information pertinent to the direct role of federal employment in the region in terms of use of (purchase) or employment in (civil servants and contractors) of producer services. A detailed economic focus on the role of federal employment would be a substantial expansion of the research goals and while highly valuable was seen as a separate activity.

In terms of producer service employment the Federal government has had influence in a number of ways, these are understood and in a variety of studies articulated. The Federal government influences the producer service sectors by being a provider of employment in activities whose description are clearly producer service-oriented. On the other hand the government is also a purchaser of producer services activities. It is here where the influence of these dollars flowing from the Federal government into the regional economy would be highly informative. The role of 'out sourcing' is an ongoing politically driven activity that impacts the type and availability with jobs in the study area and beyond. The goal is to drive down Federal spending and costs by moving some jobs out of the Federal government into the competition-based private sector. The OMB circular A76 act is used to allow the government to study and then implement the reduction the Federal workforce. The use of this circular and the impacts on both the reduction of costs to the Federal government and /or the creation of new jobs in the region are often not conclusive.

Economic Ecosystems

The results of the GIS-based analysis of producer service sectors and their location properties has allow may also allow for the further exploration of potential relationships and linkages of producer services. For example, urban areas may be perceived as an economic ecosystem[2]. The urban economic environment it is not too far a field from this natural concept when considering the types of relationships that occur between firms and how these interactions form groups that may or may not prove successful in growing, adapting to economic changes, and a host of other urban stimuli. The need for example for particular firms to engage in more face-to-face communication

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[2] Where ecosystem refers to "a localized group of interdependent organisms together with the environment that they inhabit and depend on" (Webster).

within the context of the sale offers suggests spatial relationships are important in interpreting urban economic patterns. If some of the techniques and data developed here were improved and in some instance modified it may be possible to test this concept. It is potentially valuable to be able to interpret the location patterns of economic activities, such as producer services, using the knowledge of the mix of businesses that exist in an urban area. The techniques used here have shown that it is possible to do these types of analyses at very fine spatial scales. Past research has focused on the use of the metropolitan area as the unit of study. It is argued throughout this document that a finer scale will enable geographers to say much more about the arrangements of economic functions. Depending on the data and tools available it may be possible to develop templates of producer service location tendencies where urban areas can be compared based on these patterns of business mixtures. This form of analysis could hold a good deal of explanatory power for the interpretation of urban economic systems.

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