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The Value of Access to Highways and Light Rail Transit: Evidence for Industrial and Office Firms

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The Value of Access to Highways and Light Rail Transit: Evidence for Industrial and Office Firms

DISSERTATION

submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Transportation Science

by

Sherry Ryan

Dissertation Committee:
Professor Joseph F. DiMento, Chair
Professor Marlon G. Boarnet
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1997

The dissertation of Sherry Ryan is approved
and is acceptable in quality and form
for publication on microfilm:

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Committee Chair

University of California, Irvine
1997

DEDICATION

This dissertation is dedicated to Kristina and Jonathan,
and to all children
whose mothers are consumed by graduate studies.

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ABSTRACT OF THE DISSERTATION

The Value of Access to Highways and Light Rail Transit:
Evidence for Industrial and Office Firms

by

Sherry Ryan

Doctor of Philosophy in Transportation Science

University of California, Irvine, 1997

Professor Joseph F. DiMento, Chair

This dissertation examines the relationship between transportation access and industrial and office property rents. The primary purpose of this research is to evaluate two sparsely studied topics in the transportation-land use literature: the impacts of light rail transit on property values, and the effect of transportation facilities on non-residential land uses.

Multivariate regression analysis is used on longitudinal data for approximately five hundred and twenty office properties and five hundred industrial properties collected from the San Diego metropolitan region over the period from 1986 to 1995. Asking rents ($/square foot/month) is the dependent variable. Straight-line distance of each property to the nearest freeway on/off ramp, the nearest light rail station, and to the San Diego central business district provide measures of access. Other independent variables include building and neighborhood characteristics.

The findings show that access to freeways is consistently significant in predicting office rents. This result indicates that freeways are important in shaping office property values, and by extension office land use patterns. Light rail transit did not have a significant effect on office rents. Access to the CBD was only significant for downtown office properties. The CBD variable in this case may be a proxy for the effect of localization economies. None of the measures of access was significant for industrial properties.

This research underscores the importance of refining measures of access in order to capture and better understand the transportation-land use relationship. In particular, if the distance of an industrial firm to freeways, light rail transit, and the CBD is not important, then what kinds of access do matter? This research also has important implications for planning light rail transit systems. There is strong evidence that light rail systems do not provide enough travel cost savings to increase non-residential property values. This finding should be taken seriously in planning alignments for future light rail systems. Light rail systems need to be aligned with existing activity centers, rather than expected to stimulate new development or the redevelopment of distressed urban areas.

Introduction

This dissertation presents a study of the relationship between industrial and office land rents and transportation access. Two fields of research examine this relationship. The first considers the general problem of modeling urban structure and the factors that influence where residents and firms locate. Location theory, and the monocentric and polycentric models provide the theoretical framework for this work. I refer to this body of research as the urban structure literature. The second area of research examines the relationship between transportation facilities, and land use or land value. The theoretical foundations for this research are less clear. Location theory and sometimes capitalization theory are used to provide a framework for analyzing the impact of transportation facilities on land use. I refer to this work as the transportation-land use connection literature.

My dissertation belongs primarily to the transportation-land use connection literature. Three basic questions are addressed. First, do industrial and office oriented firms value access to highway and light rail systems, and if so, what is the premium they are willing to pay for this access? Second, what role do regional transportation facilities play in determining where industrial and office oriented firms locate? And third, what do these results tell us about the potential for transportation policies to influence land use, especially policies related to light rail transit.

I use regression analysis on data collected from the San Diego metropolitan region to develop models of industrial and office rents. Property rent ($/square foot) is the dependent variable. Straight-line distances of each property to the nearest freeway on/off ramp and the nearest light rail station provide measures of access to regional transportation facilities. Other independent variables related to building and neighborhood characteristics are also included. The results should improve our understanding of the significance and magnitude of the relationship between industrial and office rents and transportation access. These results should also provide insights about the importance that transportation facilities play in the location decisions of industrial and office oriented firms.

Chapter One briefly reviews location theory and some of the urban structure literature, focusing on issues related to industrial and office location. Chapter Two presents an overview of the transportation-land use connection literature, focusing on empirical studies of the impact of transportation facilities on land values. Chapter Three presents the hypotheses analyzed in this dissertation, and the methods and data used to test these hypotheses. Chapter Four presents the office property data and regression models of office rents. Chapter Five presents the industrial data and regression models of industrial rents. Chapter Six concludes with a summary of findings, their policy implications, and directions for future research.

Chapter 1

An Overview of Location Theory for the Firm

1.1 Introduction

Location theory provides one perspective from which to examine how transportation systems influence the location decisions of firms. This chapter is included here to provide a general overview of the way economists and regional scientists study urban structure, and to familiarize the reader with some of the general issues from this field. The transportation-land use connection literature tends to overlook the complications of urban economics and location theory for the firm. It is important, however, to have an understanding of the urban economics literature, as these theories may provide some explanation for the traditionally inconsistent results found in transportation-land use studies. For example, as will be discussed in the following pages, the output a firm produces may be crucial in determining the location within an urban region that a firm values. The transportation-land use connection literature typically does not consider land use at this level of detail. In other words, the type of service or product provided by a firm may be an important factor in trying to understand how firms value access to transportation systems. One of the goals of this dissertation therefore is to bring more urban economics language and thought to the discussion of the transportation-land use connection.

1.2 Historical Overview

Location theory originated in the early 1800's to explain agricultural location and rent. Ricardo is generally considered among the earliest analysts of agricultural location and rent. Unlike more recent theories, his theory of rent is not founded on the distance of a parcel to a central market; rather he attributes rent differentials to the amounts of labor and capital necessary for production on a particular parcel of land. Ricardo maintains that different levels of land fertility at different locations result in the requirement of different amounts of labor and capital. Land that requires less capital and labor will have a higher rent than land requiring more labor and capital. Later in 1826, Johann von Thunen expands Ricardo's analysis by including the location of land in relation to a central market place as a determinant of land rent. Von Thunen makes several simplifying assumptions in developing his location model. First, there is an isolated state or region with a single city in the center; second, the region has no distinguishing geographical features; and third, the land is characterized by homogeneous fertility levels. In this simplified environment, differences in land rents are solely a function of distance to the market, in other words, rents are a function of the differences in transportation costs a farmer pays to ship his product to market. Hurd (1911) contributes to location theory by interpreting urban land in a similar way. He attributes differences in urban land value to the "superiority of location only, the sole function of city land being to furnish land on which to erect buildings," (Hurd, 1911). Alfred Weber's *Theory of the Location of Industries* (1929) is one of the first advancements made in explaining the details of industrial location. Weber discusses industrial location as a problem of minimizing a firm's transportation costs for inputs to production and for shipping outputs.

It is only in the 1960's that urban location theory becomes grounded in a more analytical framework. Alonso (1964) and Muth (1969) use contemporary microeconomic theory to reformulate theories of location and urban land value. Several location models have been developed, broadly corresponding to different economic sectors or land use types, such as agricultural, industrial, retail-service, and residential. Each of these models is an extension of microeconomic theory. Industrial, agricultural, and retail-service location models are an extension of production theory where land, along with labor and capital, is included as a factor of production. Residential location theory is an extension of consumer theory where individuals or households seek to maximize utility subject to a budget constraint.

1.3 Basic Concepts of Location Theory for the Firm

Contemporary location theory for the firm has developed within the basic microeconomic concept of profit-maximization. Traditional microeconomic theory, however, does not consider the spatial decisions facing a firm (Mills, 1989). Location theory incorporates a spatial element by including transportation costs as a factor of production. In considering transportation cost as a factor of production, the location of a firm relative to markets and suppliers becomes important. A profit-maximizing firm seeks to minimize production costs, including the cost of transporting inputs and outputs (Mills, 1989). The following model illustrates some of the basic assumptions and results of location theory for the firm. This derivation is based on the model presented in O'Sullivan (1993).

A firm's profit is equal to total revenue minus total costs (TR-TC). Total revenue is the price of the output times the quantity produced ($TR = P_q \cdot Q$). Total cost consists of the cost of inputs to production (C), transportation costs ($t \cdot Q \cdot u$), and the cost of land or land rent ($R \cdot T$). A firm's profit function (π) therefore can be expressed by the following equation:

$$\pi = (P_q \cdot Q) - C - (t \cdot Q \cdot u) - (R \cdot T)$$

where = P_q = output price
Q = quantity of output
C = cost of nonland inputs (capital, labor, raw materials)
t = freight cost per ton per mile
u = distance from the central market or export node.

R = land rent per acre
T = acreage of land

Under the assumption of perfect competition, a firm's profit will equal zero. The firm is a price-taker for all nonland inputs. The rent a firm is willing to pay equals the profit remaining after paying for nonland inputs and shipping costs. By setting profit equal to zero, dividing both sides of the equation by acreage of land (T), adding rent per acre (R) to both sides of the equation, the following equation for land rent (R) is derived:

$$R = \frac{(P_q \bullet Q) - C - (t \bullet Q \bullet u)}{T}$$

This equation shows that the rent a firm will pay is equal to its pre-rent profit divided by the amount of land consumed. This equation indicates how much a firm is willing to pay for different parcel sizes of land at different distances (u) from the central market or export node.

This model is the most general representation of how firms make location decisions. Economists and regional scientists have refined their interpretation of this model based on the specific production processes of different industries. Weber (1929) first discussed the idea that firms have distinct locational orientations based on the nature of their production processes. Firms can be oriented toward minimizing either production costs or transportation costs, depending on the specific output produced (Mills, 1989). Production-oriented firms base their location decisions primarily on minimizing production costs since they are a relatively large percentage of total costs. This means firms locate near important inputs to production that can not be easily transported, such as labor, energy supplies, or some intermediate good (O'Sullivan, 1993). Transportation-oriented firms seek to minimize transportation costs for inputs or outputs since they are a relatively large percentage of total costs. Within the category of transportation-oriented firms, there are both market-oriented and materials-oriented firms. A market-oriented firm bases it location decision mainly on access to markets where its goods are sold; in other words, it seeks to minimize transportation costs for outputs because they are relatively bulky, perishable, or fragile compared to transportation costs for inputs (O'Sullivan, 1993). Examples of such industries are automobile assembly or large bakeries. In the case of automobile assembly, the cost of shipping metal, plastic and other inputs for auto manufacturing is relatively lower than shipping the final product which is bulky. For bakeries, the cost of shipping flour and other inputs is less than shipping the final product which is highly perishable (Hoover, 1975; cited in O'Sullivan, 1993). In both cases, these industries locate near their markets to keep the shipping costs for outputs low. A materials-oriented firm seeks to minimize transportation costs for its inputs and therefore locates near the source of important inputs to production. Examples of such industries are cotton baling or canning. Inputs to cotton baling are relatively bulky compared to the output, so the cotton baler locates near the cotton fields. For the canning industry, inputs are relatively more perishable than the canned outputs, so this type of industry would locate near sources of fruits or vegetables to be canned (Hoover, 1975; cited in O'Sullivan, 1993).

Decentralization of the firm is a frequently addressed issue in the urban structure literature. A widely accepted notion is that transportation costs are becoming smaller relative to production costs due to improved transportation technologies. High levels of mobility have made transportation considerations less important in the firm's location decision. Firms which were once bound to certain locations because of the need to keep transportation costs low, are now freer to choose locations that have lower production costs. Firms which have become "free" of this dominating concern with transportation costs are referred to as "footloose industries" (Mills, 1989). Besides seeking locations which lower production costs, researchers are finding that worker-amenities are becoming a predominate consideration replacing previous concerns with transportation cost. Attributes which provide a pleasant working environment for employees have become more influential in a firm's location decisions.

In the present study, freeways and light rail transit may satisfy the needs of either transportation-oriented or amenity-oriented firms. Firms locating near a freeway on/off ramp would likely enjoy lower transportation costs for shipping inputs and outputs than firms located farther from freeway access points. Locating near a freeway on/off ramp also provides a type of worker amenity in that travel on surface street for employees coming and going to work is minimized. In the San Diego case, light rail transit also potentially provides benefits for both transportation-oriented firms and amenity-oriented firms. San Diego's light rail system is used for freight shipping during passenger service off-hours. For amenity-oriented firms, access to light rail transit could be viewed as an asset to employees.

The distinction between industrial and office land uses in the present data allows some estimation about the type of location preferred by each sector. In general, office firms value access to supporting business services and to clients, such as that provided in the downtown area. The specific type of firm is somewhat crucial in determining what type of access is most valued. Industrial firms in general would value either access to transportation services (a port, or central export node), access to inputs, or access to markets. Again, the type of industry is important in determining exactly which type of access is most valued.

1.4. Tests of Location Theories for the Firm

Sivitanidou and Sivitanides (1995) provide a brief review of the research on industrial location. They identify three strands of empirical work examining spatial variation in rents. The first is based on the traditional monocentric model where all employment is centrally located. Location is modeled in terms of distance from a central transportation or export node. Results from early studies show a declining rent gradient for firms as distance from the central node increases. The second group of studies expands rent models based on the concept that other locational attributes are important for profit-maximizing firms, such as site-specific characteristics, or community characteristics. In these models, the relationship between a firm's specific location and its production orientation becomes more complex. Instead of focusing on access to a central export node, these models incorporate access to transportation services and business services. This adjustment in the measure of access more accurately models a decentralized urban area by allowing for the possibility of important transportation or service nodes outside of the traditional urban center.

Sivitanidou and Sivitanides (1995) find that the density of freeway availability (measured as freeway miles per square mile of zoned land) and distance to an intersection of two major freeways are both significant in their rents models, and indicate that higher levels of freeway access are associated with higher industrial rents. Kowalski and Paraskevopoulos (1990) find that industrial properties abutting freeways have higher rents than properties that are not next to freeways. They attribute this result mainly to exposure gained by the firm, but there may also be transportation cost savings accruing to firms near freeways. In a more recent study, Sivitanidou (1996) finds that when access to the CBD and other secondary centers is controlled for, freeway access becomes insignificant. This recent finding identifies the dominating value firms place on access to subcenters of activity rather than actual transportation facilities. This finding further suggests that transportation systems are only important in that they provide access to specific centers of activity which are important to a particular firm's production.

In some of the literature, access to transportation systems is not explicitly considered, rather other types of access such as "personal linkages" and "market access" are viewed as determinants of firm location (Archer, 1981). A potentially important dynamic to decipher in future research is what type of firms value access to which type of subcenters. For example, Archer (1981) finds that market-oriented firms are more sensitive to the location of their markets than to personal commuting cost and personal linkages. He also finds that non-market oriented firms are more sensitive to personal linkages than market location and personnel commuting costs. Blackely (1985) develops a discussion of two types of manufacturing firms and shows differences in their bid-rent functions based on characteristics of the firms' production processes. He distinguishes between firms that are able to vertically integrate production processes and subsequently separate from other economic activity in an urban area, and those firms that are not able to integrate vertically and therefore must maintain close contact with various business services in an urban area. Further evidence has been found that specific production orientations of firms are important in determining their optimal location within an urban environment. Clapp (1980) found that office firms value access to the CBD, while Schmenner (1981) found that manufacturing firms do not value access to the CBD. In this dissertation, hypotheses at this level of detail are not made because data about the type of firm and its production orientation were not collected. In the present study, firms are separated based on two categories of land uses, industrial and office. It is hypothesized that both industrial and office firms value access to highway and light rail systems, as a means of maintaining linkages necessary for conducting business.

The following chapter presents the transportation-land use literature. These studies belong mainly to a transportation "planning" tradition: the hypotheses and methods are typically based on a hybrid of urban economics and capitalization theories. An important difference between the studies presented in Chapter 1 and Chapter 2 is that the former is focused on a comprehensive understanding of urban structure and location patterns, while the latter attempts to isolate one type of relationship within the urban environment.

Chapter 2
Impacts of Transportation Facilities on Land Value

2.1 Impacts of Freeways on Land Values

2.1.1 Introduction

Approximately thirty-five studies of highway impacts on land value have been conducted over the past four decades. Several literature reviews have also been completed (Parsons, Brinkerhoff, 1995; Giuliano, 1989; Dyett 1981; Gamble and Davinroy, 1978). A review of the literature is presented here with a particular additional emphasis on categorizing empirical research by methodology. Methodological differences may be an important reason for the wide variation in results obtained over the years. It is possible in fact for researchers to find previous studies that will support almost any proposed hypothesis about the relationship between highways and land values. An attempt is made here to identify relationships between the results obtained over the years and particular methods employed.

Transportation researchers generally adopt location theory to describe the relationship between transportation facilities and land use. Their application of location theory predicts that individuals and firms value access to transportation systems and will pay higher rents to locate near a particular facility. It should be noted, however, that this is markedly different from the traditional monocentric model where it is predicted that individuals and firms value access to a central market or a central employment center, not to a particular transportation facility itself. Within the framework of the monocentric model and location theory, a transportation facility only provides travel cost reductions if it provides increased access to centers of activity that are valued by individuals and firms. This concept is important, especially when evaluating modes such as light rail facilities that may at times fail to provide significant access to those activity centers that are important to specific individuals and firms. In sum, the relationship between transportation facilities and land use, or land value, may be more complicated than previously acknowledged by transportation researchers. Individuals and firms may not always value, across the board, all transportation facilities; it depends on the particular activities of individuals and firms, and the centers serviced by a particular transportation facility.

Two divergent opinions have developed about the magnitude of the transportation-land use relationship in the current urban environment. Some researchers believe that transportation corridors, especially transit corridors, will lead to significant intensification of land development (Cervero, 1995); while some researchers believe accessibility levels in most metropolitan regions are already so high that no amount of transportation investment could affect travel costs enough to influence land value, and by extension, actual land use (Giuliano, 1995). Either interpretation could be accurate depending on the particular scenario analyzed. Furthermore, since the results of previous research are highly inconsistent, it is possible to interpret the literature to support whichever opinion is held. Researchers who believe that new transportation investments have little influence on land use in the current urban environment can interpret the empirical work to support their particular understanding of the transportation-land use relationship. It has been claimed that studies from the fifties and sixties generally show significant land use impacts from highway construction because, as the argument follows, the marginal increase in accessibility and subsequent decrease in travel costs were dramatic enough to cause shifts in land development patterns (Giuliano, 1996). Continuing with this argument, it has been claimed that more recent studies show relatively few significant land use impacts from transportation investment since urban transportation systems have become very dense and travel costs uniformly low. In other words, in the current urban environment, it is difficult to change marginal accessibility levels and travel costs enough so that land use patterns shift to take advantage of lower transportation costs.

This interpretation of the transportation-land use literature is not entirely supported by the review conducted here. The idea that transportation effects on land use patterns are concentrated during a period of history when stark changes in technology and transportation supply occurred does not appear to be an accurate depiction of the transportation-land use research. A more accurate depiction of the empirical research is that there are no clear trends in the results obtained over the years: earlier studies found inconsistent and inconclusive results as do many of the recent studies.

By re-examining these studies, possibly overlooked trends can be identified and lead to a better understanding of the transportation-land use relationship. The first step in this examination is to review the methodologies employed by various researchers; the second step is to review the results obtained. To complete the examination, the direction and magnitude of the results will be compared across methodologies to determine if any identifiable influence is presented by a particular type of study design.

The two predominate methods used to examine the land use impacts of highways over the past several decades are experimental-control analysis and multivariate regression analysis. Although the methods used can be divided into two general categories, a review of the literature shows that almost no two studies have similar study designs. This complicates the reviewer's attempt to generalize about the overall body of results obtained from these studies. The study design factors considered here include the time period in relation to the freeway construction and opening, the duration of the study, the definition of impact and control areas, the type of land use impact evaluated, and the independent variables included in regression analyses.

Roughly thirty-five highway studies are reviewed in this chapter. Three basic generations of land use impact studies were found: the first generation studies span the fifties and sixties and employ primarily experimental-control methods; the second generation studies are from the seventies and use mainly regression analysis; the third generation studies are from the eighties and also use regression analysis but focus primarily on changes in aggregate measures of economic and demographic growth and distribution. In the following sections, the methods, study designs, and results of each generation is reviewed.

2.1.2 First Generation Studies

Methods and Study Design

The first generation studies generally analyze data associated with a test site and a control site for some designated before and after periods. This approach entails collecting land use data associated with two geographic areas. Theoretically, the test and the control areas are identical except for the presence of the freeway within the test area. Comparisons of certain variables are then made to determine whether significant differences exist between the test and control areas. Differences found between the two areas are attributed to the freeway, since all other variables have theoretically been held constant. Within this general approach, several study designs have been used. The geographical definition of "impact" area or test site ranges from an area within nine hundred feet (0.17 miles) of either side of the freeway in question (Crosby et al., 1978), to an area within two miles of the freeway (Ererly, 1966). The definition of control sites ranges from an area within 0.5-1.0 miles of the freeway (Adkins, 1959), to a non-descript area characterized as "the rest of the town" (Ererly, 1966). The time variable used in these studies also varies widely. Some researchers use the date of initial freeway planning to distinguish between the before and after periods, while others use the beginning of construction, and yet other researchers use the opening date. The duration of data collected ranges from before and after periods of three years in Adkin's study, to a before period of seven years and an after period of twelve years in Crosby's study.

The predominate measure of land use is land value or real estate value. This is the most consistent aspect of the land use impact studies. Five of the six first generation studies use some measure of land value to represent land use. Although this provides some consistency across studies, the exact source of value data varies. Value data is collected from sources such as real estate sales records and county property assessors.

Some researchers attempt to address the difference between land value and value of improvements to the land, while others do not. Adkins (1959) for example uses real estate sales data, but attempts to remove the effect of improvements to the land by subtracting the appraised tax value of the improvements from the real estate sales figure. Most researchers have used a cross-section of real estate sales values or assessed property values from a before and after period.

Results

Three of the six test-control studies reviewed show a positive relationship between freeway construction and the land use variable in question (Adkins, 1959; Bone, 1959; and Crosby et al., 1978). These studies show land value increases in the test sites ranging from 180% in Bone's study to 483% in Adkins' study, while control site values for the study period changed between -64% in Adkins' study and 85% in Bone's study. Three of the six test-control studies show a weak relationship between freeway construction and land use variables (Ererly, 1966; Golden, 1968), and in some cases no relationship (Burton, 1965).

Some general patterns relating study design and results become apparent in reviewing the test-control studies. Of those studies showing a positive relationship between freeways and land use change, the test areas are smaller geographically, and the data sets more extensive, particularly in the after period. For example, all studies showing a positive relation between freeways and land use change define impact areas no larger than 0.5 miles from the freeway; and all studies not finding a relationship used impact areas which included land up to 1.5-2.0 miles from the freeway. In terms of the timing of the data, studies finding a positive relationship all have "after" data at least ten years from the established critical point, either the planning or opening of the freeway. The studies that do not find a relationship between land use change and freeways all have "after" data that do not extend beyond four years from the critical point, either planning or opening of the facility.

Several points are learned from the above discussion. In particular, the results of these early highway studies do not show a clear positive relationship between the construction of highways and increases in land value. This finding undermines the argument which maintains that earlier studies generally find land use impacts associated with transportation facilities because levels of accessibility increased so dramatically. If this argument were accurate, one would expect more than three of six studies to show a clearly positive relationship between transportation investments and land use impacts. One explanation for the weak results is that the study design is pivotal in determining the nature of the results. As reviewed in the previous paragraph, the size of the test and control areas and the length of the before and after periods seem to be particularly important in determining the direction of the results.

2.1.3 Second Generation Studies

Methods and Study Design

Two types of models are developed in the regression analysis studies: one to estimate the effect of freeways and land values, the other to estimate the effect of freeways on the amount and type of development occurring in a community. Five of the eight second generation predict the effect of freeways on property value (Wheeler, 1956; Pendleton, 1963; Cribbins et al., 1965; Gamble et al., 1974; and Langley, 1976), while three of the second generation studies estimate the amount and type of land use change occurring after freeway openings (Corsi, 1974; Epps, 1974; Khasnabis and Babcock, 1976).

Although each of the five property value studies develops models to predict land value, the design of the individual studies varies. In terms of study areas, three of the five property value studies use regression analysis in a test-control context, comparing coefficients from analyses of test and control areas (Wheeler, 1956; Gamble et al., 1974; and Langley, 1976). The test areas for these studies range from a 1000 foot band along either side of the freeway in Gamble's study to an entire 128 acre community in Wheeler's study. The size of the control areas in these studies also varies. Two of the five property value studies do not use a test-control design to identify the effect of a freeway's presence on a community (Pendleton, 1963; Cribbins et al., 1965); rather distance to the freeway right-of-way, or distance of property to the nearest freeway on/off ramp, is included as an independent variable.

In terms of the study periods, the second generation studies also vary. Three of the studies use a before-after comparison with before periods ranging from three years in Gamble's study to ten years in Cribbin's study, and after periods ranging from three years in Gamble's study to eleven years in Langley's study. One study uses cross-sectional data collected after the opening of a freeway to predict the significance of the freeway in relation to other variables that may affect real estate value (Pendleton, 1963). Many different types of variables are included in the five property value studies; in general, researchers include some measure of accessibility to a freeway in terms of distance or travel times, characteristics of the property that affect its value such as lot size, square footage, or building type, and other variables that reflect specific interests of the researcher such as perceived noise and pollution levels. Only two of the second generation property value studies attempt to control for the effects of the economy on real estate values: Wheeler does so by including economic activity levels in the nearest metropolitan area as an independent variable, and Langley uses an index calculated from sale-resale values of the same property at two time periods. These methods minimize the variation in real estate markets linked to fluctuations in the local economy.

Three of eight regression studies focus on developing models to predict the amount and type of land use changes occurring after freeway construction (Corsi, 1974; Epps, 1974; Khasnabis and Babcock, 1976). Two of these studies analyze land around freeway interchanges within a 1.5 radius, and one study looks at a half mile band on either side of the freeway. Two of the studies use a before-after comparison, while the other study looks at land development data only after freeway opening. These studies use data spanning a relatively longer period than the other studies reviewed, twelve years in Khasnabis' study to twenty years in Corsi's study. Independent variables used in these models are similar to those used in the property value studies, including measures of distance to the freeway, availability of land, measures of traffic conditions, characteristics of nearest and largest CBD, and availability of municipal services.

Results

Three of the five property value studies show a positive correlation between freeways on land value (Wheeler, 1956; Pendleton, 1965; and Gamble et al., 1974), while Langley (1976) shows that abutting properties are adversely affected in comparison with properties 200 to 4000 feet from the freeway. Cribbins (1965) shows no effects of freeways on property values. Again, the size and location of the study area in relation to the freeway in question appears to influence the nature of the results. Langley, for example, divides his study area into three sections, abutting, impact (200-400 feet), and non-impact (400-4000 feet). The other studies do not directly evaluate the effect of freeways on abutting properties; rather they include abutting properties within a larger test area.

Results are reported in a variety of ways according to study design. Wheeler (1965) finds an increase in test area property values ranging from 70%-154% over the control area. Pendleton (1963) finds that a one minute decrease in driving time to the CBD adds $63.68 to the price of a house, and that a price increase of $444 could be attributed to a house located at three miles from the CBD rather than four miles, or a $206 increase in real estate value if located at seven miles from the CBD rather than eight miles. Gamble (1974) shows that increased accessibility accounts for an increase of $2950 per property in the entire North Springfield area.

Two of the three regression studies modeling freeways' effects on the type and amount of development occurring find a positive relation. Corsi (1974) finds that interchange development is best explained by proximity of the interchange to large and small urban centers, the growth rate of the nearest large and small urban centers, the availability of public facilities, and the traffic on the freeway and intersecting roads (R-squared = 0.92). He also develops models to explain individual types of land use development occurring at interchanges, such as residential, commercial, and industrial. Epps (1974) also develops models for total development occurring at interchanges and for three specific types of land uses: services stations, motels, and restaurants. Total interchange development is best explained by ADT (average daily travel) on the freeway, interchange type, population of nearest major urban center, and ADT on the intersecting highway.

2.1.4 Third Generation Studies

Methods and Study Design

Four recent studies develop models to determine the influence of freeways on aggregate measures of population and employment levels, and also on the distribution of population and employment within a metropolitan area. These studies use data from relatively longer study periods, ten to eighteen years. The definition of study areas is not as crucial for the purposes of this approach since the focus is on entire regions, rather than on the immediate areas around a freeway. The models developed range from two variable time-series analysis in the case of the Stephanedes and Eagle (1987) study to the analysis of over thirty different demographic and economic variables, as found in the Payne-Maxie (1980) study.

Results

The models developed to explain fluctuations in aggregate economic and demographic variables in relation to highway construction are perhaps the best designed studies in terms of time span and sophistication of statistical analysis. These studies consistently find a weak relationship or no relationship between highways and economic development. Two of the studies (Payne-Maxie, 1980; Stephanedes and Eagle, 1987) find that highways attract population and economic development from within a region although they rarely stimulate new growth. Boarnet (1995) finds that highways do have a significant effect on intrametropolitan employment growth, although this effect is smaller than many of the other variables used to estimate his model.

2.1.5. Conclusions

The current transportation-land use literature characterizes the relationship between transportation and land use as becoming weaker over time. This characterization is based on an inaccurate summary of the literature. My review of the literature does not show such a trend. First generation studies spanning the fifties and sixties generally do not find a clear, positive relationship between transportation facilities and property value. Second generation studies generally find more evidence of a positive relationship between highways and land values. And third generation studies generally find that highway development may have a small effect on the growth of aggregate economic measures, but serves mainly to redistributed growth within a region.

A major problem in trying to generalize about possible trends is that the three generations evaluate different variables. In older studies, researchers focused on areas immediately surrounding new freeways; in recent studies, entire regions have been considered. The difference in results may be related to the fact that older studies tend to look at the effect of freeways on individual parcels, and recent studies tend to look at the effect of freeway construction on a metropolitan region.

2.2 Impacts of Rail Transit on Land Values

2.2.1 Introduction

There have been two waves of rail construction in the United States in recent decades. In the sixties and seventies, several cities began constructing heavy rail systems including San Francisco, Atlanta, and Washington D.C.; in the late seventies and eighties, approximately twelve cities initiated construction of light rail systems including San Diego, Portland, and Buffalo (Cervero, 1984). Several empirical studies of the land use impacts of heavy rail were conducted following the opening of these systems. Few researchers to date have analyzed the impacts of light rail systems. The following sections present the methods, study design and results of current literature on rail transit impacts.

2.2.2 Methods and Study Design

The approaches used in the analysis of rail transit effects on land use have been varied, including regression analysis, test-control comparisons, and descriptive analysis based on surveying and interviewing.

In the late 1970's, a comprehensive study was conducted on the land use impacts of the Bay Area Rapid Transit system which opened in 1972. Changes in station area land uses from 1965 to 1977 were examined using aerial photos, assessor's maps, and other urban data. The effect of BART on property prices and rents was studied using regression analysis and before-after comparisons. Trends in aggregate measures of population, housing, and employment were analyzed using the entire BART service area as a test area and the surrounding counties as control areas. BART's effects on speculation were also analyzed to determine if public or private parties anticipated development in the rail corridors.

Gannon and Dear (1975) conducted a survey of private businesses and land developers to determine the significance of light rail in their decisions to develop and occupy office space near the rail line or stations. Qualitative data from the survey was reported, with the authors citing a lack of available data sources to conduct statistical analysis. Boyce (1977) conducted a study of the Philadelphia Lindenwold High Speed rail line which opened in 1968. The primary purpose of this study was to evaluate and measure the indirect benefits resulting from transit development. In this case, the particular focus was on property value increases. A second focus of the study was to determine the effect of the rail line on local land development policies. Lerman (1978) uses regression analysis to determine the effect of Washington's Metro Rail on property values. Separate models are developed for different land uses, including single family, multi-family and retail.

In a recent study, Cervero and Landis (1993) use test-control comparisons to evaluate the effect of transportation investment on the real estate rental rates of parcels near heavy rail corridors. The authors use data spanning an eleven year period, from 1978 to 1989. Two sets of sites are analyzed, one pair in Washington D.C. and the other in Atlanta. The study focuses on the after period, rather than a before-after comparison, as both rail systems analyzed opened in the 1970's. The variables analyzed are average office rents, net absorption rates, annual office space additions, average building size, and percent of new regional office space. T-tests are used to evaluate whether significant differences existed between test sites with rail, and control sites without rail.

Gatzlaff and Smith (1993) study the effect of the recently opened Miami Metrorail light rail system on residential sales prices. They use methods similar to Langley (1976) where sale-resale prices are used to create a sales index. The index is computed for station areas (within one mile of transit station) and then compared with an identical housing price index for the entire Miami MSA. The authors also use hedonic price regression to estimate the effect of various location and property specific characteristics on the selling price of residential property. Cervero (1994) uses regression analysis to estimate the effect of heavy rail on office and commercial rental rates. Variables used include station area market performance variables, transit service variables, regional economic and growth factors, and station area transportation, infrastructure and development characteristics.

2.2.3 Results

A general review of the rail study results show that rail has impacted land use patterns, although this influence is inconsistent and smaller than initially anticipated. Gannon and Dear (1975) found that the Philadelphia-Lindenwold line was a significant factor in the locational decisions of office builders and renters, although very little actual construction had occurred at the time of the study. The Philadelphia-Lindenwold line began operation in 1969. Since the survey was conducted in the early 1970's, the scope of the results is limited. The BART system also influenced land use and land development in the Bay Area, although data only covered three to five years after operation began. The impacts were small relative to expectations. Forty percent of the new development occurring between 1965 and 1977 within the station areas was residential; twenty-three percent, office or commercial; and twenty percent multifamily residential. Falcke's study of the effect of BART on residential and commercial property prices and rents shows that some benefit may be gained from proximity to the rail system, but it is not consistent. In the before period (1962-1965), BART had a positive impact on residential property prices, and almost no impact during the construction period (1967-1971) or the after period (1972-1977). For office development, BART had no impact in the before period or construction period, and a positive impact in the after period. Population and employment growth inside the three county BART service area was slower than in the surrounding counties; however, of the growth that did occur in the BART service area, fifty-one percent was in the vicinity of rail stations. Fourteen percent of housing growth in the BART service areas occurred in the vicinity of rail stations.

Cervero and Landis (1993) find that commercial centers with rail access do not have a consistent real estate advantage over centers with no rail access. In three of four test control comparisons, they find no significant difference in rental rates between test and control sites, while one comparison showed higher rents in the test area ($3.53/sf rental premium). Using regression analysis with the same data, however, Cervero (1994) shows that rail transit investment does positively influence commercial market performance. System ridership was a significant predictor of office rents, increasing approximately $4.00/sf for every 100,000 additional daily riders. Gatzlaff and Smith (1993) find that residential property sales indices for station areas are not significantly different than the indices for the entire Miami MSA over an eighteen year period. Using hedonic methods, these authors find that property values do not vary significantly with distance from light rail transit stations.

2.2.4 Conclusions

As compared with the number of highway studies, few rail studies have been conducted. The methodologies used in the rail studies are representative of those used in the three generations of highway studies: test-control comparisons, regression analysis to predict nearby property value impacts, and regression analysis to predict impacts on aggregate demographic measures. As with the highway studies, the rail studies do not adhere closely to the current argument which characterizes older studies as finding greater land use impacts than recent studies. The results of the rail studies are as equally inconsistent and inconclusive as those found in the highway research.

2.3 Contributions of the Proposed Research

The basic contribution of this research is to examine the relationship between property value and light rail transit. Almost no empirical work has been conducted on the land use impacts of the new generation light rail systems. In fact, only one published study was found (Gatzlaff and Smith, 1993) and this examined residential property values. No studies were found that analyzed the relationship between light rail and non-residential land uses, such as industrial and office. The data used in the current study lend some improvements to the transportation-land use literature. This study uses a relatively longer data set, spanning ten years from 1986 to 1995. Also, a relatively longer period of time, fourteen years, has elapsed since the opening of the light rail system in 1981 so that potential land use impacts have had more time to develop.

Chapter 3

Methodology

This chapter provides an overview of the study area, the data, the hypotheses and methods for testing these hypotheses. The dissertation is based on analyses of office and industrial property data collected from the San Diego metropolitan area over the period from 1986 to 1995.

3.1 Study Area

San Diego is the southernmost major metropolitan region in the state of California. The county covers an area of 4,255 square miles and borders on the counties of Orange, Riverside and Imperial to the north and east, and Mexico to the south. The 1990 population estimate for the San Diego region is almost 2.5 million persons, making it the fifteenth largest metropolitan area in the United States (SANDAG, 1992a). It is the second most populated county in the state of California, following the County of Los Angeles. Between 1981 and 1990, the San Diego region also had the second highest increase in population (30% growth rate) in the state of California, adding over 577,400 residents (SANDAG, 1992a). The four highest employment sectors in the San Diego region in 1990 were services (27.4%), retail/trade (19.2%), government (17.6%), and manufacturing (13.6%) (SANDAG, 1992a).

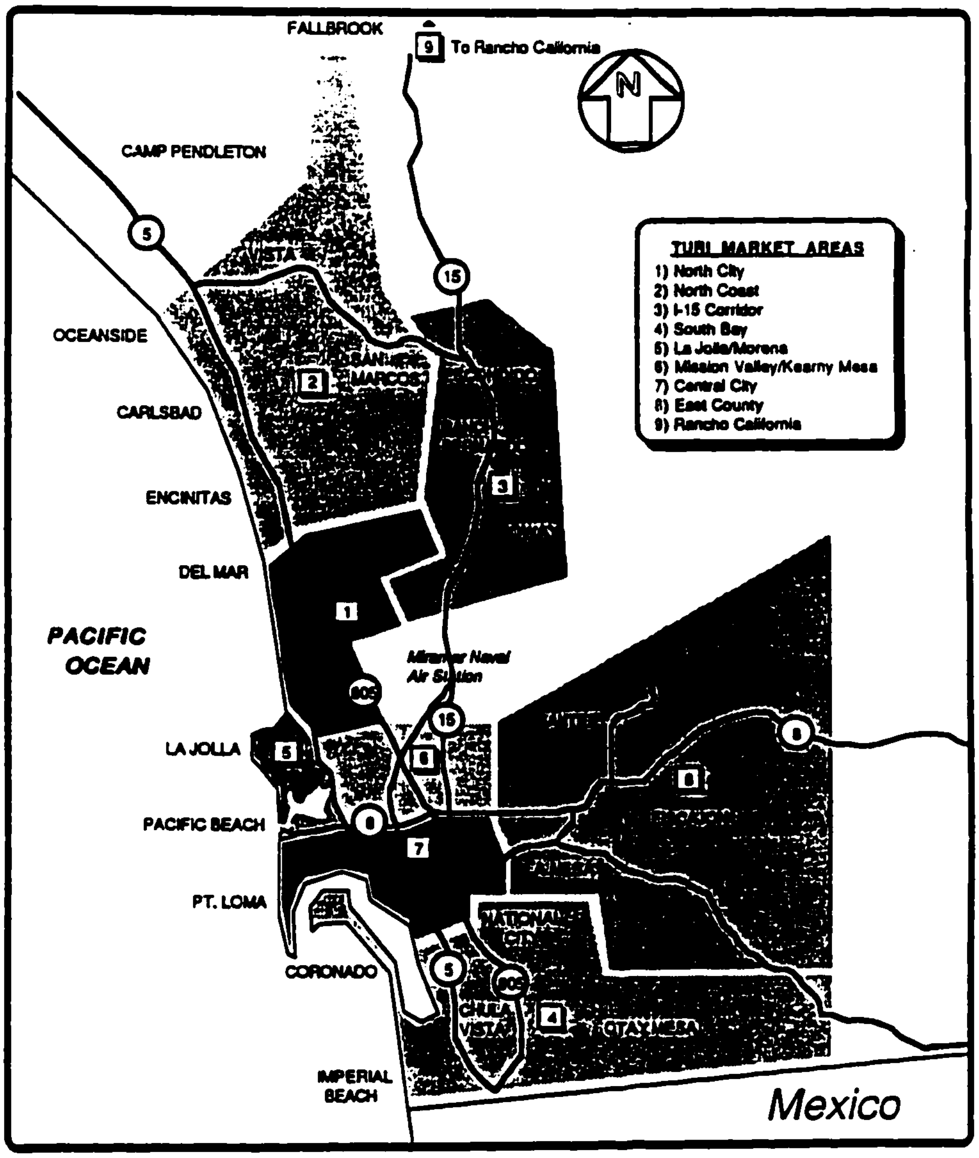
The San Diego Metropolitan Transit Development Board (MTDB) was created in 1975 by the California Legislature to plan, construct and operate a mass transit system using gasoline tax revenue made available for transit development (SANDAG, 1996). To date, the entire San Diego light rail system covers approximately thirty-five miles. In

1981, the South Line opened, running from downtown San Diego to the Mexican border. In 1984, construction began on the East Line with operation beginning in 1986. The East Line extends from downtown San Diego to the City of Santee. The Bayside Line opened in 1990 and extended service from Imperial & 12th Avenue to the Convention Center and the Santa Fe Train Depot in downtown San Diego. The light rail system operates in mixed-flow street traffic in the downtown area of San Diego, while outside of the downtown area, the South Line and East Line use mainly existing freight right-of-ways.

The primary source of data for this dissertation is a private real estate research company, Torrey Urban Research Institute (TURI). TURI divides the San Diego region into eight real estate market areas (See Figure 3.1), which are further divided into submarkets that are geographically related and have common competitive characteristics. Data from the three market areas serviced by light rail transit are analyzed in this dissertation.

South Bay Market Area

The South Bay market area is serviced by the South Line, which is approximately 16 miles in length and operates between downtown San Diego in the north and the U.S./Mexican border in the south. Nine South Line light rail stations fall within the boundaries of the South Bay market area. The South Bay market area is also traversed by two north-south interstate freeways, I-5 and I-805, and two minor east-west freeways, Route 54 and Route 905. The South Bay market area covers approximately 100 square miles and is divided into five submarket areas: National City, Chula Vista, Coronado,



Torrey Urban Research Institute

Figure 3.1: TURI's Eight Market Areas

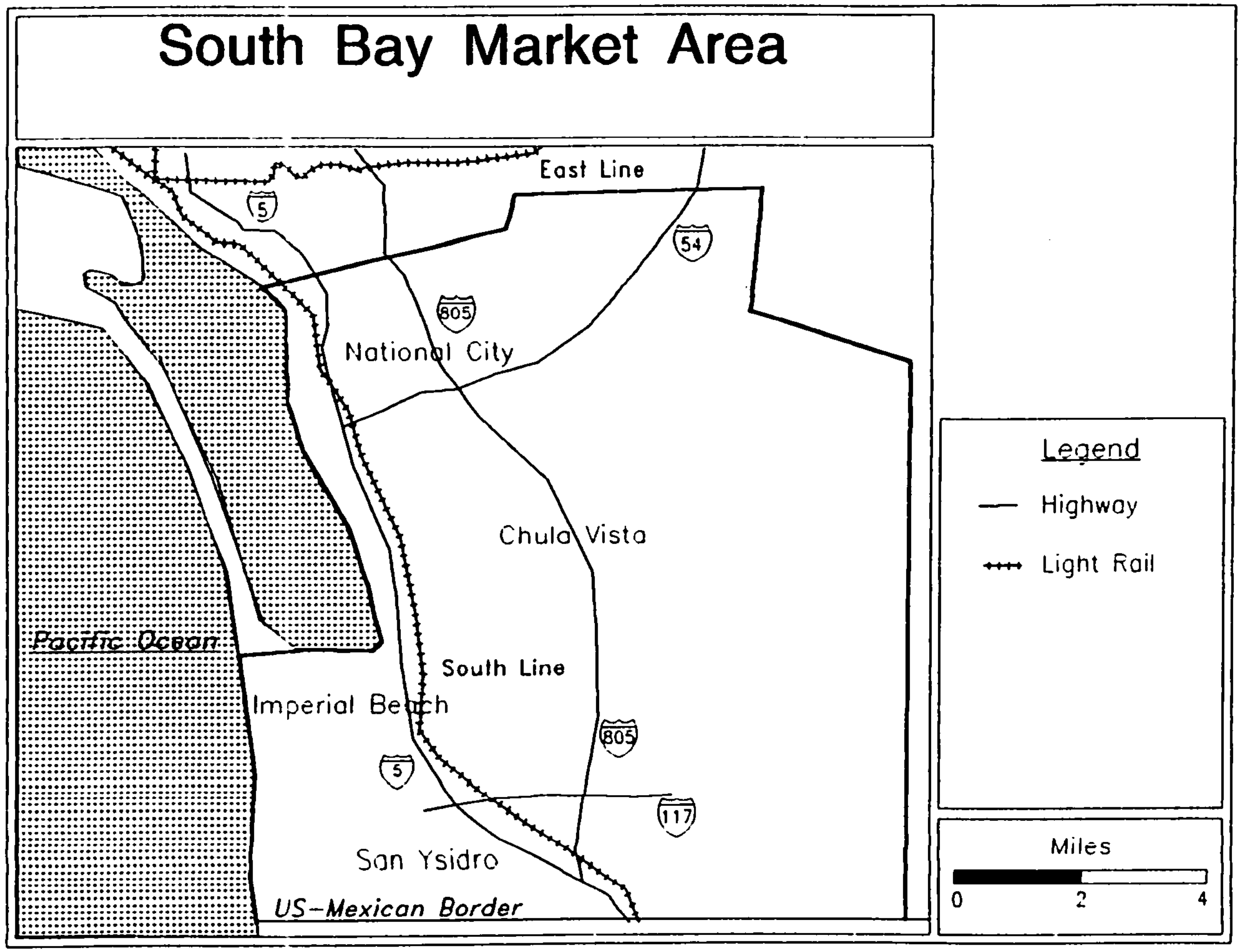


Figure 3.2: South Bay Market Area and Submarkets

Imperial Beach, and San Ysidro (See Figure 3.2). The Coronado and Imperial Beach submarkets do not have transit stations located within their boundaries

East County Market Area

The East County market area is serviced by the East Line, which is approximately 18 miles in length and operates between downtown San Diego in the west and the City of Santee in the east. Eleven East Line stations fall within the boundaries of the East County market area. The East County market area is also traversed by two east-west freeways, I-8 and Route 94. The East County market area covers approximately 175 square miles and is divided into six submarket areas: El Cajon, La Mesa, Lakeside, Lemon Grove, Spring Valley, and Santee (See Figure 3.3).

Central City Market Area

The Central City market area is serviced by portions of the South Line, East Line, and the Bayside Line which is approximately 2.1 miles in length. Sixteen light rail stations fall within the boundaries of the Central City market area. The Central City market area is traversed by two east-west freeways, I-8 and Route 94, and four north-south freeways, I-5, I-805, Route 163, and Route 15. The Central City market area covers approximately 50 square miles and is divided into five submarket areas: Downtown, Uptown, Old Town, South City, and East City (See Figure 3.4).

3.2 Land Use and Socio-Economic Characteristics of the Study Areas

This section provides a general description of the land uses, socio-economic characteristics, and the local economy in the three market areas. Understanding these characteristics is important background for analyzing land use impacts of transportation systems. Most of the summary data reported in this section is from the Bureau of the

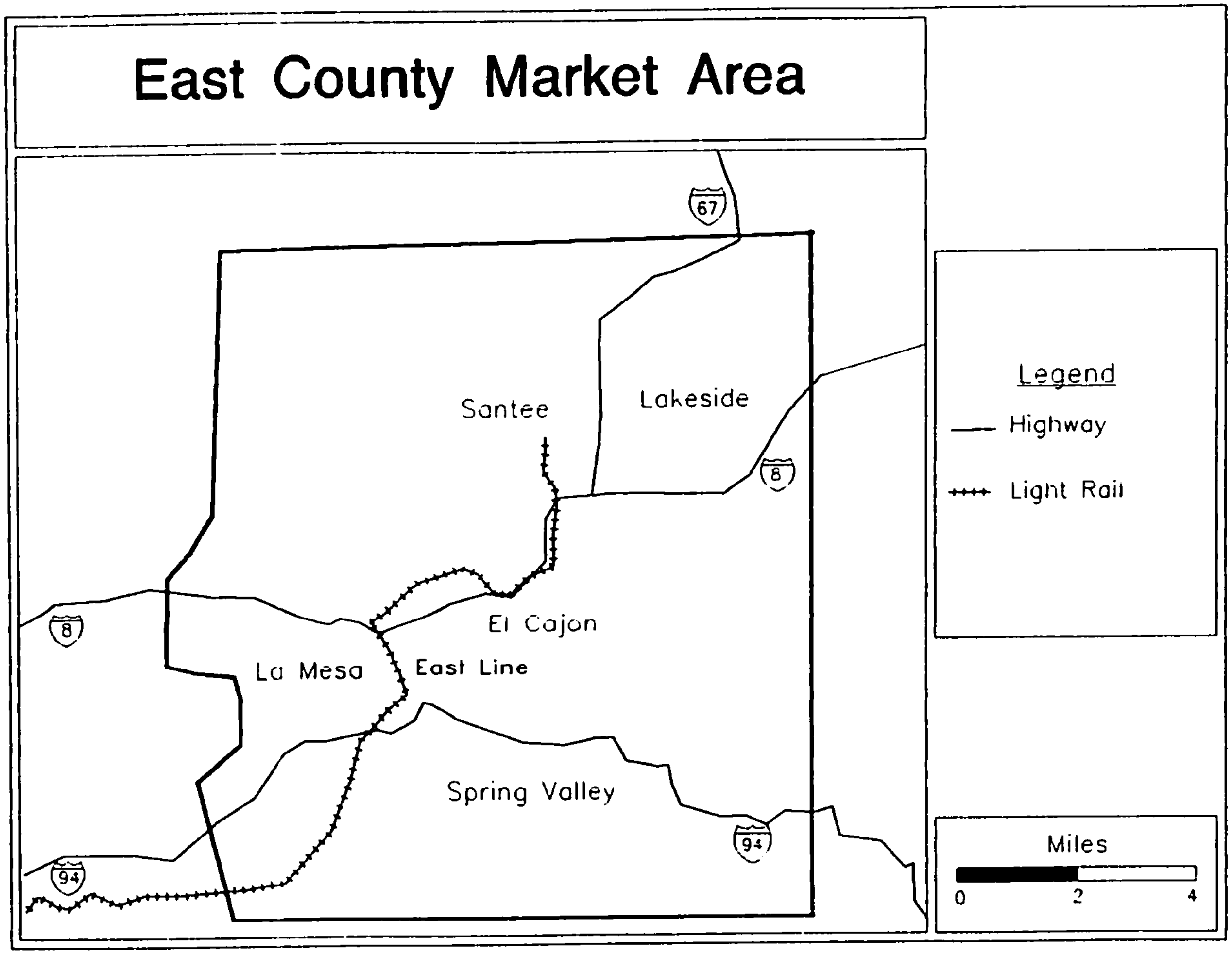


Figure 3.3: East County Market Area and Submarkets

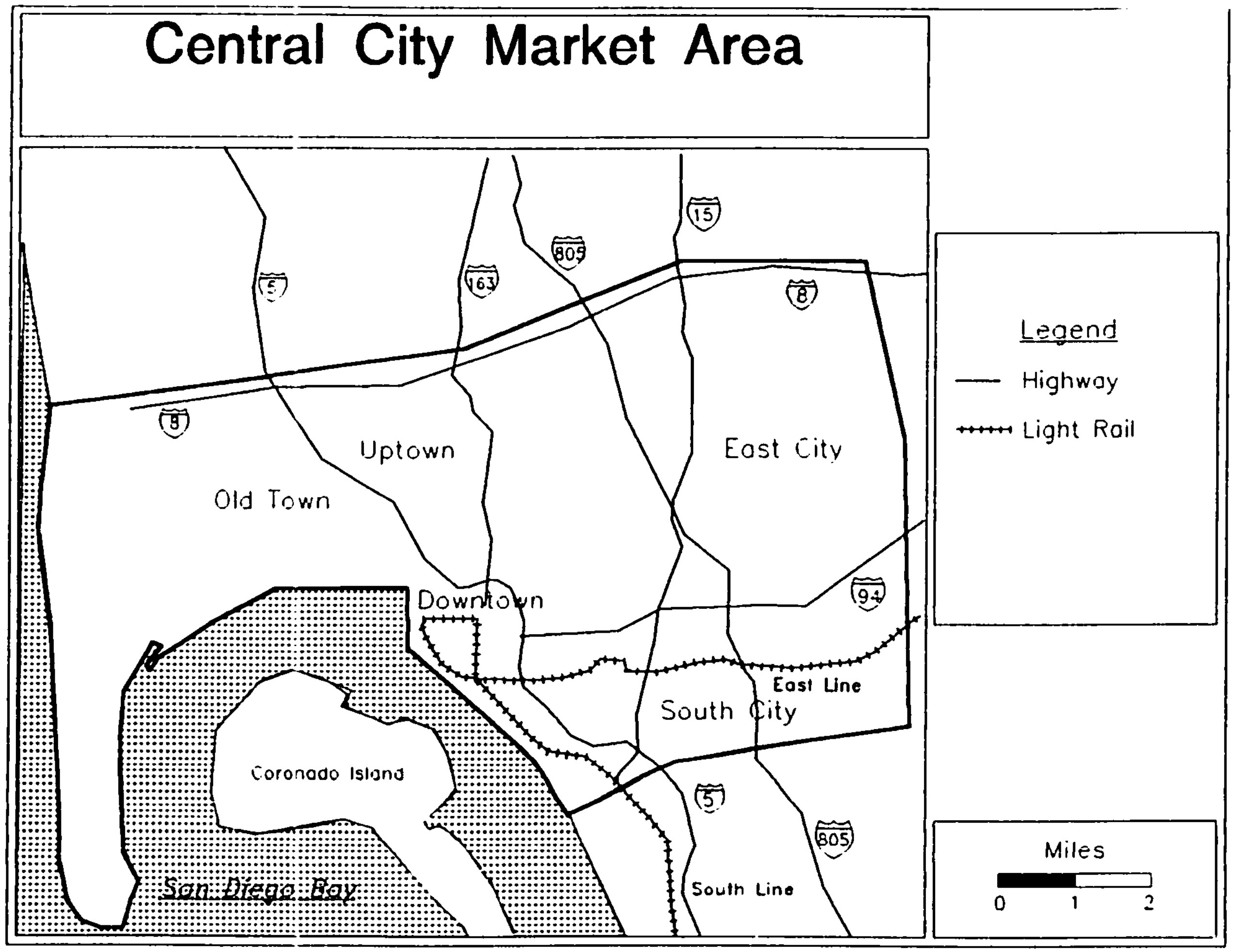


Figure 3.4: Central City Market Area and Submarkets

Census and the San Diego Association of Governments (SANDAG). Both sources provide data aggregated by census tracts. SANDAG also reports census data aggregated by Metropolitan Statistical Areas (MSA's). There are seven MSA's in the San Diego region, three of which correspond roughly to the boundaries of the South Bay, East County, and Central City market areas used by TURI in their reporting of real estate data and in this dissertation. Figure 3.5 shows the seven San Diego MSA's and Figure 3.1 shows the eight market areas used by TURI. The South Suburban, East Suburban and Central MSA's correspond roughly to the South Bay, East County and Central City market areas, however, the boundaries are not exactly the same. For purposes of providing general descriptions of the market areas, data aggregated by MSA is reported.

3.2.1 Land Use

SANDAG updated its inventory of existing land uses in the San Diego region in 1990. The updated inventory is used here to provide a general picture of the three market areas and the entire San Diego region. Table 3.1 shows that residential development is the predominant existing land use in all three MSA's and for the entire San Diego region[1].

The South Suburban MSA has the highest concentration of industrial land uses (2,742 acres or 13.3% of its total acreage) as compared with the East Suburban and Central MSA's. The Central MSA has the highest concentration of commercial/office land uses (4,406 acres or 11.4% of its total acreage), and of institutional land uses

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[1] Percentages are calculated using a ratio of the acreage of residential land over the acreage of total developed land. Agriculture, water, and vacant land are not included in total developed land acreage. These percentages better describe the urban portion of the study areas.

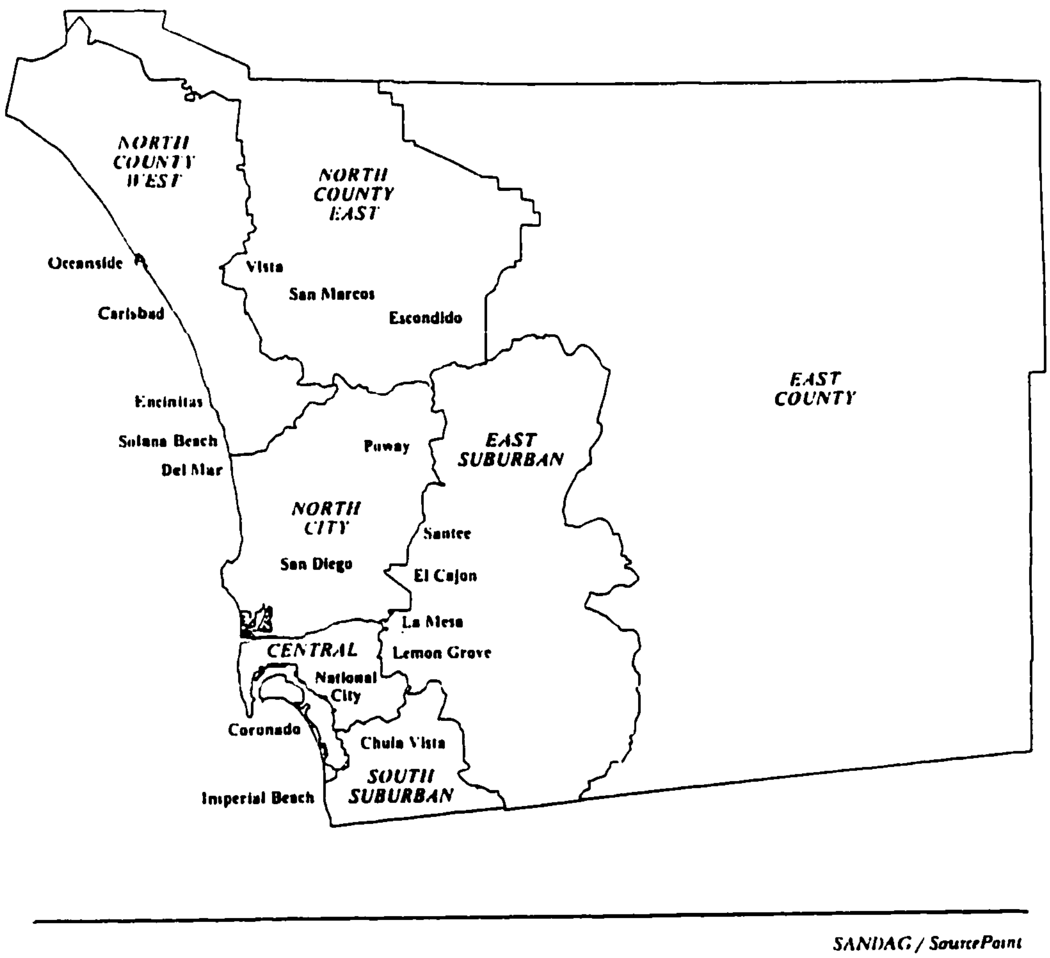

Figure 3.5: San Diego Metropolitan Statistical Areas (MSA's)

Table 3.1
Acreage of Existing Land Uses by MSA

	South Suburban		**East Suburban**		**Central**		**Total San Diego**	
Land Use	Acres	% of total	Acres	% of total	Acres	% of total	Acres	% of total
Residential	14,301	69.4%	59,681	87.3%	25,882	67.1%	239,925	78.1%
Commercial/ Office	1,903	9.3%	3,587	5.3%	4,406	11.4%	21,678	7.1%
Industrial	2,742	13.3%	2,687	3.9%	2,410	6.2%	20,292	6.8%
Institution	1,663	8.1%	2,268	3.3%	5,877	15.2%	25,183	8.2%
Total Acreage	20,609		68,223		38,575		307,078	

Source: SANDAG INFO Land Use in the San Diego Region, January-February, 1993.

(15.2% of its total acreage). The East Suburban has the highest concentration of residential land uses (59,681 acres or 87.3% of its total acreage).

3.2.2 Socio-Economic

SANDAG compiled Bureau of the Census population data for the years between 1987 and 1995, which roughly reflects the study period used in this dissertation. As seen in Table 3.2, population for the entire San Diego region increased 22.4% over the period from 1987 to 1995. Population in the South Suburban MSA grew at a slightly higher rate (24.1%) than the entire San Diego region, while population in the Central and East Suburban MSA's grew at a lower rate (12.8% and 17.8% respectively) than the overall San Diego region.

Table 3.2
Change in Population (1987-1995) by MSA

	South Suburban	East Suburban	Central	Total San Diego
1987 Population	231,402	394,444	550,724	2,223,649
1995 Population	287,118	464,778	621,400	2,720,906
1987-1995 Change	55,716	70,334	70,676	497,257
% Change	24.1%	17.8%	12.8%	18.3%

Source: SANDAG INFO January 1,1995 Population and Housing Estimates, September-October, 1995.

There is a noticeable difference between population growth in the late 1980's and the first half of 1990's for each of the three MSA's and for the entire San Diego region. Table 3.3 shows that in each of the MSA's and over the entire San Diego region, the average annual change in population growth is close to fifty percent higher during the 1987-1990 period as compared with the 1990-1995 period. The South Suburban MSA for example shows a 3.9% average annual change in population during the 1987-1990 period and a 2.0% average annual change in population during the 1990-1995 period. This is an important indicator of the local economy and has implications for trends in industrial and office rents.

Table 3.3
Average Annual Change in Population by MSA
1987-1990 vs. 1990-1995

	South Suburban	East Suburban	Central	Total San Diego
1987-1990	3.9%	2.6%	2.4%	3.6%
1990-1995	2.0%	1.7%	0.9%	1.8%

Source: SANDAG INFO January 1,1995 Population and Housing Estimates, September-October, 1995.

Table 3.4 illustrates the racial composition of the three MSA's and the entire San Diego region. The South Suburban MSA has a larger proportion of persons of Hispanic origin (42.7%) as compared with the East Suburban (12.4%) and Central (27.8%) MSA's, and the entire San Diego region (20.4%). The Central MSA has a higher proportion of Blacks (15.3%) as compared with the South Suburban (5.1%), East Suburban (3.3%) and entire San Diego region (6.4%). The Central MSA also has a higher proportion of Asians. The East Suburban MSA has a higher proportion of Whites (87.6%) as compared with the Central area (56.1%), South Suburban MSA (60.8%), and the entire San Diego region (74.9%).

The 1990 median household incomes in both the South Suburban ($31,641) and Central ($26,448) MSA's are below the median household income for the entire San Diego region ($35,022). Median household income is higher in the East Suburban MSA ($35,878) than in the entire San Diego region.

Table 3.4
Population by Race and Hispanic Origin by MSA

	South Suburban		East Suburban		Central		Total San Diego	
Race/ Ethnicity	Pop.	% of total	Pop.	% of total	Pop.	% of total	Pop.	% of total
White	159,171	60.8%	376,116	87.6%	334,010	56.1%	1,872,256	74.9%
Black	13,260	5.1%	13,957	3.3%	91,080	15.3%	159,306	6.4%
Asian	29,414	11.2%	13,623	3.2%	69,244	11.6%	198,311	7.9%
Other	59,849	22.9%	25,595	6.0%	101,386	17.0%	268,143	10.7%
Total Pop.	261,694		429,291		595,720		2,498,016	
Hispanic Origin	111,712	42.7%	53,331	12.4%	165,570	27.8%	510,781	20.4%

Source: SANDAG INFO 1990 Census Race and Hispanic Origin, March-April, 1991.

Several summarizing statements can be made about the socio-economic conditions in the three MSA's. An important finding is that population levels grew across each of the three MSA's at a higher rate in the late 1980's than in the early 1990's. This characterization mirrors the economic growth and decline in the study areas during the same period. Trends in population and employment growth should impact rental rates in these areas. Specifically, we should expect to see this growth and decline reflected in the year dummy variables.

A second interesting finding is the relationship between race and median household income in the three MSA's. The SANDAG data show that the South Suburban MSA has relatively more Hispanics, the Central MSA has relatively more Blacks, and the East MSA has relatively more Whites. The two MSA's with higher proportions of minority populations also have median household incomes below the regional median. The MSA with a predominantly White population has median household incomes above the regional average. These characterizations hint at the general conditions of each MSA and market area. The information is not necessarily directly applicable to our understanding of rents, transportation access, and commercial location, however it is useful in trying to develop an understanding of the study areas.

3.2.3 Local Economy

SANDAG has conducted employment inventories in the San Diego region since 1966. The Central MSA has the second highest employment concentration of all seven MSA's in the San Diego region, with 29% of the region's total employment, while the South Suburban and East Suburban MSA's have 6.2% and 11.4% respectively of the total employment in San Diego (Table 3.5).

Table 3.5
1990 Total Employment by MSA

	South Suburban	East Suburban	Central	Total San Diego
Employment	75,441	139,127	353,627	1,224,111
% of San Diego Total	6.2%	11.4%	28.9%	

Source: SANDAG INFO Regional Employment Inventory, March-April, 1994.

Table 3.6 shows the percentage of total San Diego employment by sector in the Central, South Suburban, and East Suburban MSA's. A distinguishing feature in the

South Suburban MSA is that, while this area has only six percent of the total employment in San Diego, ten percent of all manufacturing employment in San Diego is found there.

Table 3.6
Percent of Total 1990 San Diego Employment by Industry by MSA

	South Suburban	East Suburban	Central
Service	5.1%	11.1%	26.4%
Retail	8.8%	15.0%	22.3%
Manufacturing	9.9%	8.4%	17.9%
Total Emp.	6.2%	11.4%	28.9%

Source: SANDAG INFO Regional Employment Inventory, March-April, 1994.

A similarly distinguishing feature of the East Suburban MSA is that, while it has 11.4% of all employment in San Diego, 15% of all retail employment in San Diego is found there. The Central MSA however has higher concentrations of all three types of employment than the South Suburban or the East Suburban.

As with population levels, total employment levels in all three MSA's showed increases during the period from 1980 to 1990. Total employment increases ranged from 0.6% in the Central MSA to 7.4% in the North County East MSA.

Table 3.7
Average Annual Change in Total Employment by MSA 1980-1990 vs. 1990-1992

	South Suburban	East Suburban	Central	Total San Diego
1980-1990	4.9%	4.9%	0.6%	3.6%
1990-1992	-3.0%	-1.9%	-0.7%	1.8%

Source: SANDAG INFO Regional Employment Inventory, March-April, 1994.

Again, similarly to population levels, total employment levels in every MSA dropped over the period from 1990 to 1992. The greatest decrease in total employment occurred in East Suburban MSA (-3.6%) and the smallest decrease during this period was in the Central MSA (-0.7%).

Trends in population and employment levels in the San Diego area indicate an economic recession in the early 1990's. Average annual percent change in employment levels by sector show that, in each of the three MSA's, the service industry was least effected by the recession in the early 1990's. Retail sector employment experienced the greatest losses in each MSA.

Table 3.8
Average Annual Change in Employment by Industry by MSA
1990-1992

	South Suburban	East Suburban	Central	Total San Diego
Service	4.0%	10.4%	0.5%	2.6%
Retail	-7.1%	-4.4%	-4.8%	-4.6%
Manufacturing	-4.3%	-1.9%	-6.9%	-4.1%

Source: SANDAG INFO Regional Employment Inventory, March-April, 1994.

In summary, the South Suburban MSA has higher concentrations of industrial land uses than the East Suburban MSA, Central MSA, and the entire San Diego region. The Central MSA has higher concentrations of commercial and office land uses than the East Suburban MSA, South Suburban MSA, and the entire San Diego region. And finally, the East Suburban MSA has higher concentrations of residential land uses than the other two MSA's and the entire San Diego region. The employment data show that employment growth follows a similar trend as population growth during the study period. Within each MSA, it was found that the South Suburban MSA has relatively higher concentrations of manufacturing employment, the East Suburban MSA has relatively higher concentrations of retail employment, and the Central MSA has relatively higher concentrations of service employment. These findings are important preliminary indicators of which MSA's may contain agglomerations of particular types of industries. Although measures of agglomeration are not specifically included in the regression analysis, this background information may be useful for interpreting results.

3.3 The Data

The primary source of data is the Torrey Urban Research Institute (TURI), a private real estate research firm that collects real estate data in the San Diego region. Ten years (1986-1995) of property rent data for office and industrial land uses in the South Bay, East County, and Central City market areas were obtained from TURI. For each property, the data collected provides a date (quarter and year), address, submarket location, land use type (industrial or office), net rentable area (square feet), number of stories in the building where the property is located, the age of the building where the property is located, current net vacancy, asking rental rate ($/square foot/month), and type of lease agreement. Hard copies of this data were obtained from quarterly reports generated by TURI. Data were entered in an EXCEL spreadsheet and analyzed using SPSS 7.0.

The primary reason TURI collects real estate data is to report on vacancy trends. Vacancy levels are an important indicator of real estate market conditions. The sample of properties obtained from TURI's quarterly reports is limited to those buildings which had vacant leaseable space. The data may be biased therefore in that they only represent those buildings with vacancies. This may not be a serious problem, however. There is a general understanding in the real estate literature that landlords set rents to maintain a "steady-state" vacancy level in their buildings (Wheaton and Torto, 1988). It is likely, therefore, that most buildings in the study area have at least some vacancies, and that the sample of San Diego properties is adequately representative of this particular population of properties.

It is important to understand how TURI determines whether a property has vacant space. TURI has several approaches to insuring they know about a change in activity associated with a particular property[2]. At the end of every quarter, call sheets (a form to record telephone interview information) are automatically printed out for a subset of the total properties in their database. Properties which are automatically contacted at the end of every quarter include those in the following categories: a) properties with vacancies in the previous quarters, b) properties that are currently for sale or were for sale in the previous quarter, c) properties that are being sub-leased, which indicates the original tenant may be attempting to terminate his lease, d) properties where tenants are leasing month-to-month, e) properties that have been advertised as having space for sale or lease by commercial brokers, and f) properties that have multiple tenants. Once call sheets are printed out, a contact person for every property is interviewed to update TURI's information. When brokers are interviewed, the TURI researcher also always questions whether he/she has any other properties with vacancies or new tenants. In addition to interviewing a contact person about these specific categories of properties, other measures are taken to find out about real estate activity. "Street lists" of all streets located in areas zoned for industrial and office land uses are maintained by TURI. In the last month of every quarter, a TURI researcher drives every street on the list to look for signage indicating some type of activity may be occurring in a building, and to look for any other physical indications that space is available or new tenants have occupied a building. Another way TURI stays informed about real estate activity is to receive advertisements from all real estate brokerage companies about their properties with space available or space for sale. The Real Estate/Construction section of the San Diego Daily Transcript is also continuously monitored for new construction, changes is leases, and properties for sale. TURI's methods comply with the suggested methods of BOMA International (Building Owners and Managers Association) as set forth in their publication, "Office Leasing Market Standards" (TURI, 1994).

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[2] "Activity" is defined as a change in the amount of vacant space in a building.

The majority of variables analyzed are from TURI. The access variables were generated using ATLAS-GIS, a geographic information systems. The addresses from TURI were imported into ATLAS GIS and then "batch" matched to a San Diego geographic data file. The addresses that did not automatically match were then interactively matched by "pointing" to the location on the map. After matching the addresses to the geographic files, distances between each of the addresses and each of the on/off ramps are measured and printed to a data file. The data file with property identification numbers and the distance of each property to all on/off ramps is exported to a spreadsheet. Each case is sorted by distance to find the minimum distance to a freeway on/off ramp for each property. These steps are repeated to find distances of each property to the nearest transit station and the distance of each property to the CBD. The point selected to represent the CBD is Broadway and 4th Street which is centrally located in downtown San Diego.

3.4 Hypotheses and Approaches to Data Analysis

Two basic hypotheses are tested in this dissertation:

1) Null hypothesis: Distance to light rail transit is not a significant determinant of office and industrial rents.

2) Null hypothesis: Distance to highway on/off ramps is not a significant determinant of office and industrial rents.

Separate rent models are developed for office and industrial land uses. Three groups of explanatory variables are used to estimate rent, as shown below:

$$Rx = f(Ax, Nx, Bx,)$$

where,

Rx = Asking rent of property (x).

Ax	=	Access Variables: Straight-line distance of property to the CBD, to the nearest light rail station, and to the nearest freeway on/off ramp.
Nx	=	Neighborhood Characteristics: Median household income of census tract where property is located. A submarket dummy variable.
Bx	=	Building Characteristics: Net rentable area, number of stories, age of building, vacancy levels, and type of lease agreement.

A year dummy variable is also included to isolate the effect of annual variation in the economy. Table 3.9 presents the independent variables used in the rent models.

Table 3.9
Independent Variables

Variable Group	Variable Name	Type	Source
Building Characteristics	Rentable Area	continuous	TURI
	Stories	continuous	TURI
	Age	continuous	TURI
	Vacancy Rate	continuous	TURI
Land Use Type (Office Only)	Low Rise	dummy	TURI
	With Retail	dummy	TURI
	Mid/High Rise	dummy	TURI
Type of Lease	Full Service	dummy	TURI
	Partial Service	dummy	TURI
Neighborhood Characteristics	Median Income	continuous	1990 Census
	Submarket	dummy	TURI
Measures of Access	Freeway	continuous	Atlas-GIS
	Station	continuous	Atlas-GIS
	CBD	continuous	Atlas-GIS
Year Dummy Variable	1986-1995	dummy	TURI

The following paragraphs review the variables analyzed, and discuss the hypothesized relationships between the independent variables and asking rents.

Asking Rents

The dependent variable, asking rents, is defined as the typical rent quoted by the leasing agent for a building. It is expressed in dollars per rentable square foot per month. The office and industrial rent literature discusses the accuracy of asking rents versus actual rents. Actual rents would perhaps be a better representation of the price of commercial space, but this data is very hard to obtain. As Wheaton and Torto (1988) explain, information on actual rental rates is considered proprietary by landlords. Opening this information to the public may threaten a property owner's negotiating power for future leases. Only one study was found that analyzed actual rents. Data collection involved surveying real estate brokers about actual lease negotiations conducted over the past three years (Brennan, Cannaday and Colwell, 1984). Glascock et al. (1990) tested the relationship between actual rents and quoted rents for a subset of their data sample. They found, on average, that actual rents were only approximately three percent lower than quoted rents.

Access Variables

The primary purpose of this dissertation is to isolate the effects of access to regional transportation networks on industrial and office rents. There are three variables measuring access: straight-line distance of each property to the closest freeway on/off ramp, straight-line distance of each property to the closest light rail transit station, and straight-line distance of each property to the central business district. The hypothesized sign of the coefficients for the Freeway and Station variables is negative. The closer a property is located to the regional transportation network, the higher the rent paid for that property. The value of access to the regional transportation network should capitalize in the rent charged for the industrial and office space. Previous literature finds that access to the CBD may or may not be valued by firms. Schmenner (1981) finds that distance to the central business district is not significant in explaining manufacturing rents. Clapp (1980), however, finds that distance to the CBD was highly significant in explaining office rents. The importance of the CBD may depend on the particular business and whether services provided in the downtown area are required by that business. It is expected that the functional form of the access variables is negatively exponential, reflecting a diminishing influence of transportation access on rents as distance from a facility increases.

Neighborhood Characteristics

There are two groups of variables reflecting neighborhood characteristics: median household income for residents in the census tract where each property is located, and a submarket dummy variable. The income variable should give an indication of the quality of the residential neighborhoods in each census tract: people with higher incomes will be willing and able to pay for more desirable neighborhoods. It is hypothesized that higher household incomes will be positively related to office rents. Higher incomes indicate a more desirable area, which should collect a premium over areas associated with lower income households. A higher quality residential neighborhood however is not necessarily a better place for industrial properties. Furthermore, vital industrial areas are generally considered undesirable places to live. It is therefore hypothesized that industrial rents are negatively related to household incomes.

The second neighborhood characteristic variable is a submarket dummy variable. The South Bay market area is divided into five submarkets, four of which follow the boundaries of local jurisdictions (See Figure 3.2). In the East County market area, all five submarkets follow the boundaries of local jurisdictions. In the Central City market area, all five submarkets fall within the jurisdiction of the City of San Diego. In the South Bay and East County market areas, therefore, the submarket dummy variable controls for interjurisdictional differences in services and amenities provided by local governments. Local governments may affect property rents through various policies that facilitate or restrict business activity, such as the quality and amount of infrastructure available in the city, safety and quality of the local police force. The coefficient of the submarket dummies shows how much the asking rents vary in relation to rents in the omitted submarket.

The amount and type of zoning surrounding each property would have also been a useful measure of neighborhood characteristic[3]. Such measures would have indicated how office and industrial rents vary in relation to the type and mix of land uses surrounding a particular property. Also, this type of measure would provide an indication of how land use policy influences office and industrial rents. In some instances zoning constricts the supply of office or industrial space, either by excluding these types of land uses or by limiting the density of this type of development.

[3] This measure was not included because of the excessive time requirements for physically measuring the square footage of zoning surrounding each datapoint.

Building Characteristics

Four variables are used to model building characteristics: rentable area (square footage), number of stories, age of the building, and the type of lease agreement. All are continuous variables except for the type of lease agreement which is modeled as a dummy variable.

Previous studies have shown that the size of an office property is positively correlated with rent. Glascock et al. (1990) note that building size may be an important proxy for physical characteristics. He cites the fact that in BOMA's (Building Owners and Management Association) annual report about building operating expenses and incomes, their data is disaggregated by building size. For industrial buildings however, the literature has shown a negative correlation between property size and rent, indicating that discounts are offered for larger spaces (Kowalski and Parashevopoulos, 1990; Schmenner,1981). The number of stories has been shown to have a positive influence on rents. Wheaton and Torto (1994) show that high rise space on average is associated with a 15% rent premium over low rise space. Clapp (1980) finds that tenants are willing to pay more for higher floors within a building. Age should be negatively related to rents: older buildings should be less desirable than newer buildings (Wheaton and Torto, 1994). The lease agreement is modeled as a dummy variable. A distinction is made between full service lease agreements, which means that all "services" such as janitorial and landscaping are included in the rent, and partial service lease agreements. It is expected that properties with partial service lease agreements have lower rents than properties with full service lease agreements.

Economic Trend

The basic expectation for the year dummies is that every year should have a positive coefficient. In other words, in relation to 1986 rents, rents for each year thereafter will be higher. Beginning in 1990, there was a recession in the San Diego region as indicated by the population and employment trends in Section 3.1. This recession however was probably not strong enough to bring rents below the 1986 rates, which would be indicated by a negative coefficient on the year dummy. The coefficients for the years after 1990 should decrease relative to the years between 1986 and 1989.

Chapter Four
Office Rents

This chapter summarizes the office data and presents the results of regression analysis. In Section 4.1, data summaries are provided by market area. In Section 4.2, regression results are presented by market area. For each market area, three model specifications are analyzed: linear, semi-log and double-log. Results from the specification showing the best fit are discussed. Model refinements are also included in Section 4.2. The purpose of the model refinement subsections is to determine the effect of variations in modeling distance of a property to the nearest transit station. Initially, this variable is defined as a continuous variable where distance to the nearest transit station is measured in miles. In the model refinement subsections, distance to the nearest light rail station is modeled as a dummy variable, distinguishing between those properties within a quarter mile of a station and those beyond a quarter mile.

4.1 Summary of the Office Data

4.1.1 The South Bay Market Area

There are thirty-seven office properties in the South Bay data, with a total of 126 observations over a nine year period from 1986 to 1994. Data from 1990 and 1995 were not available from TURI at the time of data collection. Figure 4.1 shows the location of the South Bay Market Area office datapoints. Office properties are located ranging 0.39 miles to 4.78 miles from the closest transit station. These same properties are located from within 0.11 miles to 3.79 miles from the nearest freeway on/off ramp. Table 4.1 shows descriptive information for the continuous variables included in the rent models.

Table 4.1
South Bay Market Area
Office Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.50	2.00	1.14	0.29
Freeway (miles)	0.11	3.79	1.41	0.90
Station (miles)	0.39	4.78	1.83	1.17
CBD (miles)	0.24	11.12	6.03	3.28
Stories (number)	1.00	3.00	2.05	0.63
Area (sq.ft.)	1,700	47,500	16,958	11,638
Age (years)	5.0	41.0	15.2	8.1
Vacancy (sq.ft.)	0	25,000	2,789	4,522
Median HH Income ($)	10,580	54,437	25,822	13,792

The South Bay office properties are located ranging 0.24 miles to 11.12 miles from the San Diego CBD. The 1990 median household income of census tracts where properties are located is $25,822 (sd=$13,792) which is lower than the overall South Suburban median household income of $31,641. Seventy percent of the office properties are located in Chula Vista. Approximately twenty-two percent of the office properties are located in National City, and 8.1% are located in Imperial Beach.

Rentable square footage of the office buildings in the South Bay data range from 1,700 square feet to 47,500 square feet, with a mean rentable area of 16,959 square feet (sd=11,638). The majority of office properties in the South Bay market area have two stories (60%). Roughly eighteen percent of the properties have a single story, and twenty-two percent have three stories. Building age ranges from five years to forty-one years, with a mean age of 15.2 years (sd=8.09). The majority of office building tenants have a partial service lease agreement (87%). Thirteen percent of the office properties in the South Bay market area have full service lease agreements.

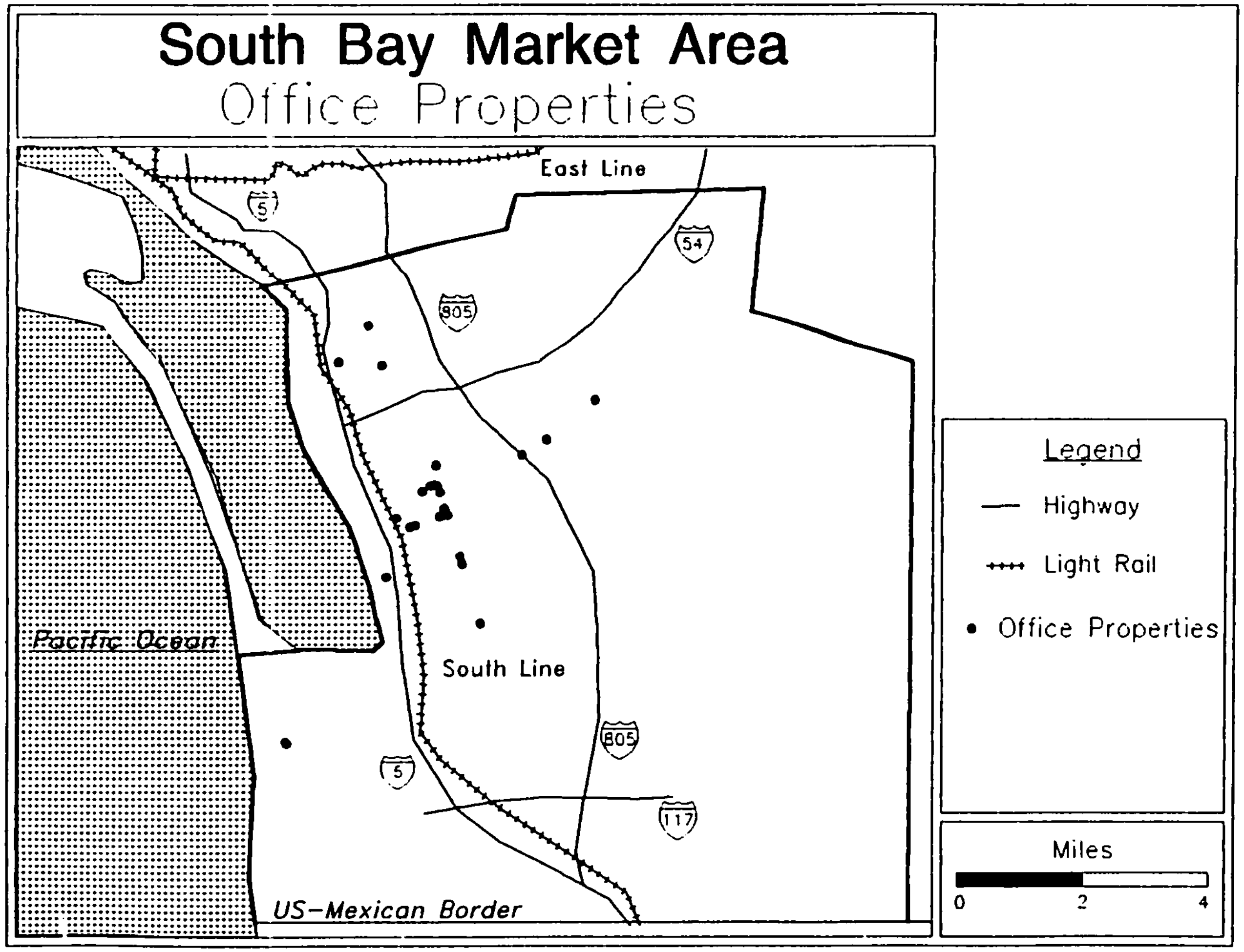

Figure 4.1: South Bay Market Area: Office Properties

4.1.2 The East County Market Area

There are one hundred and two office properties in the East County data, with a total of 432 observations over a ten year period from 1986 to 1995. Figure 4.2 shows the location of the East County market area office datapoints. Office properties are located ranging 0.02 miles to 9.32 miles from the closest transit station. These same properties are located 0.02 miles to 7.00 miles from the nearest freeway on/off ramp. Table 4.2 shows descriptive information for the continuous variables included in the rent models.

Table 4.2
East County Market Area
Office Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.45	1.70	0.98	0.25
Freeway (miles)	0.02	7.00	1.16	1.59
Station (miles)	0.02	9.32	1.81	2.19
CBD (miles)	0.45	16.48	9.49	2.83
Stories (number)	1.00	7.00	1.98	0.93
Area (sq.ft.)	930	125,000	14,177	18,180
Age (years)	1.0	65.0	12.8	9.2
Vacancy (sq.ft.)	0	55124	2829	4475
Median HH Income ($)	10,580	63,065	32,831	9,471

The East County office properties are located ranging 0.45 miles to 16.5 miles from the San Diego CBD. The 1990 median household income of census tracts where properties are located is $32,831 (sd=$9,471) which is lower than the overall East Suburban MSA median household income of $35,878. Fifty-two percent of the office properties are located in La Mesa. Approximately 30.4% of the office properties are located in El Cajon, 11.1% are located in Lemon Grove, 4.4% are in Santee, and 2% are in Lakeside.

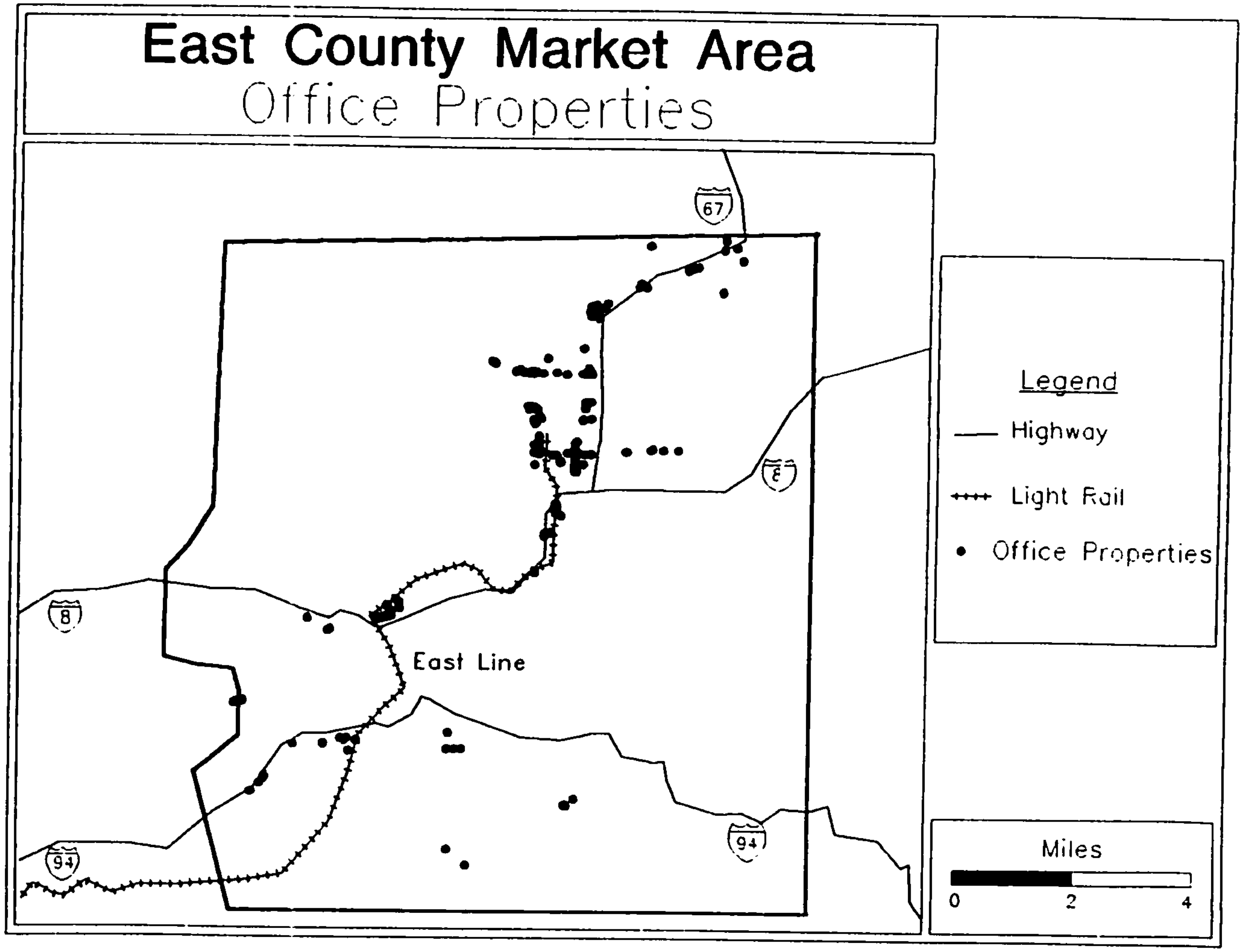

Figure 4.2: East County Market Area: Office Properties

Rentable square footage of the office buildings in the East County data range from 930 square feet to 125,000 square feet, with a mean rentable area of 14,177 square feet (sd=18,180). The majority of office properties in the East County market area have two stories (72%). Roughly twenty percent have a single story. Building age ranges from one year to sixty-five years, with a mean age of 12.8 years (sd=9.2). The majority of office building tenants have a partial lease agreement (84%). Sixteen percent of the office tenants have a full service lease agreement.

4.1.3 The Central City Market Area

There are three hundred and eighty-two office properties in the Central City data, with a total of 1806 observations over a ten year period from 1986 to 1995. Figure 4.3 shows the location of the Central City market area office datapoints.

Office properties are located ranging 0.01 miles to 7.11 miles from the closest transit station, and from within 0.02 miles to 7.19 miles from the nearest freeway on/off ramp. Table 4.3 shows descriptive information for the continuous variables included in the rent models.

Table 4.3
Central City Market Area
Office Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.20	2.95	1.15	0.36
Freeway (miles)	0.02	7.19	0.96	1.51
Station (miles)	0.01	7.11	1.92	1.82
CBD (miles)	0.06	14.96	2.47	2.60
Stories (number)	1.00	34.00	4.5	6.2
Area (sq.ft.)	800	643,019	48,399	99,039
Age (years)	1.0	114.0	20.5	18.8
Vacancy (sq.ft.)	0	289,071	10,599	24,713
Median HH Income ($)	10,494	61,838	20,439	8,216

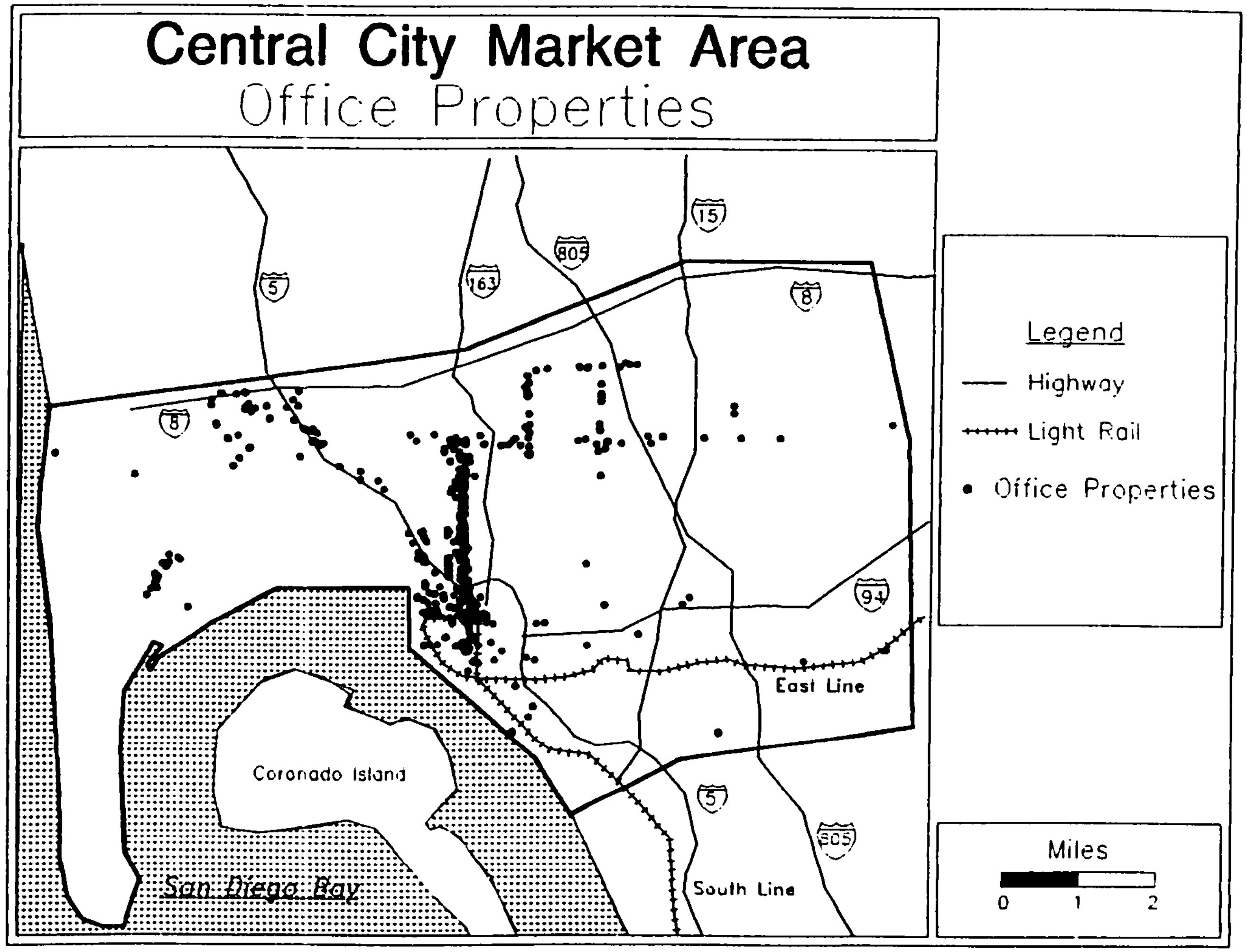

Figure 4.3: Central City Market Area: Office Properties

The Central City office properties are located ranging 0.06 miles to 14.96 miles from the San Diego CBD. The 1990 median household income of census tracts where properties are located is $20,439 (sd=$8,216) which is lower than the overall Central MSA median household income of $26,448. Forty-seventy percent of the Central City office properties are located in the Downtown submarket. Approximately twenty-six percent of the office properties are located in the Uptown submarket, 15.7% are located in Old Town, 10.5% are located in East City and only ten properties are located in South City.

Rentable square footage of the office buildings in the Central City data range from 800 square feet to 643,019 square feet, with a mean rentable area of 48,399 square feet (sd=99,039). The majority of office properties in the Central City market area have two stories (43%). Roughly eighteen percent have a single story, fourteen percent have three stories, and the remaining twenty-five percent of the Central City office properties range from four to thirty-four stories. Building age ranges from one year to one hundred and fourteen years, with a mean age of 20.5 years (sd=18.8). The majority of office building tenants have a partial service lease agreement (65%). Thirty-five percent of the Central City office properties have full service lease agreements.

4.2 Results of the Office Rent Models

This section presents the results of two groups of regressions for three market areas in the San Diego region. The primary distinguishing factor between the two groups of models involves differences in the Station variable measurement. Other refinements are also made to the models which focus on dropping variables that were consistently insignificant in the first group of models

4.2.1 The South Bay Market Area

Table 4.4a shows three models of office rents. Model 1a estimates office rents using a linear specification. Model 2a is a semi-log model using the logarithm of each access variable and the rent variable. Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. It is hypothesized that the relationship between the dependent variable, asking rent, and the property's distance to a highway or light rail system follows an exponential functional form. In other words, as distance from the transportation system increases, its influence on rent should diminish. In Table 4.4a, all access variables are modeled as continuous variables. In Table 4.4b, the Station variable is modeled as a dummy variable. The latter approach to modeling the relationship between rents and distance to the nearest light rail station may be more accurate given that access benefits associated with light rail transit should be concentrated within an area relatively close to the station. This relationship does not necessarily hold for access to highways. Access benefits associated with highways should extend over a greater distance.

To facilitate the presentation of results, I attempt to identify the specification which provides the "best fit." Upon reviewing the adjusted R-squared values and the F-test values for the South Bay office rent models, it appears that none of the specifications provides a markedly better fit relative to the others. Moreover, the sign and significance of the access variables do not vary across specifications. The linear and semi-log specifications fit almost equally well, while the double-log model shows a somewhat weaker fit. The Box-Cox test provides a method for choosing which functional form has the best fit. Usually, this test is used if the researcher is theoretically undecided between the linear and semi-log functional forms (Studenmund, 1992). In this case, there is strong theoretical support for the idea that the relationship between the access variables and rent should be exponential. The Box-Cox test therefore is not used, rather the exponential functional form (either the semi-log or double-log) is assumed to adequately model rents. The results of the semi-log model, Model 2a (adjusted R-squared = 0.518; F = 7.904), are reviewed for the South Bay market area.

Building Characteristics

Two of the building characteristic variables are significant in the office rent Model 2a for the South Bay market area: the number of stories and the age of a property. The number of stories is significant with the expected sign on the coefficient. This result is consistent in the office rent literature (Wheaton and Torto, 1994; Brennan et al., 1984; Clapp, 1980). Office space in higher buildings is more expensive than space in lower buildings. Wheaton and Torto (1994) found that rents in buildings with more than five floors charge a premium over buildings with less than five floors. Brennan et al. (1984) found that units located on higher floors within a building have higher rents than units on lower floors. These results seem to indicate that all floors in higher building charge a premium over lower buildings, and also that within a building, space on higher floors is more expensive than on lower floors. Clapp (1980) refers to the "amenity value of a view" as one explanation for this finding. Beyond this "amenity value" explanation, urban economic theory holds that locations with high levels of access lead to higher rents and more dense development, including the construction of relatively higher buildings (Alonso, 1964). It is uncertain, therefore, whether higher rents are a function of the specific building amenity, or a function of the fact that higher buildings are constructed in more desirable, higher rent locations.

The age of an office building is also significant in determining rents. As expected, older buildings rent for a discount. This finding is widely consistent in the office rent literature. The age of a building is viewed as a disamenity.

The leaseable area of an office property is insignificant for all South Bay office model specifications. As mentioned in Chapter 3, the expected sign of this coefficient is uncertain. Glascock et al. (1990) and Clapp (1980) find rentable area of a unit to be positively related to office rents, while Brennan et al. (1984) find that rentable area is negatively related to office rents. Some important, recent studies find that rentable area of an office property is insignificant (Sivitanidou, 1996; Mills, 1992).

The insignificance of vacancy in the South Bay office rent model is surprising. Many studies have explored the relationship between vacancies and rents. It is generally understood that when office supply increases, the price for space should decrease. Conversely, when office supply decreases, the price of space should increase. This process is referred to as the vacancy-rental adjustment process (Wheaton and Torto, 1988). A problem arises, however, when including vacancy levels in the rent model. Vacancies and rents are equivalent to the supply and demand for office space. These variables are jointly determined or endogenous. In other words, rent is dependent on vacancy levels which in turn depends on rents. This feedback effect is usually modeled using structural equations (Studenmund, 1992). This approach was not taken in the present study, and may be an important direction for further research. In the model refinement section, vacancy is dropped from the model.

Rents for office space with retail are not significantly different than rents for simple low rise office space. This result probably indicates that retail establishments are not considered amenities for office firms. This variable may also proxy for the age of a property: older office properties built before the "office park" concept may be more likely to have retail space, while newer office properties, built within office parks, may be less likely to have retail space. Rents for properties with partial service lease agreements are not significantly different than rents for properties with full service lease arguments. This result is surprising. By definition, office firms with partial service lease agreements are receiving fewer services (such as janitorial, landscaping, utilities, etc.) for their monthly rental payment than office firms with full service lease agreements. This leads to the expectation that firms with partial service lease agreements have lower rents than firms with full service lease agreements. One explanation for this finding is that, for the South Bay properties, the services offered in a typical full service lease agreement do not have a high value.

Access Variables

The coefficient for the Freeway variable is significant at the 95% level and has the expected negative sign. The coefficient indicates that a one percent increase in the distance of an office property from the nearest freeway on/off ramp corresponds to an 11% decrease in office rent.

The coefficient for distance from a transit station (Station) is not significant. This result indicates that office firms in the South Bay area are not paying a premium to locate near transit stations. This finding may not be surprising in the context of South Bay area. The South Line runs from the Mexican border to the San Diego downtown. This line is a much celebrated success story for light rail transit. It is one of few light rail lines in the nation that earns enough farebox revenue to cover operating expenses. Its success is generally attributed to the fact that it connects a large population of low-wage workers from Tijuana to the general San Diego area. It is unlikely that the majority of these workers commute to office jobs along the South Line corridor. It is plausible, therefore, that office firms in the South Bay area do not value proximity to transit stations as a worker amenity or benefit, because the light rail line does not provide transportation for the typical South Bay office employee. In contrast, industrial firms in this market area do pay a premium to locate near South Line transit stations (See Chapter 5, Table 5.4a). The South Line may provide industrial firms in this area with a stable supply of low-wage laborers from Mexico, which may be an important input to the industrial production occurring in this area. This is an important finding and lends support to the idea discussed in Chapter 1: namely, the value a firm places on access to transportation systems may depend on its specific type of production, and the transport requirements associated with its inputs and outputs.

The coefficient for distance to the central business district (CBD) is not significant. This finding is not surprising. It is consistent with the polycentric model of urban form where metropolitan regions develop subcenters that, in essence, reduce the importance of the primary CBD. Office-oriented businesses in the South Bay market area do not depend on the San Diego CBD for services; rather they most likely find closer, comparable services.

Neighborhood Characteristics

Median household income is not a significant predictor of office rents in any of the three South Bay specification. This finding is not necessarily surprising given that neighborhood qualities valued by high income households may not reflect the same qualities valued by office firms. The submarket dummy variables in Model 2a show that office rents in National City and Imperial Beach are significantly lower than in Chula Vista which is expected. Office rents in National City are approximately 34.4% lower than rents in Chula Vista regardless of building characteristics, access levels, or lease agreement type. Office rents in Imperial Beach are approximately 32.1% lower than rents in Chula Vista. The rent premium in Chula Vista may be associated with local government policies or general qualities of the city that make it a desirable place for businesses to locate.

Economic Trend

Based on Model 2a, rents over the years 1986 to 1994 follow the expected trend. The magnitude of the coefficient increases from 1987 through 1991, indicating that rents are increasing relative to 1986. In 1991, office rents are approximately nineteen percent greater than 1986 office rents, holding all other factors constant[4]. After 1991, the coefficients begin to decrease. By 1994, rents are only 4.6 percent greater than 1986 rents. This trend reflects the general state of the local economy reviewed in Chapter 3. Rising rents in the late 1980's reflect a strong real estate market and general economy. Falling rents in the early to mid 1990's reflect declining real estate markets and a weakening economy. The signs and relative magnitudes of the coefficients on the year dummies are as expected.

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[4] For similar interpretations of year dummy variables, see Wheaton and Torto (1994) and Glascock et al. (1990)

Table 4.4a: South Bay Office Rents
(dependent variable: asking rents $/sf)

		B Coefficients (t-statistic)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
	Constant	.790 (5.186)	-.324 (-2.534)	.640 (.463)
Building Characteristics	# of Stories	.172*** (5.148)	.179*** (6.142)	.240*** (3.371)
	Leaseable Area	1.469×10^{-06} (.659)	1.36×10^{-09} (.001)	-.021 (-.574)
	Age of Property	-.011*** (-3.636)	-.010*** (-3.744)	-.240*** (-4.111)
	Vacancy Rate	2.46×10^{-07} (.051)	-3.58×10^{-06} (-.848)	-.023 (-1.034)
Building Type	Low Rise Office			
	Office with Retail	.080 (1.449)	.069 (1.399)	-.021 (-.307)
Measures of Access	Freeway	-.103*** (-2.822)	-.113*** (-3.278)	-.104*** (-2.550)
	Station	.033 (.719)	.057 (.750)	.079 (.869)
	CBD	-.010 (-.760)	-.003 (-.102)	-.015 (-.325)
Neighborhood Characteristics	Chula Vista			
	National City	-.304*** (-3.335)	-.344*** (-4.311)	-.291* (-1.972)
	Imperial Beach	-.365*** (-2.707)	-.321*** (-2.672)	-.389** (-2.527)
	Median HH Income	3.09×10^{-06} (.666)	1.59×10^{-06} (.393)	.024 (.166)
Lease Agreement	Full Service			
	Partial Service	.084 (1.186)	.075 (1.222)	-.013 (-.163)
Year Dummy	1986			
	1987	.043 (.523)	.048 (.669)	.048 (.456)
	1988	.171* (1.871)	.165** (2.056)	.182** (2.009)
	1989	.139* (1.696)	.142* (1.978)	.122 (1.403)
	1991	.241*** (3.359)	.193*** (3.024)	.225*** (2.780)
	1992	.181** (2.388)	.143** (2.144)	.116 (1.404)

Table 4.4a (continued): South Bay Office Rents
(dependent variable: asking rents $/sf)

Independent Variables		B Coefficients (t-statistic) Model 1a Linear	Model 2a Semi-Log	Model 3a Double-Log
Year Dummy	1993	.156* (1.970)	.124* (1.784)	.137 (1.625)
	1994	.054 (.655)	.046 (.639)	.068 (.793)
N=		103	103	69
Adj. R Sq.		0.506	0.518	0.412
F =		7.566	7.904	4.250

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test
*** Significant using 0.01 one-tailed t-test.

South Bay Office Rent Model Refinement

Based on the results of the preceding section, several refinements are made to the South Bay office rent models. The primary change involves redefining the distance to rail station variable (Station) as a dummy variable instead of a continuous variable. This variable is altered based on the understanding that light rail access benefits are concentrated within a quarter mile radius of light rail stations. The literature shows that pedestrians are much less likely to use light rail transit if they are required to walk farther than a quarter mile to reach a transit station. This implies that access benefits drop for those locations beyond a quarter mile from a transit station. In Table 4.4b, the Station variable coefficient indicates to what extent office rents for properties within a quarter mile from the nearest light rail station differ from office rents for properties located beyond a quarter mile distance to the nearest light rail station. The hypothesized sign on the Station dummy variable is positive, which would indicate that properties within a quarter mile of a transit station have higher rents than properties beyond a quarter mile.

Another change implemented in the South Bay office regression is to drop the vacancy variable from the analysis. This was done for two reasons. First, vacancies were consistently insignificant in the initial regressions (Table 4.4a). Second, including vacancies in the rent models may be pose a problem given the fact that vacancies and rents are endogenous. As previously stated in this section, a structural equations model which accounts for the joint determination of rents and vacancies may provide a more accurate approach to modeling vacancies and rents.

The results of the refined South Bay office rents models (Table 4.4b) are consistent with the previous group of models shown in Table 4.4a. The explanatory power of the regression equations is not increased when distance to the transit system is modeled as a dummy variable and vacancy rates are dropped from the regressions. The only consistent change between the two groups of models occurs with the average household income variable. When distance to the transit system is modeled as a dummy variable and vacancy rates are dropped from the regression equations, the Income variable shows a positive, significant relationship with rent for all three specifications. In the previous group of models, median household income is insignificant for all three specifications.

Another less consistent change between the two groups of models, is that for the double-log specification, proximity to transit becomes a disamenity for office firms. This finding may show that the dummy variable measurement is slightly more effective for the Station variable. A negative relationship between proximity to transit stations, which are located in a freight rail right-of-ways, and office rents in the South Bay market area is also plausible given the predominance of industrial land uses in the light rail corridor area.

Table 4.4b: South Bay Office Rents
(dependent variable: asking rents $/sf)

		B Coefficients (t-statistic)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
	Constant	.776 (5.271)	-.384 (-3.217)	-.616 (-.918)
Building Characteristics	# of Stories	.173*** (5.262)	.182*** (6.387)	.270*** (5.288)
	Leaseable Area	$1.03\text{x}10^{-06}$ (.504)	$-7.480\text{x}10^{-07}$ (-.414)	-.022 (-.791)
	Age of Property	-.011*** (-3.802)	-.009*** (-3.467)	-.187*** (-4.434)
Building Type	Low Rise Office			
	Office with Retail	.093* (1.764)	.089* (1.865)	.056 (1.098)
Measures of Access	Freeway	-.090*** (-3.720)	-.107*** (-3.816)	-.099*** (-3.496)
	Station	-.107 (-1.031)	-.109 (-1.174)	-.182* (-1.850)
	CBD	-.015 (-1.442)	-.021 (-1.008)	-.030 (-1.142)
Neighborhood Characteristics	Chula Vista			
	National City	-.293*** (-3.376)	-.330*** (-4.284)	-.332*** (-4.364)
	Imperial Beach	-.373*** (-2.834)	-.318*** (-2.774)	-.382*** (-3.186)
	Median HH Income	$5.786\text{x}10^{-06}$** (2.328)	$4.010\text{x}10^{-06}$** (2.005)	.113* (1.710)
Lease Agreement	Full Service			
	Partial Service	.108 (1.656)	.105* (1.824)	.067 (1.144)
Year Dummy	1986			
	1987	.046 (.568)	.053 (.736)	.042 (.577)
	1988	.163* (1.812)	.154* (1.935)	.156* (1.915)
	1989	.132* (1.659)	.123* (1.760)	.121* (1.683)
	1991	.255*** (3.611)	.203*** (3.250)	.201*** (3.134)
	1992	.183** (2.475)	.141** (2.164)	.144** (2.150)

Table 4.4b (continued): South Bay Office Rents
(dependent variable: asking rents $/sf)

		B Coefficients (t-statistic)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy	1993	.159** (2.061)	.115* (1.688)	.111 (1.587)
	1994	.054 (.661)	.047 (.653)	.040 (.546)
N=		107	107	107
Adj. R Sq.		0.514	0.517	0.492
F =		8.357	8.441	7.736

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

4.2.2 The East County Market Area

Table 4.5a shows three models of office rents in the East County market area. Model 1a estimates office rents using a linear specification. Model 2a uses a semi-log specification where the logarithm of the rent and access variables are used. Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. As with the South Bay market area, none of the model specifications for East County shows a dramatically stronger than the others. With the double-log specification, however, both Freeway and Station variables are significant. This suggests that the exponential form of the variables may provide a better fit than the linear or semi-log specifications. The results of the double-log specification, Model 3a (adjusted R-squared = 0.333; F = 8.889), are reported in the following paragraphs.

Building Characteristics

Three of the building characteristic variables are significant in the East County Model 3a: leaseable area, the age of an office property, and the number of stories. The coefficient on the leaseable area variable has a plausible sign, larger properties rent for a premium. The age coefficient has the expected sign, older properties rent for a discount. The coefficient on the number of stories variable is also significant with the expected sign:

higher buildings rent for a premium. Office space with retail and mid-to-high rise office space do not rent for a premium over simple low rise office space. In terms of lease agreements, partial service lease agreements are not significantly different than full service lease agreements. The above results are similar to those found in the preceding section for the South Bay market area. The one exception is with the Area variable, which is now positively related to rent. Given the uncertain and varied outcomes associated with this variable in the literature, it is not entirely surprising that the South Bay and East County market areas show different results.

Access Variables

The variable for distance from the nearest freeway on/off ramp is significant at the 95% confidence level with the expected negative sign on the coefficient. Holding all other factors constant, the closer a property is to a freeway on/off ramp in the East County market area, the higher the rent.

The coefficient on the transit station distance variable is significant at the 95% level but does not have the expected negative sign. The positive coefficient implies that office properties located further from transit stations command higher rents, or conversely, office properties near transit stations have discounted rents. The transit station distance variable in Model 3a shows that a one percent increase in the distance of an office property from a transit station corresponds to a 5.5% increase in office rent. In contrast to office firms in the South Bay market area, East County office firms actually pay a premium to locate away from transit stations. There are some general characteristics of the East Line and its corridor area which may help explain these findings. First, much of the East Line corridor is located in an existing freight rail right-of-way. Freight shipping is usually associated with industrial or manufacturing firms; office firms do not generally benefit from locating along a freight shipping corridor. Moreover, it is plausible that office firms view this type of corridor area as a disamenity, thus the positive sign on the Station coefficient. Second, the East Line corridor passes through some of the most socially and economically distressed areas in the San Diego region (the communities of Southeast San Diego, Encanto and Paradise Valley). It is very likely that these areas are viewed as having neighborhood disamenities which discourage office firms from locating there, or which lead to relatively low rents in the corridor area. Another reason East County office firms do not value access to the East Line may be related to the fact that the most valuable connection provided by the East Line is between the predominantly white, mid-to-high income communities in the eastern area of East County with the downtown San Diego employment center. The typical office employee commuting on the East Line most likely begins in the eastern communities of Santee, El Cajon, and La Mesa, and travels to the downtown area. It is unlikely that the East Line provides significant access for employees to office firms in these same eastern cities. Furthermore, given the nature of the western portion of the East County market area, a typical commuter from these eastern communities would not be likely to use the East Line to access jobs in the western portion of the East County market area, where you have highly distressed communities with little office employment. In sum, it is very plausible that few office firms in the East County market area benefit from proximity to light rail stations. The predominant benefit provided by the East Line is to connect East County residents with downtown employment. The office properties which stand to gain the most benefit from East Line access are those located in the downtown area.

Distance of an office property to the central business district is not significant. Again, this finding is consistent with the polycentric model of urban form, where subcenters throughout a region detract from the importance of the downtown CBD.

Neighborhood Characteristics

Median household income is a significant predictor of office rents in the East County market area. The higher the median income of the census tract where an office

Table 4.5a: East County Office Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
	Constant	.676 (5.969)	-.318 (-2.992)	-1.99 (-4.486)
Building Characteristics	# of Stories	.038 (1.633)	.042* (1.743)	.077* (1.865)
	Leaseable Area	$3.15x10^{-06}$*** (3.149)	$2.36x10^{-06}$** (2.169)	.057*** (3.250)
	Age of Property	-.004*** (-2.763)	-.005*** (-3.455)	-.051*** (-3.565)
	Vacancy Rate	$1.79x10^{-06}$ (.695)	$3.14x10^{-06}$ (1.174)	.012 (.876)
Building Type	Low Rise Office			
	Mid-High Rise Office	-.047 (-.550)	-.073 (-.814)	.068 (.992)
	Office with Retail	.009 (.220)	.021 (.523)	.050 (1.214)
Measures of Access	Freeway	-.008 (-.306)	-.023 (-1.082)	-.042* (-1.812)
	Station	.022 (1.299)	.024 (1.169)	.054** (2.533)
	CBD	.001 (.235)	-.024 (-.993)	-.003 (-.123)
Neighborhood Characteristics	El Cajon			
	La Mesa	.122*** (4.461)	.113*** (4.074)	.082*** (2.767)

Table 4.5a (continued): East County Office Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
Neighborhood Characteristics	Lakeside	-.147* (-1.762)	-.146 (-1.606)	-.229** (-2.356)
	Lemon Grove	-.130** (-2.616)	-.182*** (-3.482)	-.243*** (-4.648)
	Santee	-.193*** (-3.340)	-.222*** (-3.800)	-.245*** (-4.159)
	Median HH Income	1.53×10^{-06} (1.205)	3.29×10^{-06}*** (2.636)	.122*** (2.818)
Lease Agreement	Full Service			
	Partial Service	-.040 (-1.403)	-.043 (-1.439)	-.040 (-1.264)
Year Dummy	1986			
	1987	.098 (1.151)	.108 (1.221)	.092 (1.030)
	1988	.134 (1.596)	.140 (1.599)	.185** (2.092)
	1989	.185** (2.111)	.193** (2.119)	.202** (2.236)
	1990	.204** (2.449)	.202** (2.325)	.173** (1.999)
	1991	.152* (1.870)	.161* (1.889)	.166** (1.989)
	1992	.125 (1.527)	.143* (1.672)	.147* (1.764)
	1993	.105 (1.274)	.126 (1.468)	.138 (1.641)
	1994	.093 (1.126)	.108 (1.237)	.108 (1.272)
	1995	.084 (1.005)	.097 (1.115)	.104 (1.225)
N=		407	407	356
Adj. R Sq.		0.318	0.292	0.333
F		9.370	8.420	8.888

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

property is located, the higher the associated asking rents. This finding is contrary to that found in the South Bay market area. Perhaps given the predominance of industrial firms in the South Bay market area, the relatively small number of office firms located there are oriented toward providing services to industrial firms. These offices probably value proximity to industrial firms in the area, not the residential populations. The quality of residential neighborhoods, therefore, has little bearing on their business operations. In the East County, we do not see a predominance of industrial land uses. The office firms in this area may be more oriented toward providing services to residential populations, rather than industrial firms. In this case, firms may place a higher value on proximity to residential areas, and subsequently pay higher rents to locate within higher income neighborhoods.

The submarket dummy variables show that office rents in La Mesa are significantly higher than in El Cajon which is expected. Office rents in La Mesa are approximately 8% higher than rents in El Cajon regardless of building characteristics, access levels, or lease agreement type. Asking rents in Lakeside, Lemon Grove and Santee are significantly lower than rents in El Cajon.

Economic Trend

Based on Model 3a, rents over the years 1986 to 1995 follow the expected trend. The magnitude of the year dummy variable coefficients increases over the period from 1987 to 1989. In 1989, office rents are approximately twenty percent greater than 1986 rents. During the period from 1989 to 1995, office rents decrease relative to 1986 rents. By 1995, office rents are approximately 10.4 percent greater than 1986 rents. This trend reflects the general state of the local economy reviewed in Chapter 3. Rising rents in the late 1980's reflect a strengthening real estate market and local economy. Rents peak in 1989 in the East County, which is earlier than the 1991 peak in South Bay office rents.

Falling rents in the early to mid 1990's reflect a weakening real estate market and local economy.

East County Office Rent Model Refinement

The explanatory power of the first group of models, where distance to the transit system is modeled as a continuous variable (Table 4.5a), is comparable to the explanatory power of the second group of models, where distance is modeled as a dummy variable (Table 4.5b). The results of the access variables change noticeably for the linear and double-log specifications, however. The linear model had no significant access variables in the first group of regressions. In the second group of models, both Freeway and Station are significant. Freeway has an unexpected sign and Station has the expected sign on the coefficient. For the double-log model, both Freeway and Station were significant in the first group of models. In the second group of models, both variables become insignificant. The CBD variable is consistently insignificant in both groups of models. These results indicate that the manner in which the Station variable is modeled may have important impact on the findings.

Table 4.5b: East County Office Rents (dependent variable: asking rents, $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
	Constant	.604 (5.656)	-.311 (-2.940)	-1.83 (-4.400)
Building Characteristics	# of Stories	.041* (1.729)	.035 (1.461)	.077** (2.013)
	Leaseable Area	3.82×10^{-06}*** (3.858)	3.362×10^{-06}*** (3.222)	.079*** (5.036)
	Age of Property	-.003*** (-2.712)	-.005*** (-3.408)	-.043*** (-3.189)
Building Type	Low Rise Office			
	Mid-High Rise Office	-.087 (-1.008)	-.082 (-.911)	.042 (.623)
	Office with Retail	.011 (.272)	.026 (.641)	.014 (.349)
Measures of Access	Freeway	.031*** (3.536)	.008 (.570)	.014 (1.045)
	Station	.086** (2.219)	.070 (1.538)	.074 (1.650)
	CBD	.008 (1.554)	-.014 (-.592)	-.004 (-.160)
Neighborhood Characteristics	El Cajon			
	La Mesa	.124*** (4.688)	.109*** (3.914)	.090*** (3.226)
	Lakeside	-.122 (-1.517)	-.088 (-1.084)	-.072 (-.904)
	Lemon Grove	-.079* (-1.944)	-.130*** (-2.848)	-.156*** (-3.604)
	Santee	-.202*** (-3.587)	-.222*** (-3.805)	-.236*** (-4.155)
	Median HH Income	9.646×10^{-07} (.793)	3.13×10^{-06}** (2.498)	.096** (2.391)
Lease Agreement	Full Service			
	Partial Service	-.029 (-1.018)	-.036 (-1.190)	-.024 (-.835)
Year Dummy	1986			
	1987	.092 (1.096)	.093 (1.057)	.089 (1.022)
	1988	.132 (1.590)	.128 (1.472)	.128 (1.495)
	1989	.188** (2.165)	.186** (2.035)	.178** (1.993)
	1990	.197** (2.389)	.189** (2.188)	.177** (2.079)

Table 4.5b(continued): East County Office Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy (continued)	1991	.145* (1.795)	.150* (1.762)	.142* (1.701)
	1992	.115 (1.421)	.128 (1.506)	.111 (1.324)
	1993	.097 (1.185)	.115 (1.336)	.100 (1.179)
	1994	.080 (.973)	.093 (1.066)	.075 (.880)
	1995	.073 (.877)	.083 (.949)	.064 (.749)
N=		408	408	408
Adj. R Sq.		0.324	0.294	0.318
F		9.989	8.789	9.737

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

4.2.3 The Central City Market Area

Table 4.6a shows three models of office rents for the Central City market area. Model 1a estimates office rents using linear variables, Model 2a is a semi-log model using the logarithm of the rent variable and the access variables, and Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. For this group of models, the linear specification appears to provide a slightly better fit than the other two specifications, based on the adjusted R-squared value (56.471) and the F-test value (0.425). The results of the access variables also depend on the specification. The Freeway variable is significant with the expected sign in the linear and semi-log models, and it is not significant in the double-log model. Both Station and CBD variables are significant with the expected sign in the semi-log and double-log models, and they are not significant in the linear model. The results of semi-log specification, Model 2a (adjusted R-squared = 0.314; F = 35.430) are reported in the following paragraphs.

Building Characteristics

Three of the building characteristics are significant in modeling office rents in the Central City market area. The number of stories is significant with the expected sign of the coefficient. Higher building charge a premium for office space. Interpretations of this finding were reviewed in detail in the South Bay office rents subsection. Buildings with larger leaseable areas also rent for a premium. This finding is consistent with the result found in the East County market area. South Bay office firms, however, do not pay a premium for larger space. The fact that office firms in the East County and Central City market areas value larger office space is most likely a function of the type of firm locating in these areas. It is very likely that office firms in the South Bay market area have a different business orientation than office firms in the East County and Central City. The age of an office building is also significant in determining rents. As expected, older buildings rent for a discount. Vacancy rates are not significant for the semi-log specifications. For the double-log model, however, vacancies are significant with the expected sign on the coefficient. Mid to high rise office space rents for a premium over low rise space in the Central City market area, while office space with retail is not significantly different from simple low rise space. Partial service lease agreements are associated with significantly lower rents in the Central City market area, which is an expected result. The fewer services included in the rent, such as utilities and janitorial, the lower the rent should be.

Access Variables

In the semi-log model, Model 2a, the coefficients for distance of a property to the nearest on-off ramp (Freeway) is significant with the expected negative sign. The Freeway variable shows that asking rents for office properties in the Central City market area decrease with distance from the nearest freeway on/off ramp. The coefficient for distance to the nearest transit station (Station) is also significant. The sign on the Station coefficient, however, is not as expected. It shows that as the distance between an office property and the nearest transit station increases, rents also increase. This finding can be explained by the fact that the majority of light rail stations in the Central City market area pass through aging and somewhat distressed areas of downtown San Diego. There is only one, relatively short corridor area, along C Street, where the light rail system passes through a vibrant, office employment center. The remaining urban areas of the light rail corridor in Central City are typically deteriorated or located in existing freight rail right-of-way. One stretch of light rail called the Bayside Line, which is located in the Central City market area, is undergoing extensive revitalization. This area, however, is developing as a tourist center, rather than an office employment center. The San Diego Convention Center was completed along the Bayside Line in the late 1980's, along with several hotels and restaurants.

The coefficients for distance of an office property to the CBD, designated as a centrally located point at the corner of 4th Avenue and Broadway, is significant with the expected negative sign. The CBD variable shows that asking rents for office properties in the Central City market area decrease with distance from the center of the downtown area.

This finding is consistent with the polycentric model of urban form, referred to previously. For office properties in the Central City market area, the downtown area is the closest subcenter and therefore exerts a significant pull on nearby office properties. In the other two market areas, we found distance to the CBD was insignificant. It was suggested, in line with the polycentric model, that there are other subcenters in these respective areas which are more important than the downtown subcenter.

Neighborhood Characteristics

Median household income is a significant predictor of office rents in the Central City market area. Census tracts with higher median household incomes are associated with office properties that command higher rents. The submarket dummy variables show that office rents in South City and East City are significantly lower than in Downtown which is expected. Office rents in East City are approximately 12% lower than rents in Downtown regardless of building characteristics, access levels, or lease agreement type. Similarly, office rents in South City are approximately 43% lower than rents in Downtown. Office rents in the Uptown submarket are significantly higher than rents in the Downtown.

Table 4.6a: Central City Office Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
	Constant	1.080 (29.793)	.024 (.507)	-.455 (-1.084)
Building Characteristics	# of Stories	.006** (2.030)	.008** (2.310)	.062*** (2.862)
	Leaseable Area	9.38×10^{-07}*** (4.988)	4.31×10^{-07}** (2.087)	.038*** (2.810)
	Age of Property	-.003*** (-9.555)	-.004*** (-8.823)	-.091*** (-10.632)
	Vacancy Rate	-3.405×10^{-07} (-.893)	-3.70×10^{-07} (-.883)	-.026*** (-3.117)
Building Type	Low Rise			
	Mid-High Rise	.186*** (7.242)	.201*** (7.071)	.178*** (5.027)
	Office with Retail	.008 (.413)	.013 (.634)	-.026 (-1.062)
Measures of Access	Freeway	-.066*** (-3.826)	-.033*** (-3.056)	-.018 (-1.586)
	Station	.025 (1.487)	.083*** (3.874)	.087*** (3.689)
	CBD	.009 (.720)	-.083*** (-3.368)	-.095*** (-3.413)
Neighborhood Characteristics	Downtown			
	Uptown	.031 (1.083)	.059** (2.133)	.102*** (3.039)
	Old Town	-.074* (-1.945)	.019 (.662)	.046 (1.383)
	South City	-.442*** (-4.842)	-.426*** (-4.243)	-.259** (-2.265)
	East City	-.234*** (-5.697)	-.121*** (-3.735)	-.073* (-1.957)
	Median HH Income	5.08×10^{-06}*** (4.121)	4.12×10^{-06}*** (2.965)	.059 (1.464)
Lease Agreement	Full Service			
	Partial Service	-.096*** (-6.043)	-.098*** (-5.676)	-.118*** (-6.004)
Year Dummy	1986			
	1987	.025 (.769)	.025 (.699)	.029 (.724)
	1988	.076** (2.337)	.067* (1.900)	.084** (2.192)
	1989	.122*** (3.677)	.114*** (3.142)	.113*** (2.855)
	1990	.087*** (2.683)	.080** (2.241)	.082** (2.164)

Table 4.6a (continued): Central City Office Rents
(dependent variable: asking rent $/sf)

Independent Variables		Coefficients (t-statistics) Model 1a Linear	Model 2a Semi-Log	Model 3a Double-Log
Year Dummy (continued)	1991	.051 (1.638)	.053 (1.541)	.069* (1.887)
	1992	-.031 (-.985)	-.009 (-.257)	.025 (.662)
	1993	-.045 (-1.360)	-.037 (-1.005)	-.015 (-.388)
	1994	-.102*** (-3.093)	-.086** (-2.414)	-.063 (-1.631)
	1995	-.082** (-2.389)	-.038 (-.997)	.009 (.236)
N=		1779	1779	1453
Adj. R Sq.		0.425	0.314	.329
F		56.471	35.430	31.213

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

Economic Trend

Based on Model 2a, rents over the years 1986 to 1995 follow the expected trend. During the years from 1987 through 1989, office rents in the Central City market area increase relative to 1986 rents. Rents peak in 1989 when they are 11% greater than 1986 rents. In 1990, office rents begin to decrease relative to 1986 rents. By 1994, rents are actually 8% lower than 1986 rents. Rents in the late 1980's were relatively stronger than in the early 1990's which was shown in Chapter 3. The signs and relative magnitudes of the coefficients on the year dummies are as expected.

Central City Office Rent Model Refinement

As with the previous two market areas, there is almost no difference between the explanatory power for the group of models where distance is modeled as a continuous variable (Table 4.6a) and the group of models where it is modeled as a dummy variable

Table 4.6b: Central City Office Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
	Constant	1.132 (29.286)	.018 (.384)	-.807 (-2.328)
Building Characteristics	# of Stories	.007** (2.256)	.006* (1.792)	.054*** (2.897)
	Leaseable Area	$9.995x10^{-07}$*** (5.015)	$4.744x10^{-07}$** (2.403)	.025** (2.325)
	Age of Property	-.003*** (-9.499)	-.003*** (-8.608)	-.089*** (-11.805)
Building Type	Low Rise			
	Mid-High Rise	.187*** (7.348)	.216*** (7.641)	.189*** (6.034)
	Office with Retail	.010 (.534)	.017 (.834)	-.018 (-.868)
Measures of Access	Freeway	-.055*** (-3.384)	-.027** (-2.483)	-.017 (-1.613)
	Station	-.090 (-3.734)	-.103*** (-3.529)	-.083*** (-2.894)
	CBD	.012 (1.388)	-.023* (-1.846)	-.030** (-2.269)
Neighborhood Characteristics	Downtown			
	Uptown	.007 (.263)	.068** (2.460)	.108*** (3.765)
	Old Town	-.067** (-2.112)	.045 (1.569)	.076*** (2.694)
	South City	-.484*** (-5.340)	-.502*** (-5.087)	-.440** (-4.471)
	East City	-.229*** (-6.395)	-.098*** (-3.085)	-.055* (-1.724)
	Median HH Income	$4.664x10^{-06}$*** (3.819)	$4.220x10^{-06}$*** (3.042)	.084** (2.525)
Lease Agreement	Full Service			
	Partial Service	-.095*** (-6.058)	-.100*** (-5.768)	-.120*** (-6.887)
Year Dummy	1986			
	1987	.026 (.805)	.025 (.682)	.033 (.930)
	1988	.077** (2.404)	.069* (1.942)	.083** (2.356)
	1989	.123*** (3.736)	.117*** (3.206)	.121*** (3.355)
	1990	.090*** (2.780)	.082** (2.318)	.1 (2.678)

Table 4.6b (continued): Central City Office Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy (continued)	1991	.055* (1.783)	.056 (1.647)	.073** (2.140)
	1992	-.028 (-.888)	-.008 (-.230)	.011 (.307)
	1993	-.041 (-1.247)	-.035 (-.956)	-.013 (-.370)
	1994	-.101*** (-3.073)	-.089** (-2.425)	-.058 (-1.612)
	1995	-.079** (-2.320)	-.038 (-1.002)	-.002 (-.050)
N=		1780	1780	1780
Adj. R Sq.		0.429	0.313	.326
F		59.798	36.784	38.968

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

(Table 4.6b). The only difference in results is seen with the Station variable. In Model 1a, the Station variable is not significant; in Model 1b, this variable becomes significant with the unexpected sign on the coefficient. The Station variable for the semi-log and double-log specifications for both groups of models shows that properties closer to light rail transit stations have lower rents than properties farther away.

4.3 Summary of Results

Several summarizing statements can be made about the above results. First, the general explanatory power of the office models is consistent with models developed by other researchers. Based on the adjusted R-squared values, the models explained roughly 33% to 60% of the variation in office rents. Previous researchers have developed models explaining 40% to 66% of the variation in office rents (Clapp, 1980; Hough and Kratz, 1983; and Cannaday and Kang, 1984). Second, although some of the findings are contrary to expectations, especially with respect to the access variables, interpretations based on the particular environment of each market area provide helpful explanations.

Tables 4.7a, 4.8a and 4.9a summarize the results, across market areas, for the distance variables, the building characteristic variables, and the year dummy variables respectively (neighborhood characteristics are not summarized because submarkets are different for each market area). Tables 4.7b, 4.8b and 4.9b summarize the results, across market areas, for the group of models where the Station variable is modeled as a dummy variable. Presenting the results in this manner illuminates potential patterns across market areas in the sign and significance of the access, building characteristics and year dummy variables. This summary also allows us to compare the results of modeling distance to the nearest transit station as a continuous variable and a dummy variable.

Table 4.7a shows that for all three market areas, distance to the freeway system is a significant predictor of office rents and has the expected inverse relationship. This finding indicates that in all three market areas, office properties with more direct access to the freeway system command higher rents than office properties farther away. This is an intuitive result given the dominance of auto travel. As reviewed in Chapter 2, however, some researchers maintain that transportation facilities are losing their importance in shaping rental patterns and land use, as a result of the wide availability of freeway access. The results of this study do not support this idea. This study finds that access to freeways is still a prominent factor in determining office rents. When the Station variable is modeled as a dummy variable, Freeway significance changes only in the East County market area.

As indicated in Table 4.7a, proximity to transit stations is not valued by office firms in the East County and Central City markets areas. In these market areas, office firms actually pay to locate away from transit stations, which is indicated by the positive sign on the Station coefficients. Interpretation of these results was previously discussed in this chapter. In sum, this result can be explained by the fact that most of the San Diego light rail system is located in distressed corridor areas that have been freight rail right-of-ways for several decades. Office oriented firms do not value access to these locations. We would expect possibly that industrial firms, or firms that depend on freight shipping, would value such station areas. We find this to be the case in the South Bay market area where there are dense clusters of industrial firms. There are no dense clusters of industrial activity in the East County or Central City market areas, and likewise, no firms in these areas value access to the light rail transit station areas. The Station results change slightly when the distance to a transit station is modeled as a dummy variable. In Table 4.7b, the results now show that firms in the Central City market area pay premiums to be within a quarter mile of a light rail station.

In terms of the San Diego central business district, only office firms in the Central City market area value proximity to this subcenter (Table 4.7a). When the Station variable is modeled as a dummy variable, the result changes, indicating that no office firms value proximity to the CBD.

Table 4.7a
Office Property Measures of Access
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Freeway	(-)	(-)*	(-)*
Station	NS	(+)*	(+)*
CBD	NS	NS	(-)*

* Sign and significance of coefficient depends on choice of specification.

Table 4.7b
Office Property Measures of Access
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Freeway	(-)	NS*	(-)*
1/4 Mile Station Dummy	NS*	(NS)*	(-)
CBD	NS	NS	(-)*

* Sign and significance of coefficient depends on choice of specification.

The following two tables (Table 4.8a and Table 4.8b) summarize the relationships between the building characteristic variables and rents for office firms. Table 4.8a corresponds to the group of models where the Station variable is modeled as a continuous variable. Table 4.8b reflects regression results when the Station variable is modeled as a dummy variable, and vacancy rates are dropped from the regression. In Table 4.8a, three of the building characteristic variables show a consistent relationship across market areas: the number of stories is positively related to office rents in all three market areas, the age of a property is negatively related to office rents in all three market areas, and finally, the vacancy rate is not a significant predictor of office rents in each of the three market areas. These results are consistent with those reported in Table 4.8b.

In Table 4.8a, the relationship between office rents and the leaseable area of an office property is not consistent across the three market areas: in both the East County and Central City market areas, leaseable area is positively related to office rents, while in the South Bay market area, leaseable area is not a significant predictor of rents. Again, these results are consistent with those seen in Table 4.8b. The role of the lease agreement in determining office rents is not consistent across the three market areas: in the East County and Central City market areas, properties with partial service lease agreements have significantly lower rents than properties with full service lease agreements, while in the South Bay market area, there is no significant difference in rents for properties with partial service or full service lease agreements. The results for lease agreement type are affected by the change in Station variable and by dropping vacancy rates from the regression. In Table 4.8b, we see in the South Bay market area that properties with partial service lease agreements rent for a significantly higher price than properties with full service lease agreements. In the East County market area, there is no significant difference in rents for properties with partial service or full service lease agreements. And in the Central City market area, properties with partial service lease agreements rent for significantly less than properties with full service lease agreements, as is expected.

Table 4.8a
Office Property Building Characteristics
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Stories	(+)	(+)*	(+)
Area	NS	(+)	(+)
Age	(-)	(-)	(-)
Vacancy	NS	NS	NS*
Partial Service (in comparison to Full Service)	NS	NS	(-)

* Sign and significance of coefficient depends on choice of specification.

Table 4.8b
Office Property Building Characteristics
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Stories	(+)	(+)*	(+)
Area	NS	(+)	(+)
Age	(-)	(-)	(-)
Partial Service (in comparison to Full Service)	(+)*	NS	(-)

* Sign and significance of coefficient depends on choice of specification.

Table 4.9 shows the coefficients for the year dummy variables for each of the three market areas. The year dummies provide a measure of the change in rents that occurs when all other factor are held constant except for the progression of time. The year dummies allows us to measure conditions unrelated to the property itself or to the location of the property, such as effects of the local economy and local real estate markets. Each coefficient is interpreted relative to the omitted condition which is 1986 rents. For the year dummy variables, only the first group of models (where Station variable is continuous) is reported. Comparison between the two groups of models is not necessary since the coefficients were very similar.

The trends in office rent changes for each of the three markets is fairly similar over the study period. The trends in East County and Central City are more similar than that seen in the South Bay market area. This may be related to the fact that these two market areas are more similar in terms of land use types, both having mainly office oriented land uses, while the South Bay market area has a predominance of industrial land uses. The differing economic cycle in the South Bay market area may be related to the type of firm located there which is typically heavy industry and manufacturing. It has been shown that downward turns in these industries usually follow downward turns in service-oriented industries such as those found in the Central City and East County market areas. This finding therefore is consistent with expected behavior of local economies, given the differences in industries located in the respective market areas.

Office properties in the East County and Central City market areas both show an increasing trend in rent from 1987 to 1989. There is a peak in office rents in both market areas in 1989, and then rents decline until 1994 in the Central City market area and decline until 1995 in the East County market area. For the South Bay market area, rents increase, then decrease, then peak in 1991. After 1991, South Bay office rents continue to decline relative to 1986 rents until 1994.

Table 4.9
Office Property Year Dummy Coefficients*
(% change in rents from previous year)

	South Bay	East County	Central City
1986 (omitted condition)			
1987	.048 (4.8%)	.092 (9.2%)	.025 (2.5%)
1988	**.165 (11.7%)**	**.185 (9.3%)**	**.067 (4.2%)**
1989	**.142 (-2.3%)**	**.202 (1.7%)**	**.114 (4.7%)**
1990		**.173 (-2.9%)**	**.080 (-3.4%)**
1991	**.193 (5.1%)**	**.166 (-.7%)**	.053 (-2.7%)
1992	**.143 (-5.0%)**	**.147 (-1.9%)**	-.009 (-5.4%)
1993	**.124 (-1.9%)**	**.138 (-.9%)**	-.037 (-3.6%)
1994	.046 (-7.8%)	.108 (-3.0%)	**-.086 (-4.9)**
1995		.104 (-.4%)	-.038 (4.8%)

* Bold indicates coefficient significant above the 95% level.

Chapter Five
Industrial Rents

This chapter summarizes the industrial data and presents the results of regression analyses. In Section 5.1, data summaries are provided by market area. In Section 5.2, regression results are presented by market area. For each market area, three model specifications are analyzed: linear, semi-log and double-log. Results from the specification showing the best fit are discussed. Refined models are also included in Section 5.2. The purpose of the model refinement subsections is to examine variations in modeling distance of a property to the nearest transit station. Initially, this variable is defined as a continuous variable where distance to the nearest transit station is measured in miles. In the model refinement subsection, distance to the nearest light rail station is modeled as a dummy variable, distinguishing between those properties within a quarter mile of a station and those beyond a quarter mile.

5.1 Summary of the Industrial Data

5.1.1 The South Bay Market Area

There are one hundred and fifty-three industrial properties in the South Bay data, with a total of 487 observations over a nine year period from 1986 to 1994. Data from 1990 and 1995 were not available from TURI at the time of data collection. Figure 5.1 shows the location of the South Bay market area industrial datapoints

Industrial properties are located ranging from 0.02 miles to 6.35 miles from the closest transit station. These same properties are located from within 0.04 miles to 4.96 miles from the nearest freeway on/off ramp. Table 5.1 shows descriptive information for the continuous variables included in the rent models.

Table 5.1
South Bay Market Area
Industrial Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.25	1.15	0.51	0.12
Freeway (miles)	0.04	4.96	1.41	1.73
Station (miles)	0.02	6.35	1.88	1.89
CBD (miles)	4.18	17.57	10.89	4.34
Stories (number)	1	11	1.09	0.51
Area (sq.ft.)	2,400	322,000	72,870	77,630
Age (years)	4.0	52.0	12.65	7.22
Vacancy (sq.ft.)	0	283,100	18,349	35,856
Median HH Income ($)	14,066	54,437	24,170	7,624

The South Bay industrial properties are located ranging from 4.18 miles to 17.57 miles from the San Diego central business district. The 1990 median household income of census tracts where properties are located is $24,170 (sd=$7,624) which is lower than the overall South Suburban median household income of $31,641. Forty-one percent of the industrial properties are located in San Ysidro, thirty-nine percent in Chula Vista, twenty percent in National City and less than one percent in Imperial Beach.

Rentable square footage of the industrial buildings in the South Bay data range from 2,400 square feet to 322,000 square feet, with a mean rentable area of 72,870 square feet (sd=77,630). The majority of industrial properties in the South Bay market area are single story (93%). Building age ranges from four years to fifty-two years, with a mean age of 12.7 years (sd=7.22). The majority of industrial building tenants have a partial service lease agreement (63%). Twenty-seven percent of the industrial properties in the South Bay market area have full service lease agreements.

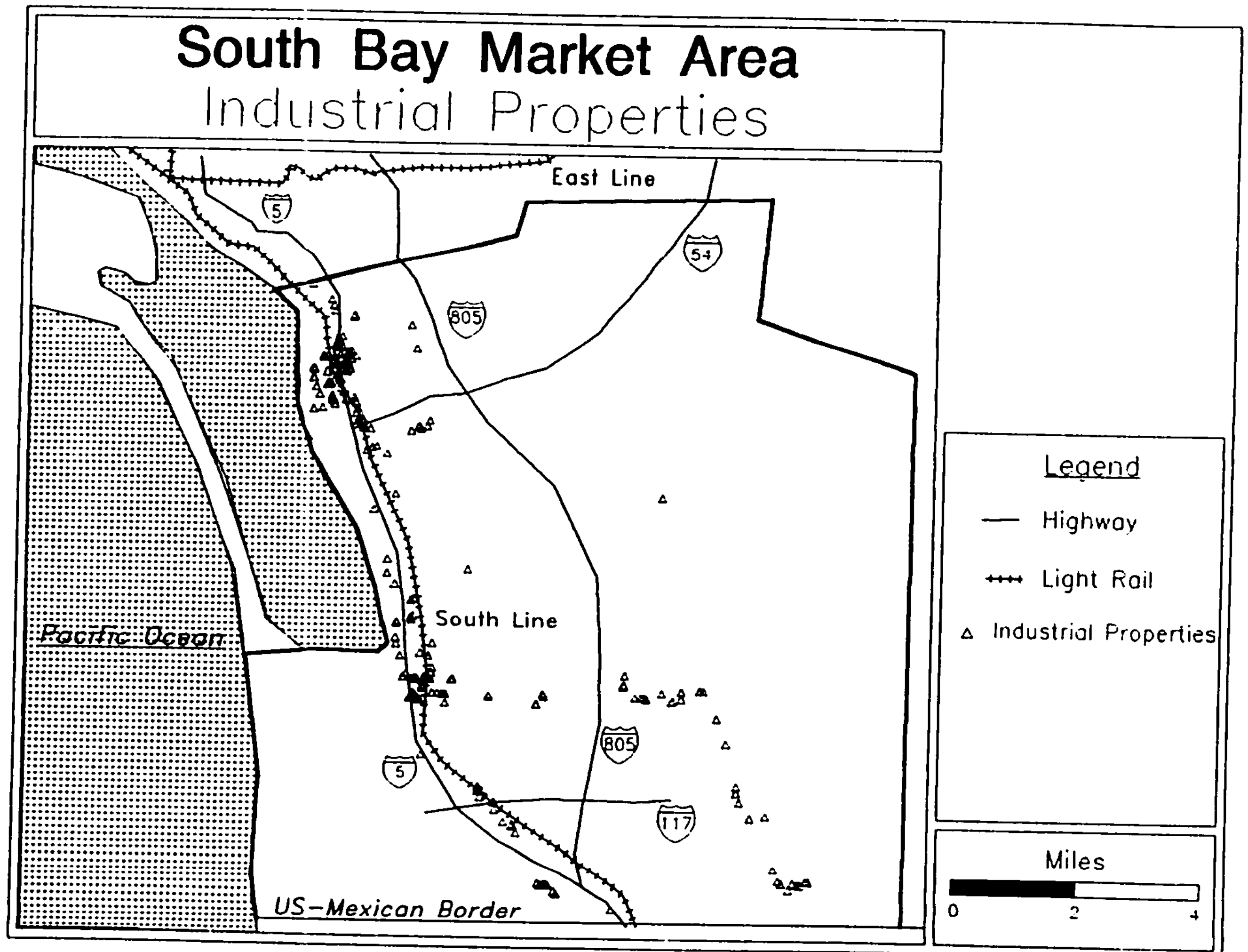

Figure 5.1: South Bay Market Area: Industrial Properties

5.1.2 The East County Market Area

There are one hundred and fifty-nine industrial properties in the East County data, with a total of 534 observations over a ten year period from 1986 to 1995. Figure 5.2 shows the location of the East County market area industrial datapoints

Industrial properties are located ranging from 0.12 miles to 6.36 miles from the closest transit station. These same properties are located from within 0.02 miles to 6.98 miles from the nearest freeway on/off ramp. Table 5.2 shows descriptive information for the continuous variables included in the East County industrial rent models.

Table 5.2
East County Market Area
Industrial Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.25	1.2	0.5	0.1
Freeway (miles)	0.02	6.98	0.75	0.97
Station (miles)	0.12	6.36	1.06	1.10
CBD (miles)	0.30	19.02	12.55	2.83
Stories (number)	1	2	1.03	0.17
Area (sq.ft.)	1,000	151,100	29,555	23,187
Age (years)	1.0	34.0	10.9	5.81
Vacancy (sq.ft.)	0	95,467	5620	8490
Median HH Income ($)	10,949	45,278	27,548	7225

The East County industrial properties are located ranging from 0.30 miles to 19.05 miles from the San Diego central business district. The 1990 median household income of census tracts where properties are located is $27,548 (sd=$7,225) which is lower than the overall East Suburban MSA median household income of $35,878. Fifty percent of the industrial properties are located in El Cajon. Approximately 30.7% of the industrial properties are located in Santee, 7.5% are located in Lemon Grove, 6.8% are in La Mesa,

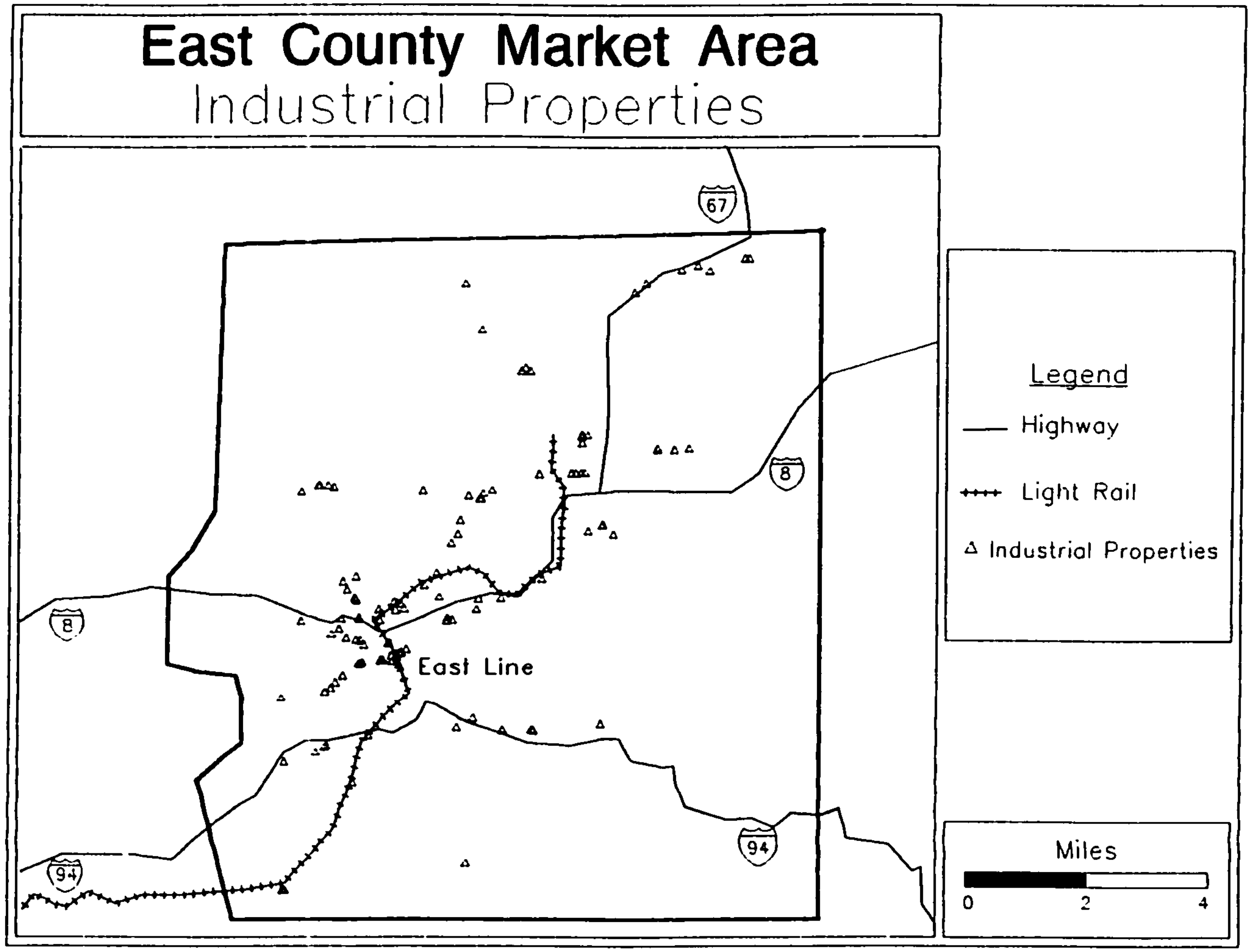

Figure 5.2: East County Market Area: Industrial Properties

and 5.2% are in Lakeside.

Rentable square footage of the industrial buildings in the East County data range from 1000 square feet to 151,100 square feet, with a mean rentable area of 29,555 square feet (sd=23,187). The majority of industrial properties in the East County market area have a single story (97%). Building age ranges from one year to thirty-four years, with a mean age of 10.9 years (sd=5.8). The majority of office building tenants have a partial service lease agreement (99.5%).

5.1.3 The Central City Market Area

There are one hundred and ninety-five industrial properties in the Central City data, with a total of 646 observations over a ten year period from 1986 to 1995. Figure 5.3 shows the location of the Central City market area industrial datapoints.

Industrial properties are located ranging from 0.01 miles to 7.99 miles from the closest transit station. These same properties are located from within 0.06 miles to 7.32 miles from the nearest freeway on/off ramp. Table 5.3 shows descriptive information for the continuous variables included in the Central City industrial rent models. The Central City industrial properties are located ranging from 0.29 miles to 10.06 miles from the San Diego central business district. The 1990 median household income of census tracts where properties are located is $17,507 (sd=$5,745) which is lower than the overall Central MSA median household income of $26,448. Forty-two percent of the Central

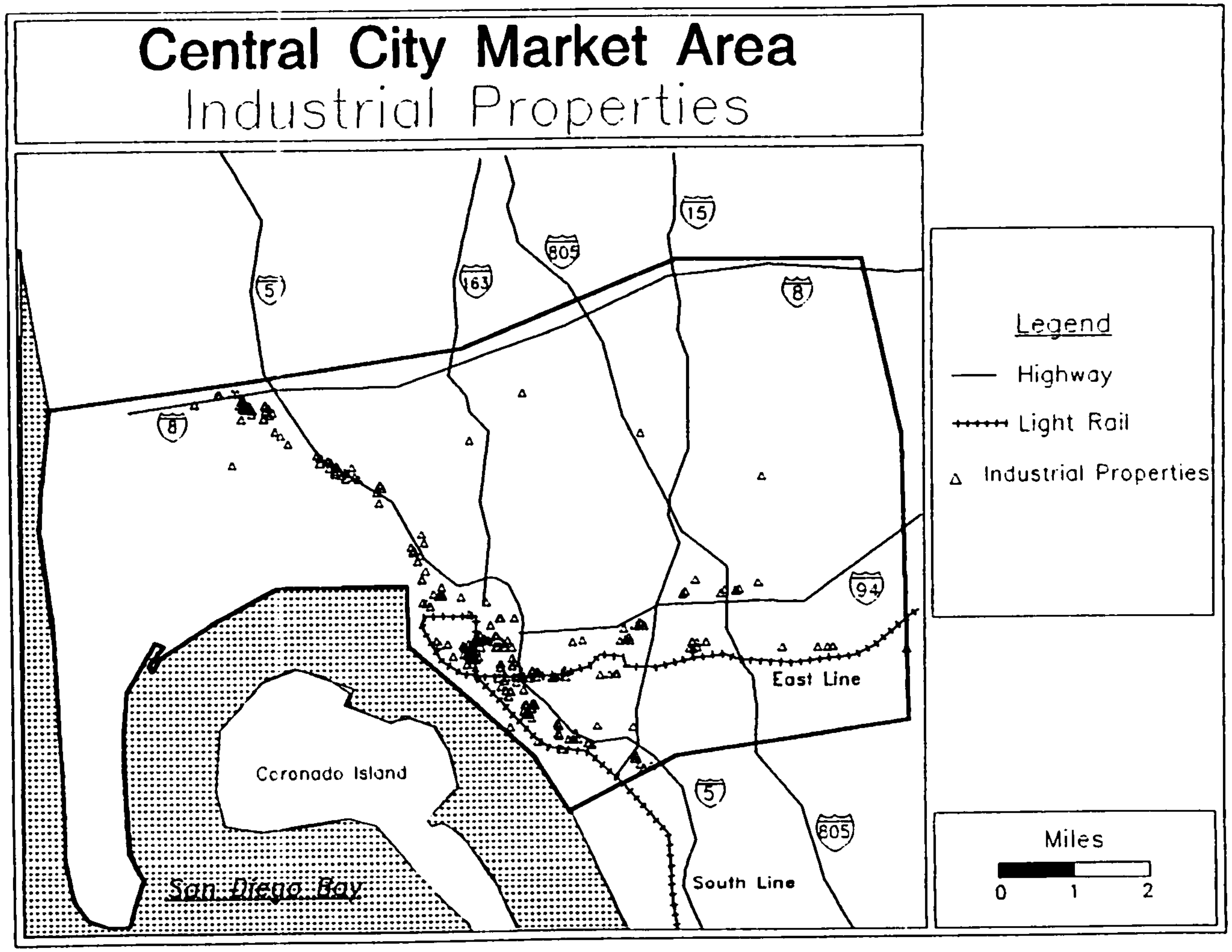

Figure 5.3: Central City Market Area: Industrial Properties

Table 5.3
Central City Market Area
Industrial Data Descriptives

Variable	Minimum	Maximum	Mean	Standard Deviation
Rent ($/sq.ft./month)	0.2	3.00	0.55	0.23
Freeway (miles)	0.06	7.32	1.01	1.73
Station (miles)	0.01	7.99	1.70	2.12
CBD (miles)	0.29	10.06	2.92	2.64
Stories (number)	1.00	5.00	1.2	0.45
Area (sq.ft.)	1000	185,000	23,631	26,626
Age (years)	1.0	83.0	25.5	16.27
Vacancy (sq.ft.)	0	78,000	7,752	10,443
Median HH Income ($)	10,580	37,743	17,507	5,745

City industrial properties are located in the Downtown submarket. Approximately thirty-one percent of the industrial properties are located in the South City submarket, 22.3% are located in Old Town, 3.2% are located in East City and only nine properties (1.5%) are located in the Uptown submarket.

Rentable square footage of the industrial buildings in the Central City data range from 1,000 square feet to 185,000 square feet, with a mean rentable area of 23,631 square feet (sd=26,626). The majority of industrial properties in the Central City market area have a single story (82%). Roughly eighteen percent have two stories. Building age ranges from one year to eighty-three years, with a mean age of 25.5 years (sd=16.3). The majority of industrial building tenants have a partial service lease agreement (93.8%). Approximately sixteen percent of the Central City industrial properties have full service lease agreements.

5.2 Results of the Industrial Rent Models

This section presents the results of two groups of regressions. The primary distinguishing factor between the two groups of models involves differences in the Station variable. Other refinements are also made to the models which mainly involve omitting variables that were consistently insignificant in the first group of models

5.2.1 The South Bay Market Area

Table 5.4a shows three models of industrial rents. Model 1a estimates industrial rents using all linear variables, Model 2a is a semi-log model using the logarithm of each access variable and the rent variable, and Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. It is hypothesized that the distance variables follow an exponential functional form because, as distance from the regional transportation system increases, its effect on rents should diminish. The explanatory power associated with the three specifications do not vary greatly. Based on the adjusted R-squared value and the F-test value, none of the models provides a dramatically better fit than the others. In terms of the Station and CBD variables, however, the choice of specification does affect the results. In the following paragraphs, results from the double-log model, Model 3a adjusted R-squared = 0.400; F = 14.349) are reported.

Building Characteristics

Three of the building characteristic variables are significant in the South Bay industrial rent model. Leaseable area is significant and suggests that larger industrial spaces rent for a premium. As mentioned in the previous chapter, the sign on the office Area coefficient is undetermined. The industrial rent literature, however, points more consistently to a negative relationship between the area of an industrial property and its rent. Schmenner (1981) finds a negative relationship between rents and area, which he attributes to a quantity discount. Sivitanidou and Sivitanides (1995) find a similarly negative relationship between rents and square footage of an industrial property.

The age of an industrial building is also significant with the expected sign, older buildings rent for a discount. As expected, higher vacancy rates are associated with lower rents. This result is different than the South Bay office rent models. In each of the three

South Bay office rent models, vacancies were not significant. For industrial properties, vacancies are significant with the expected sign. This is an unexplained difference between industrial and office properties, and may be linked to differences in the real estate markets for these two property types.

Partial service lease agreements play a significant role in determining industrial rents in the South Bay market area, however the sign of the coefficient is unexpected. The partial service lease agreement dummy variable should have a negative sign to reflect the fact that properties with partial service lease agreements rent at lower rates than properties with full service lease agreements.

Access Variables

The Freeway variable coefficient is not significant for industrial rents in the South Bay area. This is not consistent with the Freeway result for South Bay office rents. This finding may be related to the fact that the South Bay industrial areas predate freeway construction and are largely oriented toward the nearby port and freight-shipping facilities (which coincide with the South Line right-of-way). The fact that distance to the nearest transit station is significant with the expected sign lends support to this explanation. The rail corridor has most likely been a crucial transportation facility for the industrial businesses in this area for many years. Also, as previously mentioned, not only does this corridor provide freight shipping, it also provides quick access to a large pool of low-wage workers from Mexico. The transit station coefficient in Model 3a shows that a one percent increase in the distance of an industrial property from a transit station (in miles) corresponds to a 4.3% increase in industrial rents.

For Model 3a, distance to the CBD is not a significant predictor of South Bay industrial rents. This result depends on the choice of specification, however. For the semi-log specification, distance to the CBD is significant with the expected negative sign on the coefficient.

Table 5.4a: South Bay Industrial Rents
(dependent variable: asking rent $/sf)

Independent Variables		Model 1a Linear	Model 2a Semi-Log	Model 3a Double-Log
		Coefficients (t-statistics)		
	Constant	.613 (13.194)	-.340 (-2.223)	.948 (2.017)
Building Characteristics	# of Stories	.009 (.970)	.009 (.572)	.033 (.778)
	Leaseable Area	8.17×10^{-08} (1.101)	2.04 (1.516)	.028*** (2.717)
	Age of Property	-.005*** (-6.514)	-.012*** (-8.213)	-.161*** (-6.817)
	Vacancy Rate	-5.78×10^{-07}*** (-3.705)	-1.14×10^{-06}*** (-4.029)	-.057*** (-5.731)
Measures of Access	Freeway	.001 (.096)	.009 (.721)	.005 (.348)
	Station	.005 (.499)	-.012 (-.836)	-.043** (-2.583)
	CBD	-.006 (-1.536)	-.117* (-1.874)	-.036 (-.489)
Neighborhood Characteristics	Chula Vista			
	National City	-.025 (-1.257)	-.066 (-1.565)	-.074 (-1.478)
	Imperial Beach	.020 (.328)	.067 (.623)	-.078 (-.438)
	San Ysidro	.017 (.901)	.042 (1.372)	.019 (.550)
	Median HH Income	-3.16×10^{-06}*** (-3.578)	-5.26×10^{-06}*** (-3.846)	-.114*** (-2.618)
Lease Agreement	Full Service			
	Partial Service	.058*** (5.920)	.131*** (7.346)	.132*** (6.498)
Year Dummy	1986			
	1987	-.012 (-.495)	-.018 (-.413)	.011 (.215)
	1988	.065** (2.432)	.136*** (2.780)	.181*** (3.247)
	1989	.079*** (3.168)	.163*** (3.663)	.231*** (4.051)
	1991	.096*** (4.631)	.183*** (4.919)	.215*** (4.827)
	1992	.043** (2.080)	.095** (2.558)	.112** (2.528)

Table 5.4a (continued): South Bay Industrial Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
Year Dummy (continued)	1993	.021 (1.014)	.050 (1.326)	.080* (1.752)
	1994	.021 (.997)	.044 (1.151)	.079* (1.750)
N=		487	487	362
Adj. R Sq.		0.282	0.337	.400
F		11.443	14.518	14.349

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

Neighborhood Characteristics

Median household income is a significant predictor of industrial rents in each of the three South Bay industrial models. Industrial rents are lower in census tracts with higher income households. This finding indicates that high quality residential neighborhoods are a disamenity for industrial firms. Perhaps restrictions are placed on industrial firms located in higher quality neighborhoods, which may increase the cost of conducting business. The submarket dummy variables show that industrial rents in the National City, Imperial Beach, and San Ysidro are not significantly different than industrial rents in Chula Vista. This finding suggests that industrial rents in the South Bay region are generally similar across jurisdictions.

Economic Trend

Based on Model 3a, rents over the years 1986 to 1994 follow the expected trend. Industrial rents peak in 1989 when they are approximately 23.1% greater than rents in 1986. After 1989, industrial rents begin to decrease but are still significantly higher than 1986 rents. By 1994, industrial rents are only 7.9% higher than 1986. This trend reflects a strengthening real estate market in the late 1980's followed by a declining real estate market in the early to mid 1990's.

South Bay Industrial Rent Model Refinement

Two modifications are made to the South Bay industrial regressions: changing the Station variable from a continuous to a dummy variable, and dropping the number of stories from the analysis. The number of stories was dropped from this regression since there is almost no variation in this variable. All industrial properties in the South Bay market area are in either single or double storied buildings. The regression results change somewhat as a result of the refinements (Table 5.4b). The relationship between industrial rents and distance to the nearest freeway on/off ramp, and distance to the CBD remain similar between the two groups of models. For the Station variable, however, the results change noticeably. In the first group of models, when distance to the transit system is modeled as a continuous variable, only one of three specifications (the double-log) shows a significant relationship with the expected sign on the coefficient. When distance to the transit system is modeled as a dummy variable, each of the three specifications shows a significant relationship between rents and transit access, with the expected sign on the coefficients: properties within a quarter mile of a transit station have higher rents than properties beyond a quarter mile. This consistency between the two groups of models strongly confirms the relationship between transit stations in the South Bay market area and industrial rents.

Results for the CBD variable are the same for the first and second groups of models. The significance of distance to the CDB depends on the choice of model specification:

Table 5.4b: South Bay Industrial Rents
(dependent variable: asking rent $/sf)

Independent Variables		Model 1b Linear	Model 2b Semi-Log	Model 3b Double-Log
		Coefficients (t-statistics)		
	Constant	.608	-.305	1.337
		(14.513)	(-2.088)	(3.018)
Building Characteristics	Leaseable Area	7.845×10^{-08}	2.097×10^{-07}	.031***
		(1.076)	(1.586)	(3.055)
	Age of Property	-.005***	-.012***	-.160***
		(-6.772)	(-8.399)	(-6.752)
	Vacancy Rate	-5.554×10^{-07}***	1.125×10^{-06}***	-.058***
		(-3.569)	(-3.988)	(-5.784)
Measures of Access	Freeway	.006	.004	-.017
		(1.093)	(.377)	(-1.449)
	Station	.035*	.058*	.069*
		(1.901)	(1.755)	(1.845)
	CBD	-.005	-.125**	-.085
		(-1.346)	(-2.077)	(-1.236)
Neighborhood Characteristics	Chula Vista			
	National City	-.020	-.072*	-.108**
		(-1.075)	(-1.780)	(-2.304)
	Imperial Beach	.021	-.072	-.038
		(.343)	(-.679)	(-.214)
	San Ysidro	.061***	.042	.038
		(6.166)	(1.371)	(1.135)
	Median HH Income	-2.893×10^{-06}***	-5.568×10^{-06}***	-.146***
		(-3.986)	(-4.277)	(-3.438)
Lease Agreement	Full Service			
	Partial Service	.061***	.132***	.130***
		(6.166)	(7.487)	(6.377)
Year Dummy	1986			
	1987	-.012	-.016	.013
		(-.416)	(-.351)	(.250)
	1988	.066**	.135***	.175***
		(2.440)	(2.784)	(3.127)
	1989	.079***	.163***	.227***
		(3.188)	(3.666)	(3.954)
	1991	.096***	.181***	.206***
		(4.660)	(4.901)	(4.617)
	1992	.043**	.093**	.102**
		(2.088)	(2.518)	(2.295)

Table 5.4b (continued): South Bay Industrial Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy (continued)	1993	.022 (1.054)	.049 (1.296)	.071* (1.551)
	1994	.022 (1.052)	.045 (1.163)	.075* (1.664)
N=		488	488	363
Adj. R Sq.		0.287	0.341	.394
F		12.299	15.528	14.786

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

CBD is not significant in the double-log model, but is significant with the expected sign in the semi-log model.

5.2.2 The East County Market Area

Table 5.5a shows three models of industrial rents in the East County market area. Model 1a estimates office rents using all linear variables, Model 2a is a semi-log model using the logarithm of each access variable and the rent variable, and Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. The double-log model, Model 3a (Adjusted R-squared = 0.274; F = 7.586) shows a slightly better fit based on the adjusted R-squared value and the F-test value. The following paragraphs report results from Model 3a.

Building Characteristics

Three of the building characteristic variables are significant in the East County model of industrial rents. The leaseable area, the age, and the vacancy rate of industrial properties are significant. The signs of all three coefficients are as expected: larger properties rent for a discount, older properties rent for a discount, and properties with higher vacancy rates are associated with lower rents. The number of stories is not significant in the East County industrial rent model. In terms of lease agreements, partial service lease agreements are not significantly different than full service lease agreements. This is an unexpected result, and may indicate that for industrial properties in the East County market area, services included in the full service lease agreement are not particularly costly.

Access Variables

None of the access variables is significant in the double-log model of industrial rents for the East County market area. In all three models of industrial rents, the only significant access variables are distance to the nearest freeway on/off ramp (Freeway) and distance to the San Diego CBD in the semi-log model. The coefficients have the unexpected signs, however, indicating that industrial properties further from freeway on/off ramps command higher rents, and likewise, properties further from the San Diego CBD command higher rents. The lack of importance of transportation access in the East County market area for both office and industrial properties may be a reflection of the fact that businesses in this area are locally oriented, both in terms of inputs to production (transportation for employees and supplies) and outputs (transporting goods to their markets). This explanation is supported by the fact that no significant concentrations of either office nor industrial firms exist in this market area. If there were significant concentrations of business activity, connections to non-local markets (for inputs and

Table 5.5a: East County Industrial Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
	Constant	.619 (6.810)	-.886 (-5.060)	1.165 (2.130)
Building Characteristics	# of Stories	.073*** (2.866)	.127*** (2.752)	-.120 (-1.455)
	Leaseable Area	-1.88×10^{-07} (-.931)	-3.85×10^{-07} (-1.083)	-.032*** (-2.897)
	Age of Property	-.001 (-1.462)	-.003 (-1.536)	-.060*** (-4.003)
	Vacancy Rate	-1.97×10^{-06}*** (-3.891)	-3.71×10^{-06}*** (-4.032)	-.079*** (-8.125)
Measures of Access	Freeway	-3.13×10^{-04} (-.031)	.024** (2.095)	.009 (.666)
	Station	.002 (.382)	.005 (.372)	.023 (1.307)
	CBD	.002 (.383)	.038* (1.700)	.036 (1.285)
Neighborhood Characteristics	El Cajon			
	La Mesa	.115*** (4.385)	.208*** (5.370)	.159*** (3.425)
	Lakeside	.050** (2.166)	.106** (2.575)	.005 (.108)
	Lemon Grove	.073*** (2.638)	.132*** (4.022)	.067* (1.716)
	Santee	.029*** (2.668)	.064*** (3.273)	.049** (2.170)
	Median HH Income	-1.07×10^{-06} (-1.285)	-1.08×10^{-06} (-.713)	-.076 (-1.373)
Type of Lease Agreement	Full Service			
	Partial Service	-.194*** (-3.421)	-.214** (-2.082)	-.128 (-1.315)
Year Dummy	1986			
	1987	.005 (.147)	.007 (.127)	.050 (.729)
	1988	.009 (.296)	.010 (.195)	.029 (.471)
	1989	.019 (.657)	.035 (.652)	.034 (.533)
	1990	.054 (1.553)	.084 (1.578)	.093 (1.536)
	1991	.026 (.901)	.048 (.918)	.080 (1.311)
	1992	.014 (.490)	.418 (.022)	.061 (.995)

Table 5.5a (continued): East County Industrial Rents
(dependent variable: asking rent $/sf)

Independent Variables		Coefficients (t-statistics) Model 1a Linear	Model 2a Semi-Log	Model 3a Double-Log
Year Dummy (continued)	1993	-.008 (-.281)	-.021 (-.390)	.023 (.364)
	1994	-.007 (-.228)	-.268 (-.014)	.023 (.368)
	1995	.031 (1.031)	.050 (.916)	.072 (1.142)
N=		534	534	361
Adj. R Sq.		0.151	0.143	.274
F		5.494	5.203	7.586

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

outputs) may be more important, and lead to rent premiums for locations with higher transportation access. In the Central City and South Bay market areas, both of which have high concentrations of business activity, we see more value placed on access to regional transportation facilities

Neighborhood Characteristics

Median household income is not a significant predictor of industrial rents in the East County market area. The submarket dummy variables show that industrial rents in La Mesa, Lemon Grove and Santee are significantly higher than those in El Cajon. Rents in La Mesa are approximately 16% higher than rents in El Cajon regardless of building characteristics, access levels, or lease agreement type. Similarly, rents in Lemon Grove are approximately 6.7% higher than in El Cajon, while rents in Santee are approximately 5% higher than El Cajon industrial rents. Rents in Lakeside are not significantly different than El Cajon rents properties are significant.

Economic Trend

Based on Model 3a, rents over the years 1986 to 1995 follow the expected trend. Industrial rents in the East County market area peak in 1990 when they are approximately 9.3% greater than 1986 rents. After 1990, rents decline until 1994 when they are only 2.3% greater than 1986 rents. In 1995, rents begin to rise again, increasing to 7.2% over 1986 rents. This trend reflects the general state of the local economy reviewed in Chapter 3. Rents are steadily increasing in the late 1980's and then fall in the early 1990's indicating a decline in the real estate markets and weakening general economy. This trend is similar to that observed in the industrial rent model for the South Bay market area.

East County Industrial Rent Model Refinement

In the East County market area, the only difference in regression results between the two groups of models is seen with the Age variable. For the linear and semi-log specifications, property age becomes significant with the expected sign on the coefficient. When distance to the transit system is modeled as a continuous variable and the number of stories is included in the analysis, property age is insignificant for the linear and semi-log specifications. Another minor difference between the two groups of models occurs with the Freeway variable in the semi-log model. The Freeway variable becomes insignificant in the semi-log specification when distance to the transit system is modeled as a dummy variable.

Table 5.5b: East County Industrial Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
	Constant	.699 (8.423)	-.549 (-4.320)	.995 (1.909)
Building Characteristics	Leaseable Area	$-2.533x10^{-07}$ (-1.290)	$-5.218x10^{-07}$ (-1.462)	-.032*** (-2.810)
	Age of Property	-.002* (-1.990)	-.004** (-2.194)	-.056*** (-3.825)
	Vacancy Rate	$-2.07x10^{-06}$*** (-4.067)	$-3.874x10^{-06}$*** (-4.185)	-.078*** (-7.980)
Measures of Access	Freeway	-.002 (-.216)	.019 (1.557)	.011 (.735)
	Station	.005 (.592)	-.002 (-.091)	-.018 (-.807)
	CBD	$3.95x10^{-04}$ (.101)	.031 (1.563)	.022 (.917)
Neighborhood Characteristics	El Cajon			
	La Mesa	.102*** (3.730)	.192*** (4.916)	.154*** (3.343)
	Lakeside	.051** (2.301)	.101*** (2.621)	.038 (.855)
	Lemon Grove	.065** (2.471)	.120*** (3.689)	.078* (2.049)
	Santee	.024** (2.230)	.057*** (2.856)	.056** (2.440)
	Avg. HH Income	$-6.581x10^{-07}$ (-.825)	$-8.2262x10^{-07}$ (-.583)	-.058 (-1.137)
Type of Lease Agreement	Full Service			
	Partial Service	-.189*** (-3.308)	-.202** (-1.943)	-.132 (-1.342)
Year Dummy	1986			
	1987	.006 (.190)	.008 (.140)	.050 (.723)
	1988	.011 (.369)	.013 (.245)	.028 (.445)
	1989	.022 (.734)	.038 (.714)	.034 (.516)
	1990	.049* (1.675)	.090* (1.695)	.090 (1.468)
	1991	.031 (1.074)	.057 (1.080)	.075 (1.233)
	1992	.020 (.701)	.032 (.613)	.054 (.881)

Table 5.5b (continued): East County Industrial Rents
(dependent variable: asking rent $/sf)

		Coefficients (t-statistics)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy (continued)	1993	-.001 (-.034)	-.008 (-.152)	.017 (.279)
	1994	.001 (.044)	-2.271×10^{-07} (.000)	.017 (.274)
	1995	.037 (1.224)	.060 (1.102)	.068 (1.075)
N=		535	535	362
Adj. R Sq.		0.139	0.131	.271
F		5.287	5.020	7.778

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

5.2.3 The Central City Market Area

Table 5.6a shows three models of industrial rents for the Central City market area. Model 1a estimates industrial rents using linear variables, Model 2a is a semi-log model using the logarithm of the rent variable and the access variables, and Model 3a is a double-log model using the logarithm of all variables except for the dummy variables. Model 3a provides a slightly better fit (adjusted R-squared = 0.354; F = 12.578) relative to the other specifications. The results from Model 3a are reported in the following paragraphs.

Building Characteristics

All of the building characteristics are significant in modeling industrial rents in the Central City market area. The number of stories is positively related to rent: higher buildings rent for a premium. Industrial buildings with larger leaseable areas rent for a discount. The age of an industrial property is inversely related to rent, indicating that older properties rent for a discount. Vacancy rates are significant with the expected sign, higher vacancy levels are associated with lower rents. Partial service lease agreements are associated with significantly lower rents in the Central City market area, which is an expected result. Properties with fewer services included in the rent, such as utilities and janitorial, have lower rents.

Access Variables

The coefficients for distance to the nearest transit station (Station) and distance to the nearest on/off ramp (Freeway) are both significant, however the relationships are not as expected. The positive signs indicates that industrial properties closer to the regional transportation systems have lower rents than properties farther away. This result is plausible for the Freeway variable, given the fact that the main industrial concentrations in this area are not near the I-5, rather they are focused on the port area and the freight rail right-of-way. For the Station variable, however, since the Bayside Line runs in the same corridor as the freight right-of-way, it is surprising that distance to the nearest transit station is not significant.

Neighborhood Characteristics

Median household income is a significant predictor of office rents in the Central City market area, with the expected positive sign. Locations with higher median household incomes are associated with industrial properties that have higher rents. The submarket dummy variables show that industrial rents in East City and Old Town are significantly higher than in Downtown. Industrial rents in East City are approximately 21% higher than rents in Downtown regardless of building characteristics, levels of access, or lease agreement type. Similarly, industrial rents in Old Town are approximately 23%

higher than rents in Downtown. Industrial rents in the South City and Uptown submarkets are not significantly different than Downtown industrial rents.

Economic Trend

Based on Model 3a, rents over the years 1986 to 1995 follow the expected trend. Industrial rents peak in 1990 when they are approximately 27.3% higher than 1986 rents. After 1990, industrial rents begin to decline until 1995 when they are only 4% greater than 1986 rents. Central City industrial rents in the late 1980's are relatively stronger than in the early 1990's. This trend is consistent with that seen in the two other market areas, and reflects a strong economy in the late 1980's followed by a weakening economy in the early 1990's.

Table 5.6a: Central City Industrial Rents
(dependent variable: asking rents, $/sf)

Independent Variables		Model 1a Linear	Model 2a Semi-Log	Model 3a Double-Log
		Coefficients (t-statistic)		
	Constant	.641 (10.401)	-.410 (-4.830)	-.964 (-1.237)
Building Characteristics	# of Stories	-.032* (-1.707)	-.078*** (-2.989)	-.133*** (-2.731)
	Leaseable Area	-8.29×10^{-07}** (-2.355)	-1.66*** (-3.235)	-.058*** (-3.457)
	Age of Property	-.001* (-1.954)	-.003*** (-4.253)	-.082*** (-4.770)
	Vacancy Rate	-2.15×10^{-06}** (-2.528)	-4.23×10^{-06}*** (-3.550)	-.071*** (-4.341)
Measures of Access	Freeway	-.066*** (-3.151)	.019 (1.188)	.034* (1.858)
	Station	.043** (2.361)	.047*** (3.180)	.033** (2.038)
	CBD	.021* (1.706)	-.031 (-1.041)	-.037 (-1.035)
Neighborhood Characteristics	Downtown			
	Uptown	-.089 (-1.064)	-.060 (-.543)	-.032 (-.231)
	Old Town	-.035 (-.722)	.152*** (3.321)	.233*** (4.340)
	South City	-.089*** (-3.912)	-.082** (-2.176)	-.055 (-1.279)
	East City	.070 (1.289)	.266*** (3.648)	.213*** (2.803)
	Median HH Income	2.86×10^{-06} (.999)	4.26 (1.335)	.184** (2.279)
Type of Lease Agreement	Full Service			
	Partial Service	-.175*** (-4.583)	-.162*** (-3.011)	-.153** (-2.468)
Year Dummy	1986			
	1987	.014 (.332)	.0003 (.006)	-.011 (-.167)
	1988	.162*** (3.592)	.191*** (2.994)	.256*** (3.497)
	1989	.132*** (2.821)	.173*** (2.624)	.181** (2.334)
	1990	.137*** (3.018)	.210*** (3.278)	.273*** (3.835)
	1991	.130*** (3.045)	.189*** (3.139)	.194*** (2.846)

Table 5.6a (continued): Central City Industrial Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistic)		
Independent Variables		**Model 1a Linear**	**Model 2a Semi-Log**	**Model 3a Double-Log**
Year Dummy (continued)	1992	.111** (2.558)	.130** (2.105)	.127* (1.852)
	1993	.061 (1.328)	.055 (.851)	.082 (1.125)
	1994	.037 (.804)	.021 (.322)	.044 (.616)
	1995	.022 (.467)	.004 (.057)	.040 (.532)
N=		646	646	442
Adj. R Sq.		0.199	0.277	0.354
F		8.534	12.640	12.578

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

Central City Industrial Rent Model Refinement

As with the other two market areas, changing the Station variable from a continuous to a dummy variable does not change the explanatory power of the regression equations. The only difference occurs with the access variables, in particular the Station and CBD variables. In both cases, however, the changes are minor. The Station variable in the linear and double-log specifications of the refined models becomes insignificant, with the same unexpected sign on the coefficients as in the previous group of models. The CBD variable in the linear specification becomes significant in the refined model, with the same unexpected sign on the coefficient.

Table 5.6b: Central City Industrial Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistic)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
	Constant	.696 (11.083)	-.359 (-4.135)	-.622 (-.814)
Building Characteristics	# of Stories	-.026 (-1.404)	-.073*** (-2.804)	-.124** (-2.564)
	Leaseable Area	$-9.56\text{x}10^{-07}$*** (-2.648)	-1.75*** (-3.442)	-.060*** (-3.538)
	Age of Property	-.001* (-2.100)	-.003*** (-4.375)	-.082*** (-4.767)
	Vacancy Rate	$-2.316\text{x}10^{06}$*** (-2.728)	$-4.078\text{x}10^{06}$*** (-3.397)	-.071*** (-4.250)
Measures of Access	Freeway	-.030** (-2.115)	.036** (2.281)	.045** (2.441)
	Station	-.032 (-1.500)	-.087*** (-2.782)	-.057 (-1.510)
	CBD	.031*** (2.750)	-.004 (-.158)	-.016 (-.484)
Neighborhood Characteristics	Downtown			
	Uptown	-.032 (-.405)	-.017 (-.157)	.001 (.009)
	Old Town	.039 (1.180)	.178*** (4.006)	.253*** (4.853)
	South City	-.094*** (-4.147)	-.101*** (-2.774)	-.067 (-1.625)
	East City	.101* (1.946)	.269*** (3.686)	.215*** (2.824)
	Median HH Income	$2.578\text{x}10^{-08}$ (.010)	$2.02\text{x}10^{-06}$ (.663)	.151* (1.911)
Type of Lease Agreement	Full Service			
	Partial Service	-.183*** (-4.770)	-.173*** (-3.206)	-.159** (-2.576)
Year Dummy	1986			
	1987	.015 (.356)	.005 (.076)	-.012 (-.174)
	1988	.160*** (3.534)	.190*** (2.970)	.252*** (3.439)
	1989	.131*** (2.800)	.173** (2.612)	.177** (2.274)
	1990	.140*** (3.063)	.211*** (3.277)	.269*** (3.771)
	1991	.130*** (3.033)	.191*** (3.153)	.191*** (2.792)

Table 5.6b (continued): Central City Industrial Rents
(dependent variable: asking rents, $/sf)

		Coefficients (t-statistic)		
Independent Variables		**Model 1b Linear**	**Model 2b Semi-Log**	**Model 3b Double-Log**
Year Dummy (continued)	1992	.115*** (2.621)	.133** (2.151)	.127* (1.838)
	1993	.065 (1.409)	.061 (.931)	.081 (1.112)
	1994	.042 (.902)	.023 (.361)	.042 (.586)
	1995	.029 (.597)	.006 (.094)	.040 (.521)
N=		646	646	442
Adj. R Sq.		0.194	0.275	0.352
F		8.340	12.489	12.441

* Significant using 0.05 one-tailed t-test.
** Significant using 0.025 one-tailed t-test.
*** Significant using 0.01 one-tailed t-test.

5.3 Summary of Results

Several summarizing statements can be made about the above results. First, the general explanatory power of the industrial models is consistent with models developed by other researchers. The models explain roughly 27% to 40% of the variation in industrial rents based on the adjusted R-squares. Second, many of the variables in the models are significant with the expected signs on the coefficients.

Tables 5.7a, 5.8a and 5.9a summarize the results across market areas for the access variables, the building characteristic variables, and the year dummy variables respectively (neighborhood characteristics are not summarized because submarkets are different for each market area). Tables 5.7b, 5.8b and 5.9b summarize the results, across market areas, for the group of models where the Station variable is modeled as a dummy variable. Presenting the results in this manner illuminates potential patterns across market areas in the sign and significance of the access, building characteristics, and year dummy variables. This summary also allows us to compare the results of modeling distance to the nearest transit station as a continuous variable and a dummy variable.

Table 5.7a shows that for the South Bay and East County market areas, distance of an industrial property to the freeway system is not a significant predictor of rent. In the Central City market area, the Freeway variable has an unexpected positive relationship to industrial rent, indicating that as distance of a property to the freeway system increases, rents increase, or conversely, as distance decreases, rents decrease. Proximity to transit stations is valued by industrial firms in the South Bay market area, which is revealed by the negative coefficient on the Station variable. In the East County market area, distance to a transit station is not a significant predictor of industrial rents. In terms of the San Diego central business district, industrial firms in each of the three market areas do not value proximity to this subcenter.

Table 5.7a
Industrial Property Measures of Access
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Freeway	NS	NS*	(+)*
Station	(-)*	NS	(+)
CBD	NS*	NS*	NS*

* Sign and significance of coefficient depends on choice of specification.

Table 5.7b summarizes the results of the access variables for the refined models, which include modeling the Station variable as a dummy rather than a continuous variable, and dropping the number of stories from the analysis (except for in the Central City market area where there was variation in the number of stories for industrial properties). The only change in results occurs with the Station variable in the Central City market area. In the first group of models, rents for the Central City market area and distance to the nearest transit station had a positive relationship. In the second group of models, this relationship becomes insignificant.

Table 5.7b
Industrial Property Measures of Access
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Freeway	NS	NS	(+)*
1/4 Mile Station Dummy	(+)	NS	NS*
CBD	NS*	NS	NS*

* Sign and significance of coefficient depends on choice of specification.

Table 5.8a summarizes the relationships between the building characteristic variables and rents for industrial firms. Two of the five building characteristic variables show a consistent relationship across market areas: the age of an industrial property is negatively related to industrial rents in all three market areas, and the vacancy rate for an industrial property is negatively related to industrial rents in all three market areas. The relationship between industrial rents and the number of stories for a particular industrial property is not significant in the South Bay and East County market area, and is negatively related to rents in the Central City market area. The leaseable area of an industrial property is not consistent across the three market areas: in both the East County and Central City market areas, leaseable area is negatively related to industrial rents, while in the South Bay market area, leaseable area is positively related to rents. The role of the lease agreement in determining industrial rents is also not consistent across the three market areas: in the South Bay market area, industrial properties with partial service lease agreements have significantly higher rents than properties with full service lease agreements, while in the East County market area, there is no significant difference in rents for properties with partial or full service lease agreements. In the Central City market area, industrial properties with partial service lease agreements rent at lower rates than properties with full service lease agreements.

Table 5.8a
Industrial Property Building Characteristics
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Stories	NS	NS*	(-)
Area	(+)*	(-)*	(-)
Age	(-)	(-)*	(-)
Vacancy	(-)	(-)	(-)
Partial Service (in comparison to Full Service)	(+)	(NS)*	(-)

* Sign and significance of coefficient depends on choice of specification.

In Table 5.8b, summaries of the building characteristic variables for the refined models are presented. The results are almost entirely consistent with those shown in Table 5.8a, except for two cases. The relationship between industrial rents and the area of a property in the South Bay market area changes from positive to negative. The significance of the lease agreement dummy for the East County data also changes. In the first group of models, partial service lease agreements are associated with properties that have lower rents, while in the second group of models, differences in lease agreements become insignificant. In sum, the results for the industrial building characteristics variables are stable across the two groups of models, as they were for the office properties.

Table 5.8b
Industrial Property Building Characteristics
Sign and Significance (NS=not significant)

	South Bay	East County	Central City
Stories	na	na	(-)*
Area	(+)*	(-)*	(-)
Age	(-)	(-)	(-)
Vacancy	(-)	(-)	(-)
Partial Service (in comparison to Full Service)	(+)	NS*	(-)

* Sign and significance of coefficient depends on choice of specification.

Table 5.9 shows the coefficients for the year dummy variables for each of the three market areas. The year dummies provide a measure of the change in rents that occurs when all other factors are held constant except for the progression of time. The year dummies allows us to measure conditions unrelated to the property itself or to the location of the property, such as effects from the local economy and local real estate markets. Each coefficient is interpreted relative to the omitted condition which is 1986 rents. For the year dummy variables, only the first group of models (where Station variable is continuous) is reported. Comparison between the two groups of models is not necessary since the coefficients were very similar.

The trends in industrial rents for each of the three markets are somewhat different over the study period. The main similarities between the trends for all of the market areas are that rents in each market area peak in 1990 or 1989 (relative to 1986 rents). After 1990, rents decline or remain the same in all three market areas until 1994. The trends seen here roughly follow the same trends displayed by the office properties and the same trend discussed in the context of population and employment growth and decline occurring during the study period.

Table 5.9
Industrial Property Year Dummy Coefficients*
(% change in rents from previous year)

	South Bay	East County	Central City
1986 (omitted condition)			
1987	.011 (1.1%)	.050 (5.0%)	-.011 (-1.1%)
1988	**.181 (17.0%)**	.029 (-2.1%)	**.256 (26.7%)**
1989	**.231 (5.0%)**	.034 (0.5%)	**.181 (-7.5%)**
1990		**.093 (5.9%)**	**.273 (9.3%)**
1991	**.215 (-1.6%)**	.080 (-1.3%)	**.194 (-7.9%)**
1992	**.112 (-10.3%)**	.061 (-1.9%)	**.127 (-6.7%)**
1993	**.080 (-3.2%)**	.023 (-3.8%)	.082 (-4.5%)
1994	**.079 (-.1%)**	.023 (0%)	.044 (-3.8)
1995		.072 (4.9%)	.040 (-0.4%)

* Bold indicates coefficient significant over the 95% level

Chapter 6

Conclusions and Directions for Future Research

6.1 The Main Findings

Office Rents

Freeway access proves to have a consistent and expected relationship with office rents. In each of the three market areas, freeway access is significant with the expected sign. This is an important finding and lends support to the idea that freeways play a role in shaping land value patterns, and by extension, land use patterns for office firms. Another important conclusion is that freeways provide more access benefits to office firms than light rail transit or the San Diego central business district. Light rail transit is not significant for office rents in any of the three market areas. Furthermore, in the East County and Central City market areas, we find evidence that office firms pay to locate away from light rail corridors. Access to the CBD is only valued by office firms in the Central City market area.

Industrial Rents

There is only one scenario where transportation access is significant in the industrial rent models. This occurs with distance to light rail transit in the South Bay market area.

Interpretation of Main Findings

It is evident that freeway access plays a more dominant role in determining rents, especially for office properties. Although less evident, the two scenarios where the Station and CBD variables had a significant and expected relationship with rents may also provide important insights. Access to transit exhibited the hypothesized relationship to industrial rents in the South Bay market area. This result remained consistent regardless of the manner in which distance to light rail was modeled. Access to the CBD exhibited the hypothesized relationship to office rents in the Central City market area. In examining these scenarios, a possible pattern emerges. In considering first the South Bay market area, we see a region that is predominantly industrial, as shown in Chapter 3; and we see a region with clusters of industrial properties (see Figure 5.1). The regression results show that these industrial properties pay higher rents to be near light rail stations. What may be happening in this case is that distance to light rail stations in the South Bay market area is a proxy for distance to dense concentrations of industrial firms. These areas of dense industrial development may provide agglomeration benefits, or more specifically localization economies, for which firms are willing to pay higher rents. Localization economies arise when firms are able to realize cost savings by locating near concentrations of similar firms. If it were in fact proximity to light rail stations that South Bay industrial firms valued, we would expect more consistency in this result across market areas, such as with the Freeway variable. In sum, one possible interpretation is that access to transit is significant in the South Bay market area simply because the transit stations coincide with previously existing concentrations of industrial firms. The access to transit variable may actually be measuring localization economies realized by industrial firms in this area. The fact that the South Line was constructed in a freight rail corridor further supports this interpretation of results.

Likewise, in the Central City market area, we see that office properties value access to the CBD, which is defined as a centrally located point in Downtown San Diego. Similarly to the South Bay market area, this market area also contains a dense concentration of a single land use type, predominantly office land uses. As with distance to a light rail station in the South Bay market area, distance to the CBD may actually be a proxy for distance to a dense cluster of similar firms. The sign and significance of the CBD variable in the Central City office rent models may tell us that office firms in this market area value access to concentrations of like-firms. In other words, localization economies again may explain why downtown office firms value access to the CBD. This argument is further supported by the fact that office firms farther away do not value CBD access: office firms in the other two market areas are too far away to gain localization benefits from the San Diego CBD.

6.2 Policy Implications of the Main Findings

A preliminary conclusion, therefore, is that while freeways provide clear access benefits for office firms, access to light rail transit and to the CBD subcenter are only valued when they coincide with significant pre-existing centers of activity. It is useful for transportation planners and land use planners to know that, holding all other factors constant, access to light rail transit is not as important to office real estate markets as freeway access. This study shows that transit systems are not likely to generate enough travel costs benefits to stimulate nearby office development. The study supports a planning approach where optimal locations for light rail lines are chosen in advance, rather than expecting light rail stations to stimulate real estate markets. Identifying existing clusters of high value properties and designing systems that connect these subcenters may be the best planning prescription for light rail transit.

In terms of industrial properties, the overall results suggest two important points. The first point is that for industrial properties, transportation access may be weaker than localization benefits. This is evident in the fact that none of the measures of access was significant for industrial properties except for when measures of access coincided with areas of dense industrial activity. A second point suggested by the results is that industrial firms may value other types of access not measured in this study such as distance to the Port of San Diego. For urban planners, it is useful to understand that within industrial areas, both freeway and light rail systems may not be strong enough to compete with localization economies. Enough time has elapsed since the construction of both the light rail and freeway systems to exert shifts in real estate markets. Since these shifts did not occur, we can assume that market forces alone will not bring them about. The results suggest that if freeways or light rail systems are constructed in urban areas without penetrating existing subcenters of industrial activity, it may be unlikely that these facilities attract significant development. The concept of building transportation systems for economic development may not apply in the case of industrial firms. Land use and transportation planners need to be sensitive to the particular type of access valued by an industrial sector.

This finding is even more important for light rail transit systems, which did not play a significant roie in either industrial or office rents. Advocates of light rail transit speak of the importance of land use policies to support high density development near transit stations. In many cases, areas of high density development already exist. A more effective approach to successful light rail transit may be to design alignments that take full advantage of existing opportunities. In the case of the San Diego system, the transit agency purchased existing freight rail right-of-ways. They chose to minimize constructions costs instead of picking optimal locations for right-of-ways. Building light rail alignments and then expecting land use policies to attract development interests to the station areas may not be a successful approach. A more effective approach may be to design systems that connect existing clusters of activities. One advantage of light rail, which will become increasingly important, is that it can penetrate existing high value areas with minimal disruption, unlike highway construction.

6.3 Directions for Future Research

For urban structure researchers, this study shows that transportation access still needs to be considered in evaluations of urban form, especially for office land uses. For transportation-land use researchers, this study shows that some important aspects of urban structure, namely consideration of the role of subcenters, are missing from their studies. Future studies of the impact of transportation on land value need to consider more seriously the role of agglomeration economies in determining the land value patterns within an urban region. This absence of controls for agglomeration effects, or access to subcenters, may be one reason for the inconsistency in results obtained over the years. Transportation-land use researchers typically focus on only access to transportation systems, and ignore the value a firm places on access to concentrations of activity. The particular clusters of activity valued by a firm depend on a firm's production process, specifically where its inputs come from and where its outputs are going. Studies examining the role that transportation access plays in determining rents can not overlook the orientations firms have based on their production processes and based on the locations of their markets. This oversight by previous transportation researchers may explain the wide variation in results obtained over the years. We can not understand the role transportation plays in a firm's location decisions until we understand the specific transportation issues faced by that industry. In the future, this study could be improved by controlling for subcenters which may be valued by office and industrial firms. In the South Bay market area, the predominant type of industry could be identified, and then clusters of this type of industry located. These industries could be surveyed to identify the predominant mode utilized for transporting inputs and outputs. By refining the measures of access, we would have a more accurate picture of how industries value particular locations within an urban area. Specific measures should include distance to clusters of like industries and distance to most utilized mode of transportation (ocean shipping, rail, or highway trucking).

This type of continued research is valuable for both land use planners and transportation planners. Land use planners need information about land value patterns associated with firms so that future trends can be anticipated. Understanding the factors that influence a firm's location decisions is crucial background for planning urban development. For transportation planners, this same knowledge is important for planning transportation systems that will be effective. In the case of light rail transit, this study shows that identifying existing subcenters and aligning the system accordingly may be the only way to insure successful ridership.

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