Using Transactional and Spatial Data to Determine Drivers of Industrial Land Value

by

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ABSTRACT

The value of a given parcel of land is determined by a multitude of factors based on its location and physical characteristics. No two parcels are alike, making direct comparison between parcels and the study of underlying land values difficult. Further, in locations where land is most valuable, there are often existing improvements on the land. In order to determine a land-only value, the value of the existing buildings or infrastructure must be estimated. This leads to the potential for errors and other issues. There has been a great deal of research conducted on land value for specific real estate uses, such as residential or office. However, little research has been conducted on industrial land. This study will focus specifically on industrial land value and the individual factors that drive it.

This study analyzes a database of 1,000 transactions in 10 of the largest industrial real estate markets in the United States. The data set is unique because most of the data points are land only, lessening the impact of appraisal and estimation techniques. Additional variables were added to each data point to account for local land use regulation, as well as spatial location. A regression analysis determined how these variables influenced the underlying land values. From this analysis, the following conclusions emerged: First, land use regulation is a strong driver of industrial land values. Using index values from the Wharton Residential Land Use Regulatory Index (WRLURI), the analysis showed that land values increased when the stringency of land regulation increased. Second, proximity to interstate highways, airports, and the central business district are also significant drivers of industrial land value. Decreased distances to these points of interest resulted in increased land value. Third, industrial land values are also positively influenced by the cumulative income of the surrounding population. A 1 percent increase in cumulative population income resulted in an approximately 0.47 percent increase in land value. Lastly, physical land features impacted land values intuitively. Flattened, developed sites were much more valuable than raw, undeveloped sites.

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Table of Contents

Index of Figures & Tables

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Chapter 1: Introduction

1.1 Background

Little research has been completed on industrial land values relative to other types of real estate. It is especially difficult to study the value of land due to the small quantity of market transactions that are land only. In most real estate transactions, the land already has improvements on it, such as buildings and infrastructure. In order to determine a land-only value, the value of existing improvements must be estimated or appraised using multiple assumptions. This process can lead to issues and create concerns over accuracy. This thesis will analyze a database provided by CBRE Group, Inc. (CBRE) consisting of mostly land-only transactions to determine the significance of various drivers of value. A small number of the included properties have existing improvements on them, but these improvements are either insignificant or a value for demolition is subtracted to arrive at a land-only value. This is a unique data set of real market transactions to evaluate the value factors for land in its simplest form. The data set focuses on ten key United States markets for industrial land use. The transaction database also includes different site characteristics that will be analyzed, such as existing zoning classification, parcel shape, parcel size, and sale date. The focus of this thesis is a regression analysis that utilizes land price per square foot as the dependent variable, and all of the land characteristics as independent variables.

It is also difficult to quantify the impact of location on land value. Through the use of Geographic Information System (GIS) software, distance values will be assigned to each property in the database based on each property's distance to significant points of interest. Some of the points of interest are especially important to industrial use. Relative to other land uses (such as residential or office), industrial users often value location with different priority. For example, some industrial users are heavily linked to supply chain distribution, and value proximity to the interstate highway system or local port. Residential users value proximity to these points with different priority. A residential user likely values an increased distance from a highway due to noise and traffic impacts. The influence of these distances to each point of interest on the underlying value of each site will be quantified by the analysis.

Prologis, Inc. (Prologis) suggested the topic of this analysis and provided the CBRE data set. Prologis is a multinational real estate investment trust (REIT) that focuses on the industrial property sector. They are the largest owner of industrial real estate in the world, with over 678 million square feet in their portfolio. Prologis is a large player in the global real estate market with $67 billion of assets under management in 19 countries. The last portion of this thesis (Chapter 6), will include a section based on interviews with three industrial real estate professionals from Prologis. The professionals reviewed the results of the analysis, as well as provided qualitative input based on their experience in the field. Their insight regarding the markets they work in on a daily basis is also included. Lastly, they provided suggestions for future research in this subject matter.

1.2 Industrial Real Estate Fundamentals

Industrial real estate in the United States totals approximately 25 billion square feet of space. It is also the largest sector of US real estate, based on square feet and value (Yap & Circ, 2013). Industrial real estate consists of land and buildings that serve industrial uses. Industrial buildings are designed to be practical and efficient, while accommodating a variety of uses. There are a wide variety of uses that fall within the industrial category. Some examples include: warehousing, distribution, production, manufacturing, research, and storage. The NAIOP Research foundation categorizes the main types of industrial buildings in Figure 1.

	Manufacturing	Warehouse				Flex	
Primary Type	General Purpose	General Purpose Warehouse	General Purpose Distribution	Truck Terminal	Fulfillment Center	General Purpose Flex	Service Center or Showroom
Primary Use	Manufacturing	Storage	Distribution	Truck Trans-shipment	Distribution	Research and Development, Cold Storage, Office, Lab, Light Manufacturing, High-tech, Data or Call Center	Retail Showroom
Subsets	Heavy, Light Manufacturing	Bulk Warehouse, Cold or Refrigerator Storage, Freezer Storage, High-Cube	Overnight Delivery Services, Air Cargo	Heavy, Light Manufacturing	Delivery directly to consumer		

Figure 1 - NAIOP's Industrial Building Categories from "Commercial Real Estate Terms and Definitions." Maria Sicola (2017).

Industrial buildings play an important role in the US economy and supply chain. Virtually all businesses are impacted either directly or indirectly by industrial real estate. Demand for industrial real estate is closely correlated to the strength of the overall economy. Global trade, consumption, and supply chain reconfiguration are currently the main demand drivers within the sector (Prologis Research, 2016). Supply in the industrial real estate market can be more responsive to demand shifts, due to shorter construction times.

1.3 Industrial Users and Uses

According to Prologis Research (2016), industrial real estate users can be grouped into five categories: wholesalers, retailers, manufacturing, transportation/freight, and third party logistics. Outside of these five main groups, the remaining users comprise approximately 2.5 percent of all industrial real estate by total square footage. Among these five main user groups, Prologis classifies their space use into five distinct categories: business-to-business distribution, retail store distribution, transportation, e-commerce fulfilment, and manufacturing. It should be noted that many users employ multiple uses within a single building. Lastly, Prologis classifies industrial real estate customers into 14 different industries: electronics & appliances, food & beverage, diversified retailer, apparel/specialty goods, auto & parts, consumer products, packaging/paper/plastics, construction/home improvement, transport & distribution, home goods & furnishings, industrial/machinery/commodities, healthcare/pharma, and data center/office/other. This data illustrates the diversity of both users and uses of industrial real estate, making this seeming straightforward real estate sector much more complex.

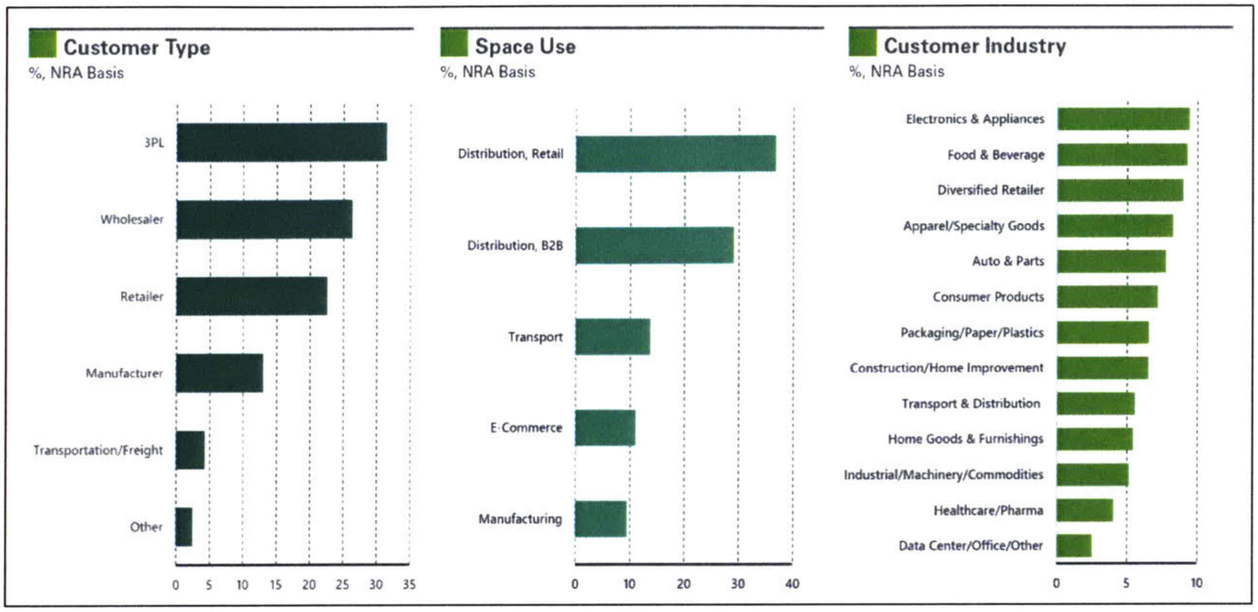

Figure 2 - Industrial Customers, Uses, & Industries from "Broad-Based Demand Drives Logistics Real Estate." Prologis Inc. Research Department (2016).

1.4 Industrial Real Estate Owners

On a global scale, Prologis is the largest owner of industrial real estate. As of 2015, Prologis owned more industrial real estate (by square footage) than the next six companies combined (National Real Estate Investor, 2015). After Prologis, the next largest owners are Duke Realty, Clarion Partners, and Liberty Property Trust. The 2015 rankings of largest industrial owners are shown in Figure 3. Prologis is also the largest owner of industrial real estate in the United States as of 2017, owning approximate 375 million square feet of space (Prologis Research, 2017). On a US basis, Prologis owns more than double the space of the closest competitor, GLP. The top US owners are shown in Figure 4.

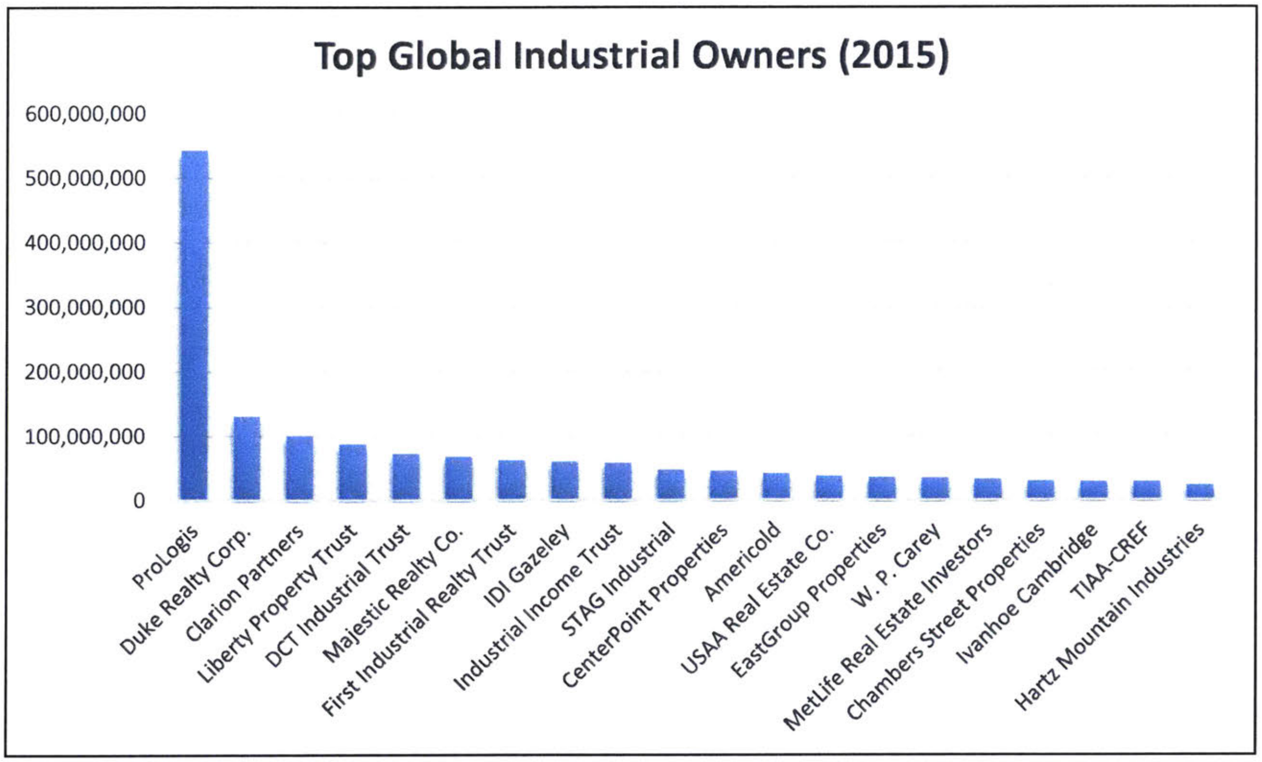

Figure 3 – Top Global Industrial Owners (2015) from "Top of the Heap, Part 8: Top Industrial Owners." National Real Estate Investor (2015).

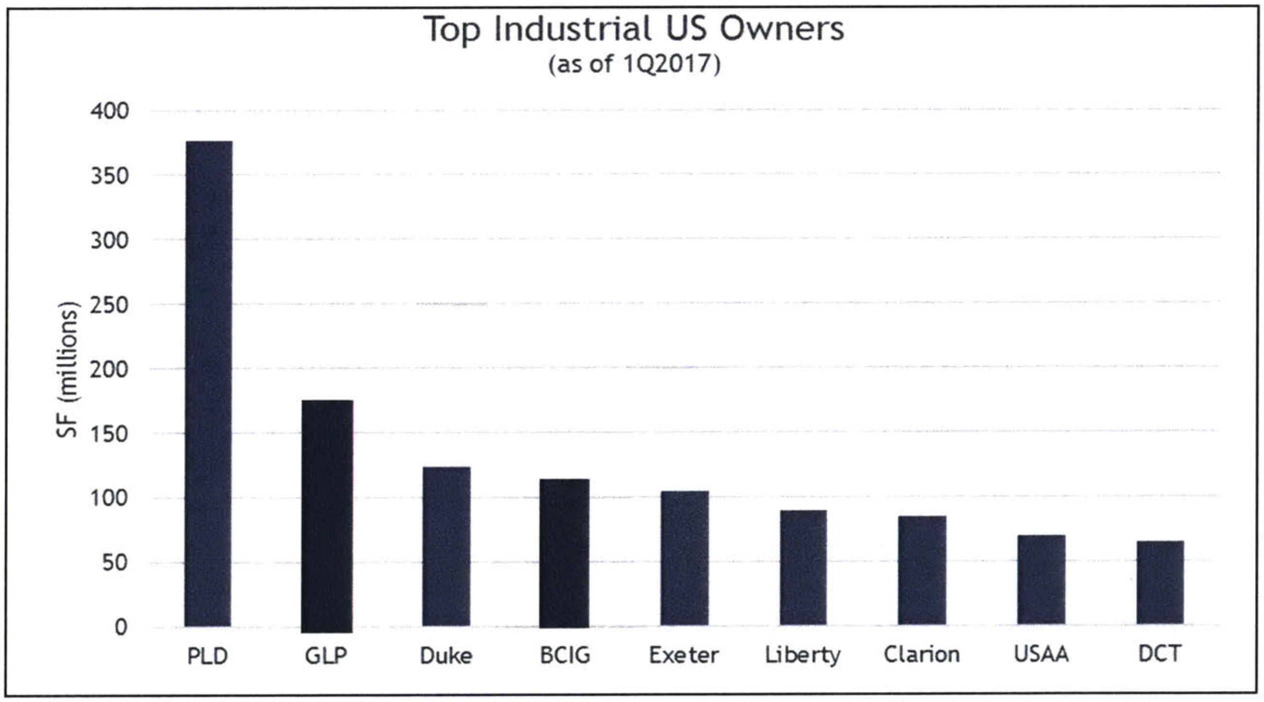

Figure 4 - Top US Industrial Owners 2017. Prologis Research (2017)

1.5 Current Market Status/Outlook

The industrial real estate market is in the midst of a transformation. According to James R. DeLisle (2003), the industry has become an increasingly dynamic marketplace. Warehouse properties were once considered to be safe, low risk investments that generated modest returns. Many investors and developers were attracted to this stability, relative to more dynamic property types – such as office, hotel, or retail. However, as DeLisle argues, this trend should not be assumed to continue. The industrial real estate market has grown increasingly diverse, driven by structural changes in space demand, changes in manufacturing and distribution channels, and growing product diversity (physical and locational). Structural changes in market demand have occurred rapidly over the past decade, propelled by improved production processes, advances in productivity as a result of automation and technology, and better inventory tracking and forecasting techniques. Growing product diversity has been a response to the needs of users seeking more efficient and productive spaces, resulting in products that cannot simply be categorized into the same three categories historically used to classify industrial buildings. These categories (manufacturing, warehouse, research & development) were laid out in Figure 1.

The industrial real estate market has enjoyed a period of strong growth and expansion over the last several years. While market rents were initially slow to rebound following the global financial crisis in 2009, in early 2017 they were up 35 percent from their lows during that period (Prologis, 2017). Rental growth has been driven by multiple factors, including historically low vacancy rates and a lack of new supply. In the second quarter of 2017, vacancy rates were under 5 percent (Prologis, 2017). The market has been prudent with the delivery of new supply to the market. In fact, completions in the US have trailed demand, as measured by net absorption, for 25 consecutive quarters, dating back to 2010 (CBRE, 2016).

Industrial real estate has also grown more competitive as an investment. Real Capital Analytics (RCA) reports that sales of industrial properties grew 3 percent in the first quarter of 2017 to $13.9 billion (RCA, 2017), compared to the same period last year. RCA notes that this makes industrial stand out relative to other sectors, where sales growth has been flat or decreased during the same time period. As of early 2017, investors were struggling to find assets to buy, as most owners are looking to hold their industrial assets due to the strong market. There are several reasons why the sector has been popular with investors (Kirk, 2017):

1. Industrial tenants are looking for higher quality in their assets, which in turn commands higher rents. More features (higher clear heights and dock doors) allow them to turn around their product faster.
2. The growth of e-commerce is believed to fuel the demand for industrial for the foreseeable future.
3. There is a lot of capital chasing industrial, and it is viewed as very efficient relative to other asset types.

Looking ahead, some have predicted that uncertainty regarding global trade and a slowdown in trade point to a slowdown of growth in the industrial market. However, CBRE predicts that the sector will "benefit from structural changes, such as online retailing, that have forced a transformation of global supply chains and will continue to act as a significant engine for growth (CBRE, 2016)." These structural changes are being driven by the explosive growth of e-commerce, as well as the changing expectations of consumers. Customers are demanding faster shipping times, which puts pressure on e-commerce companies to operate more efficiently and locate closer to consumers. This drives the need for significant change to the existing infrastructure that these supply chains previously relied upon.

1.6 Current Industry Challenges/Opportunities

As previously mentioned, e-commerce has been a force of change in the industrial real estate sector. More and more consumers are shopping online, and the National Retail Foundation predicts that online sales will grow 8-12 percent in 2017, with overall sales topping $425 billion (Linder, 2017). Not only has e-commerce increased demand for industrial real estate, but the way they use their space is changing the sector as well. According to Prologis Research (2014), e-commerce fulfillment requires three times the space of traditional users. These space needs are illustrated in Figure 5 below. This is due to four e-commerce market characteristics: shipping parcels versus pallets, high inventory turn levels, broader product variety, and returned inventory. E-commerce users are also changing the requirements for the buildings they occupy. For example, many are requiring more space for car parking, higher clear heights (up to 40 feet), increased load capacity for warehouse floors as product is stacked on increasing taller racks, and increased roof capacity for larger HVAC equipment (Derven, 2016).

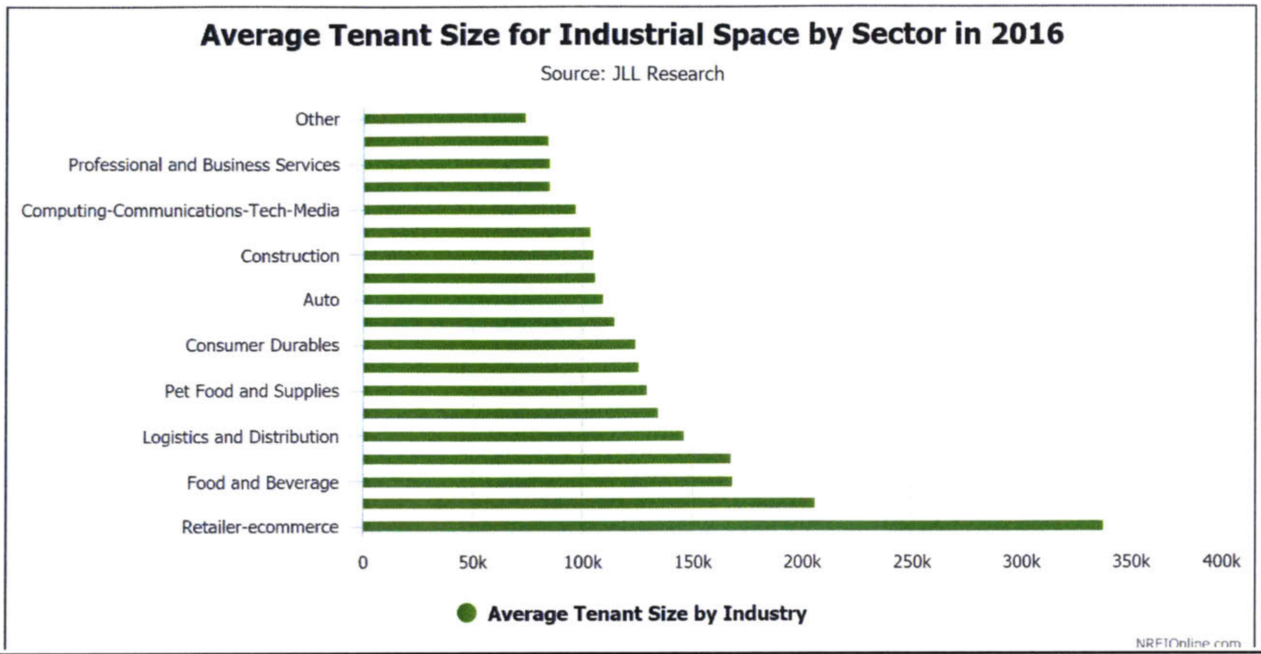

Figure 5 – Average Industrial Tenant Size, "US Industrial Outlook Q4-2016." Jones Lang LaSalle IP, Inc (2016).

Another challenge in the industrial real estate market is finding a solution for the last mile. The last mile refers to the final segment of the shipping process before a product reaches the consumer. This segment is often the most inefficient, accounting for 28 percent or more of the total cost to transport the item (Rodrigue, Comtois, Slack, 2009). Due to demand for shorter shipping times, this issue has continued to grow in importance for many industrial real estate users. Many companies are striving for same-day delivery service. However, it is not an easy goal to attain without significant changes to a company's existing distribution infrastructure. For example, Amazon rolled out same-day delivery in Chicago in 2016, but the delivery area did not include the South Side of the city, which represented a significant portion of city's physical area and population. This led to public outcry, and became a public relations issue for Amazon. Increasing consumer demand and last-mile concerns led Amazon to implement same-day service when they were not ready.

In order to decrease cost impacts of the last-mile issue, many users locate distribution facilities closer to consumers. However, this results in higher land costs and more competition from other real estate uses. Companies are also testing different ideas to address the last mile problem. Some are utilizing “lockers” in public places, such as an office building or convenience store. With this model, a package is delivered to the locker and the customer retrieves it with a unique code. Similarly, other large retailers, like Wal-Mart and Home Depot, are encouraging store pickup options. This idea has evolved into last mile fulfillment starting from their retail stores, although this typically requires the allocation of more square footage to inventory. Crowd-sourced delivery solutions are also being implemented. Amazon Flex allows people to pick up several packages and deliver them with the assistance of an app on their phone, similar to Uber. Uber has also entered the market with “UberRush”, a city-center courier service. Uber tried to leverage its already in-place network of drivers and scale to provide on demand delivery. Initially, the service was focused on individual consumers, but the company is now refocusing on “powering backend delivery logistics for merchants and enterprises such as grocery stores and florists (Chang, 2017).” Mercedes Benz is also working on potential solutions, with a concept called the “Vision Van.” The electric van is driven by a person, but autonomous drones launch from the roof of the van to deliver packages. There are also start-up companies providing third party solutions, such as FLEXE. FLEXE is “a cloud-based peer-to-peer warehouse marketplace for sharing excess warehouse capacity; the Airbnb for warehouses (Mabe, 2017).” From start-ups to traditional public companies, there are many groups looking to capitalize on the opportunity presented by the last-mile problem.

Chapter 2: Literature Review

2.1 Introduction

Relative to other real estate sectors, there has been little research conducted on the determinants of industrial land value. This thesis seeks to fill part of this void by evaluating a variety of factors that influence industrial land values. The first section of the literature review highlights the most relevant studies of the past several decades. Many of the older studies have tried to focus on defining the location qualities without the benefit or accuracy of GIS software available today. The second part of the literature review will look at the implications of incorporating data from GIS analysis into evaluating land values. The final portion of the literature review will focus on quantifying the impact of land use regulation. Regulation has an important impact on industrial land values, in addition to being one of the hardest to define and quantify.

2.2 Industrial Land Value Drivers

Peiser (1987) conducted a study of nonresidential land values in the Dallas metropolitan area, focusing on the sale prices of vacant land only, in order to eliminate problems encountered with the appraisal of improvements on the land. He used a data set consisting of 467 vacant land transactions completed between 1978 and 1982. The land parcels were classified based on the following uses: office, commercial, or industrial. Peiser then employed a hedonic pricing analysis to evaluate the determinants of the land prices, with special emphasis given to the impact of agglomeration through proximity. The proximity variables included were: distance to downtown, distance to suburban nodes, and distance to employment centers. In addition, his analysis included other land characteristics such as lot size, zoning, and density, as well as macroeconomic variables. Peiser's analysis concluded that proximity to the central business district (CBD) had a greater impact on office land value than on commercial land value, and that it was not a significant determinant of industrial land value. He also found that proximity to employment appeared to be more important than distance from the CBD for industrial and commercial land. Ultimately, Peiser asserted that his results supported the idea that office activities have a greater tendency towards agglomeration than commercial or industrial uses. For industrial land specifically, he found that land value per acre decreased as parcel size increased. Street frontage was also a value driver for industrial properties, and the results showed a 43 percent premium for frontage on a major arterial and a 68 percent premium for expressway frontage, relative to frontage on a minor street. The results also showed that industrial users pay a premium to locate in neighborhoods with higher-priced homes, but the same did not hold in areas with high rental rates. Initially, Peiser hypothesized that industrial land users would pay a premium to be located in areas with apartments due to the need for labor force, assuming they would be part of the rental population. However, the results did not support this idea. Given the structural changes in the industrial market today, one might expect similar results with an even stronger value impact for location near high-priced neighborhoods. However, this could be a result of the last-mile issue and the desire to locate distribution closest to the consumers that consume the most. Peiser's analysis also included four macroeconomic indicators as variables: unemployment rates, changes in unemployment rates, interest rates, and changes in interest rates. Interestingly, none of these factors tested as significant for industrial land. This thesis employs a similar methodology, using distances and land characteristics in a hedonic pricing analysis. However, unlink Peiser, this thesis includes 10 different markets and focuses on industrial land only.

While Peiser focused on several types of land uses, Kowalski and Paraskevopulos (1990) sought to evaluate the impact of location on industrial land alone. They asserted that industrial land does not follow a radial price gradient originating from the CBD, but rather that price gradients exist within the submarkets of a metro area. The pair used a database of 56 industrial land sites around Detroit, Michigan, and conducted a regression analysis of various site variables on the land prices. They defined a single submarket, rectangular in shape, along Interstate 275 to the west of Detroit. Next, they defined the northern border of the submarket as the geographical reference (origin) for all parcel locations to be measured from. They selected this point within the submarket because industrial land values are highest in that area. Each data point was assigned a value for the distance from this point. Additionally, each location was assigned a value for distance from the CBD, a dummy variable for highway visibility, a dummy variable for location within an industrial park, lot size, street frontage, and year of sale. Kowalski and Paraskevopulos produced two regression models that differed only in the measurement used to compare location. One model used radial distance from the CBD, while the other used distance from the origination point of the submarket. Their results found location within the submarket to be more significant, confirming their hypothesis of market segmentation of industrial submarket rent gradients. Further, they found that sites with expressway visibility commanded a 56 percent premium over sites without visibility. They also found that sites located within an industrial park had sales prices that were 67 percent higher than parcels not located in platted industrial parks. Land price per acre also decreased as lot sized increase, confirming the plattage effect observed by Peiser (1987). Parcels with more frontage also commanded higher prices. This thesis will only account for distance from the local CBD, not submarket centers.

While the previous two studies focus on price gradients, Ryan (2005) focused on a specific spatial variable: access to highway and light rail transit and its impact on industrial and office rents. Ryan utilized 10 years of industrial and office property rents in San Diego, California. With asking rent as the dependent variable, Ryan conducted a regression analysis to determine the impact of the independent variables on the office and industrial rents. These variables included building characteristics, land use type, type of lease, neighborhood characteristics, measures of access, and year. For the measures of access, she utilized the straight-line distance from each property to the nearest highway exit, light rail transit station, and central business district. Office and industrial analyses were conducted separately, and further divided into three different regions within each product type (South Bay, East County, Centre City). Overall, the results of the industrial rent analysis showed that industrial firms were not paying rent premiums to locate near highways or light rail transit. Only one of the three submarkets showed significance, and Ryan suggested that it reflected the dense industrial activity in that region, akin to the agglomeration benefits observed in other studies. Ryan suggested that industrial properties may value proximity to other points, such as ports or airports that were not included in the analysis. The analysis in this thesis includes proximity to airports as a spatial variable for each subject property.

Tchang (2016) conducted a study that focused on a specific spatial characteristic (distance to highway) and its relationship to a specific type of industrial real estate (distribution centers). This particular subset of product type was selected due to its dependence on infrastructure for distribution. Tchang highlighted that firms seek to minimize transportation costs, and locating closer to highways decreases time and money spent on transportation. However, he also established that the rent premium for locating closer to a highway must be exceeded by the savings realized on transportation costs in order for a firm to make the decision to locate there. Tchang utilized a hedonic pricing analysis featuring the log of industrial property rents as the dependent variable. The data set consisted of rent data from 554 industrial properties in the Netherlands during a defined period (1984-2015). The Netherlands serve as an important logistics hub for all of Europe. Other variables in the analysis included distance to railway station, percentage of office space at each property, and time period. Ultimately, the analysis results showed that a one kilometer increase from the nearest highway decreased the rent of an average sized distribution center by approximately 11,000 euros annually. Most of the facilities in the analysis were located two kilometers or less from a highway. Tchang also conducted an analysis to compare distribution centers to other types of logistics real estate. He found that highway proximity had a stronger impact on rent for distribution centers, but that the difference was not statistically significant. The results also showed a positive relationship between rents and proximity to the central business district. Interestingly, the results showed a negative relationship with railway stations, as rents decreased the closer they were to a railway station. This surprising result was not examined further. Tchang utilized straight-line distances for his analysis. This is noteworthy, as it is not as reliable as the accuracy of distance via the local road network. Tchang concluded that the results of the analysis were similar to other studies, although the relationship was much stronger in his results. He hypothesized that this was due to the specific product type focus, or the fact that most other studies utilize data based in the United States.

2.3 GIS Software and Hedonic Pricing Models

Bernknopf, Gillen, Wachter, and Wein (2008) explored the impact of adding spatial data via geographic information system (GIS) software to hedonic pricing models. The authors reflected on the large quantities of land valuation research that has been conducted using hedonic pricing models. They also defined this method of estimation as a "statistical regression analysis where the property sale transaction price is correlated with the parcel's characteristics to describe the market value of a parcel, as a function of the property's physical characteristics and location amenities" (Bernknopf, R., Gillen, K., Wachter, S., & Wein, A.,2010, p.3). The authors' goal was to illustrate the statistical value of incorporating spatial explanatory variables into hedonic pricing models. They created a case study of land values in Miami-Dade County in Florida, in order to evaluate the impact of zoning and environmental regulations, location and distance to amenities, and year and season of property transaction on land values in the area. Their data set for the case study initially included 541,184 observations, which was eventually reduced to 24,000 after removing outliers and incomplete data entries. They produced two models to evaluate factors of land value in Miami-Dade, one with spatial variables obtained via GIS software, and one without. The first model contained explanatory variables that included property characteristics, land zoning, and sale year. This model produced some results that confirmed some of their initial hypotheses, such as a negative relationship between lot size and price per acre. However other variables performed non-intuitively, such as a positive relationship between price and location within a flood zone. This model produced an adjusted R^2 of 0.34. This is a measure of the explanatory power of the model, and falls within a range of 0 to 1. A value of 1.0 means that the model explains 100 percent of the variation in land values. The second model included 11 GIS-measured spatial variables, including distance to highway, distance to CBD, distance to canal, and distance to secondary CBD. This model resulted in an adjusted R^2 value of 0.77, more than double the explanatory power of the first model. Although it was not focused on industrial real estate, this study shows the impact that spatial data can have on evaluating factors of land values. This thesis will employ a similar set up of a regression model using spatial data from GIS. Following the example of Bernknopf, Gillen, Wachter, and Wein, the r-squared of regression outputs before and after the addition of GIS data are compared in Chapter 5.

Shim and Kim (2016) utilized GIS data to employ a similar hedonic price method to analyze the determinants of industrial land prices with the Southeastern Maritime Industrial Region of South Korea. Their data set consisted of 195 parcels of industrial land sold during 2014 in 13 different industrial parks. The industrial parks were located within the following regions: Busan Metropolitan City, Ulsan Metropolitan City, and Changwon Metropolitan City. Explanatory variables for each parcel were from one of three categories: physical characteristics of each parcel, land use characteristics, and distance to nearest highway and port. Physical characteristic variables included lot size, altitude, and width of adjacent roads. The results for these factors found a negative relationship between parcel size and price per acre; a 1 percent increase in parcel size was estimated to decrease the parcel price by .092 percent. A negative relationship was also observed for altitude and price (the regions were surrounded by mountains and higher altitude land was presumably less valuable). A strong relationship was also found between price and width of adjacent roads. Parcels abutting roads with a width greater than 25 meters were valued, on average, 111 percent higher than parcels abutting roads with a width of 8 meters or less. The land use characteristics analyzed included zoning classification. The classifications were heavy manufacturing, medium manufacturing, and mixed-use. The results showed that land classified as medium had a unit price that was 21 percent less than land classified as mixed-use. For the final category of land value factors, distance to expressway and distance to port, Shim and Kim utilized the Network Analyst tool package in ArcGIS 10 software. The results pointed to a negative coefficient for distance to expressway, reflecting the trade-off between transport costs and parcel prices. However, distance to port resulted in a positive coefficient, which was contrary to the initial hypothesis that land closer to ports would be more valuable. Shim and Kim believed this was the result of unique regional context, and that the manufacturing companies in the area do not utilize the area ports.

2.4 Quantifying Local Regulatory Environments

One of the most important factors affecting land value is the local regulatory environment. Across all sectors of real estate, regulation can impact cost in a variety of ways. First, real estate development projects can be prohibited entirely or delayed significantly. Also, projects can be changed in scope or design by the regulatory process, or they can be subject to mitigations or exactions. Lastly, the ease with which regulatory decisions can be challenged and upheld is of utmost importance. All of these potential regulatory issues can affect a project's viability and profitability. Stringent regulation serves as a barrier to entry in certain markets and ultimately adds to land values as a way to pass along costs and uncertainties associated with the regulatory environment.

Gyourko, Saiz, and Summers (2007) devised a way to measure the local regulatory environment by creating the Wharton Residential Land Use Regulatory Index (WRLURI). The index is an aggregate of 11 subindexes, two of which reflect state court and state legislative behavior, while the other nine subindexes reflect local municipality characteristics. The subindexes were established based on the results of a survey sent out to 6,896 municipalities across the United States; 38 percent of the surveys were returned, which represented 60 percent of the population surveyed. The eleven subindexes are summarized in Table 1.

Sub-Index Name	**Description**
Local Political Pressure Index (LPPI)	Reflects the degree of involvement by various local actors in the development process.
State Political Involvement Index (SPII)	Reflects historical state legislative and executive branch involvement in land use regulation.
State Court Involvement Index (SCII)	Reflects the tendency of state courts to uphold or restrain four types of municipal land use regulations.
Local Zoning Approval Index (LZAI)	Reflects which organizations or regulatory bodies have to approve a request for a zoning change.
Local Project Approval Index (LPAI)	Reflects which organizations or regulatory bodies have to approve a project that does not require a zoning change.
Local Assembly Index (LAI)	Reflects whether a community meeting or assembly is required before a zoning or rezoning request can be voted upon.
Supply Restrictions Index (SRI)	Reflects the extent to which there are explicit constraints on supplying new units to the market.
Density Restrictions Index (DRI)	Reflects the presence of minimum lot size requirements.
Open Space Index (OSI)	Reflects the presence of open space requirements.
Exactions Index (EI)	Reflects whether exactions for infrastructure improvements are mandated by the locality.
Approval Delay Index (ADI)	Reflects the average duration of the review process (application for rezoning to building permit, application for subdivision approval to building permit).

Table 1 - WRLURI Subindexes from "A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index". Gyourko, Saiz, and Summers (2007).

Gyourko *et al.* (2007) found a strong correlation across the subindexes that make up the aggregate Wharton Residential Land Use Regulatory Index, meaning that if a community is rated as highly regulatory for one of the subindexes, they are likely to be highly regulated for the other subindexes. The authors found that communities in metropolitan areas tend to be more highly regulated than those outside of metropolitan areas. They also found a large variation within density restrictions across those groups. Land-restricted markets tended to have higher regulatory constraints, as well as markets with higher income levels.

The study results showed that there was significant variability across metro areas, but less variability across communities within the same metro area. This will be important to consider in applying the MSA WRLURI Index Values to the data points utilized in the analysis for this thesis. Table 2 illustrates the index values that the study defined as lightly regulated, average regulated, and highly regulated. Based on the MSA Index values provided, the focus markets for this thesis are all considered to classify as average to highly regulated.

Comparing Communities with Different Degrees of Local Land Use Regulation			
	Means		
	Lightly-Regulated Bottom Quartile of WRLURI Distribution WRLURI < -0.55 (n=476)	*Average-Regulated* Interquartile Range of WRLURI Distribution -0.55 < WRLURI < 0.74 (n=952)	*Highly-Regulated* Top Quartile of WRLURI Distribution WRLURI > 0.74 (n=476)
	The Eleven Subindexes		
Local Political Pressure Index (LPPI)	-0.46	0.07	0.93
State Political Involvement Index (SPII)	-0.68	0.17	0.74
State Court Involvement Index (SCII)	2.15	2.04	2.03
Local Zoning Approval Index (LZAI)	2.13	1.99	1.91
Local Project Approval Index (LPAI)	1.16	1.67	1.99
Local Assembly Index (LAI)	0.00	0.002	0.12
Supply Restrictions Index (SRI)	0.03	0.18	0.53
Density Restrictions Index (DRI)	0.04	0.18	0.57
Open Space Index (OSI)	0.26	0.68	0.75
Exactions Index (EI)	0.66	0.79	0.75
Approval Delay Index (ADI)	3.2	5.7	10.5
	Local Traits		
Median Family Income (2000)	$50,742	$58,641	$72,576
Median House Value (2000)	$110,926	$150,576	$216,748
Percent College Graduates (2000)	23.6%	27.0%	35.4%
Percent Poverty (2000)	8.5%	7.0%	4.8%
Percent White (2000)	78.6%	76.9%	81.1%
Population (2000)	62,760	43,408	51,567
Land Area in Square Miles (2000)	21.0	18.4	31.1
Density, Population per Square Mile (2000)	2,599	2,886	2,046

Table 2 - Comparing Communities with Different Degrees of Local Land Use Regulation from "A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index." Gyourko, Saiz, and Summers (2007).

Chapter 3: Focus Markets

3.1 Introduction

The analysis in this thesis will focus on land in 10 key United States markets for industrial real estate. The markets are: Atlanta, Chicago, Dallas, Houston, Inland Empire, Los Angeles, Miami, New Jersey, and Seattle. With the majority of industrial real estate users heavily involved in the transport of goods, proximity to distribution networks and infrastructure is of paramount importance. For this reason, proximity to major highways, ports, and airports is valuable to these users. This allows industrial users to minimize transportation costs, which are a significant portion of overhead costs. All 10 markets are also in close proximity to large populations with large consumer bases. This also helps to minimize the distance traveled that is factored into last-mile costs. Proximity to large population centers is also important because large distribution facilities need significant labor forces to operate. Larger pools of available workforce population are valued for users with higher labor needs. The reliance on transportation infrastructure and consumer population helps to explain the locations of the focus markets for this study, and why they have developed into the top industrial markets in the United States.

Each of the 10 focus markets is ranked in the top 15 Metropolitan Statistical Areas (MSA) by population based on 2016 estimates. The United States Census Bureau defines an MSA as "the county or counties (or equivalent entities) associated with at least one urbanized area of at least 50,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties" (United States Census Bureau, 2016, *Metropolitan and Micropolitan Glossary*, Paragraph 8). Appendix B contains a table with the top 15 MSA populations, with the focus markets highlighted by asterisks. The focus markets are also served by some of the largest airports in North America. Appendix B also includes a table with the 2015 airport rankings by total cargo traffic. Similarly, many of the focus markets are served by the largest ports in North America. The 2016 rankings of all North American ports by container traffic are also included in Appendix B.

3.2 Atlanta

The first focus market is Atlanta, GA. Atlanta is the most populated metro area in the state of Georgia, and it has the ninth-largest metropolitan statistical area population in the United States (US Census Bureau, 2016). The US Census Bureau estimated its 2016 population to be 6,066,387 people. The Atlanta-Sandy Springs-Roswell, GA MSA spans an area of 8,681 square miles (US Census Bureau, 2015). This area includes 28 counties and is comprised of 140 cities and towns. There are approximately 2 million households, averaging 2.8 people per household (US Census Bureau, 2015). Atlanta's median household income is $60,219, which is about 10 percent higher than the US average.

Atlanta's gross metro product in 2016 was $353 billion, according to IHS Global Insight (2016). This ranks Atlanta at #10 for total GMP among all US metro areas. Major industries that operate in Atlanta include financial services, technology, telecommunications, and industry. Seven Fortune 100 companies are headquartered in Atlanta, including Coca-Cola, Home Depot, United Parcel Service, Delta Airlines, AT&T, and Newell Rubbermaid. Over 75 percent of the Fortune 1000 companies have a presence in the Atlanta area (Georgia Department of Economic Development, 2017). According to the US Bureau of Labor Statistics (2017), the unemployment rate in Atlanta was 4.5 percent in April 2017. This is slightly above the national average of 4.1 percent. The BLS also reports that nonfarm employment stands at 2,739,500 as of April 2017, up 3.3 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 597,000 in April 2017. Atlanta's strong economy, large employment base, and population growth make it an attractive market for industrial real estate.

Atlanta is well-connected by road, rail, and air. The area is served by three major interstate highways. Interstate 75 runs north-south and connects to Tennessee and Florida. Interstate 85 runs northeast to southwest, and connects to Alabama and South Carolina. Interstate 20 runs east-west and also connects Atlanta to Alabama and South Carolina. Atlanta began its history as an important railroad hub, and still remains a key part of the US railway system. By air, Atlanta and the surrounding region are served by the Hartsfield-Jackson Atlanta International Airport. Atlanta International is the twelfth largest airport by cargo traffic in the United States (Airports Council International, 2015). Atlanta's excellent connectivity is highlighted by the fact that 80 percent of the US population is reachable within two days by truck or two days by air (Prologis, 2017), further strengthening its status as key industrial market. Atlanta is also 250 miles northwest of the Port of Savannah on Georgia's coast, which is fourth largest port in North America by container traffic (American Association of Port Authorities, 2016). Atlanta's inland location and mild terrain contribute to its land availability, relative to some of the other focus markets which are land constrained due to natural features like mountains and bodies of water.

Fifty-one properties in the CBRE data set are located in the Atlanta area. Twenty-five were completed sales occurring between 2013 and 2016, while 26 were listings. The parcel sizes ranged from 4.5 to 65 acres, and all were established as a variation of industrial or manufacturing zoning classification. The sales occurred in 15 different towns, with the majority of the listings located in Atlanta, Fairburn, Buford, Union City, and Austell. Prices ranged from $0.13 per square foot to $25.11 per square foot, with an average of $3.23. The Atlanta subject properties are mapped on Figure 6.

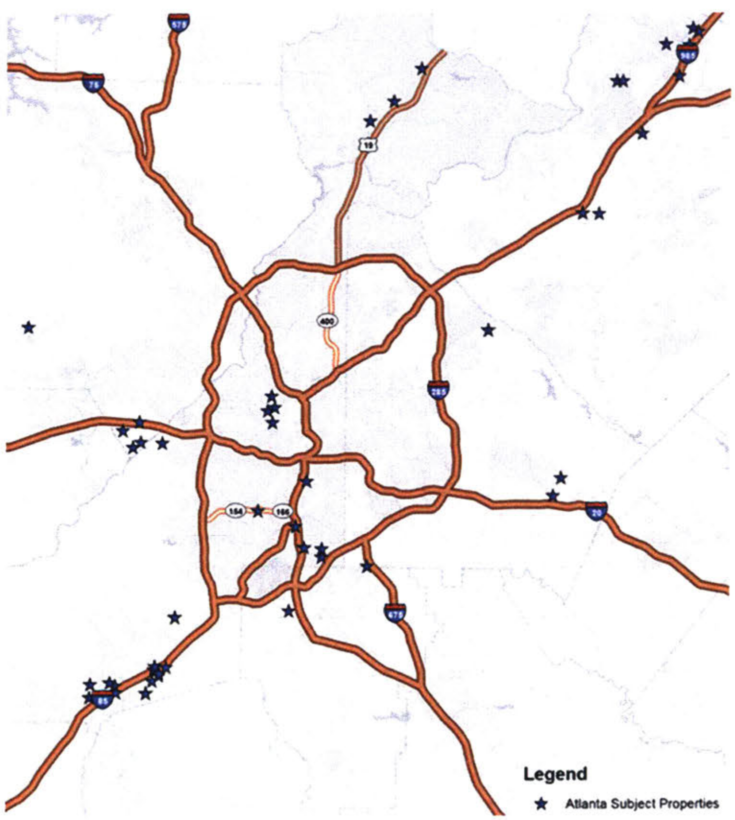

Figure 6 - Atlanta Market Properties

According to a local market report from Jones Lang LaSalle IP, Inc. (2017), vacancy in the Atlanta market stood at 7.9 percent as of Q1 2017, with an average asking rent of $3.79 per square foot. (Note that Jones Lang LaSalle IP, Inc. is also known as JLL). Despite large amounts of construction activity, demand in the market has continued to outpace supply. Two of the largest submarkets in Atlanta are the Airport/South I-85 and the Northeast region.

3.3 Chicago

With an estimated population of 9,512,999 in 2016, Chicago is the third-largest MSA based on population (US Census Bureau, 2016). The Chicago MSA is officially defined as Chicago-Joliet-Naperville, IL-IN-WI, which is comprised of eight counties in Illinois, five counties in Indiana, and one county in Wisconsin (US Census Bureau, 2015). It covers 7,197 square miles across those three states. According to Census data, there are 3,470,000 households in Chicago, with an average size of 2.7 people per household. Median household income is $63,153, which is about 10 percent higher than the average income in the US (US Census Bureau, 2015).

Chicago's gross metro product in 2016 was $644 billion, according to IHS Global Insight (2016), which placed Chicago at #3 among all US metro areas. Major industries that operate in Chicago include financial services, engineering, publishing, and food processing. Chicago serves as the headquarters for 31 Fortune 500 companies, including: Boeing, Caterpillar, Motorola, Discover Financial, United Continental Holdings, and Walgreens (Chicago Tribune, 2017). According to the US Bureau of Labor Statistics (2017), the unemployment rate in Chicago was 4.2 percent as of April 2017. The BLS also reports that nonfarm employment stood at 4,611,000 in March 2017, up 0.8 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment at 932,000 in April 2017, the top industry in the region. Manufacturing also has a strong presence, with 412,000 employees.

Although Chicago stands out geographically among the 10 target markets due to its landlocked location in the Midwest, it is very well-connected to the rest of the country when it comes to transportation infrastructure. Chicago is the busiest freight rail hub in the United States, and handles more than 3 million freight cars annually (Union Pacific, 2017). Chicago serves as the central rail connection between the east and west portions of the US. The area is also served by O'Hare International Airport, which is the sixth largest airport by freight volume in North America (Airports Council International, 2015). Seven interstate highways serve the Chicago area. Its central location in the US has anchored Chicago's position as one of the largest industrial real estate markets in the world, with over 1.1 billion square feet of industrial space (JLL, 2017).

Although it is not located near an ocean, development patterns in the Chicago area have been influenced by a body of water, Lake Michigan, which serves as a natural barrier preventing eastward development. Chicago's industrial real estate market is defined by multiple submarkets. One of the largest submarkets is known as O'Hare, one of the first submarkets outside of the city, close to the airport. This area has some of the oldest buildings in the region, and has experienced redevelopment of existing buildings recently. Another important submarket is the Interstate 55 (I-55) area, which is located about 25 miles outside of the city. This area is one of the more recent submarkets to be built out, and serves most of the regional distribution for the Chicago area. Dupage County is another submarket that borders Chicago, and has been attractive for industrial real estate due to lower tax liabilities. Lastly, another important submarket is Interstate 80 (I-80), which has very good interstate highway access and is home to several larger industrial buildings, ranging in size from 250,000 to 1,000,000 square feet.

The Chicago data set from CBRE contains 183 entries. One hundred twenty-six were completed sales occurring between 2013 and 2016, while 57 were listings. The parcel sizes ranged from 3.91 to 71 acres, and all were established as a variation of industrial or manufacturing zoning. The sales occurred in 57 different towns, with double-digit listings located in Chicago, Joliet, and Aurora. Prices ranged from $0.31 per square foot to $20.86 per square foot, with an average of $5.32. The Chicago property locations are mapped in Figure 7 below.

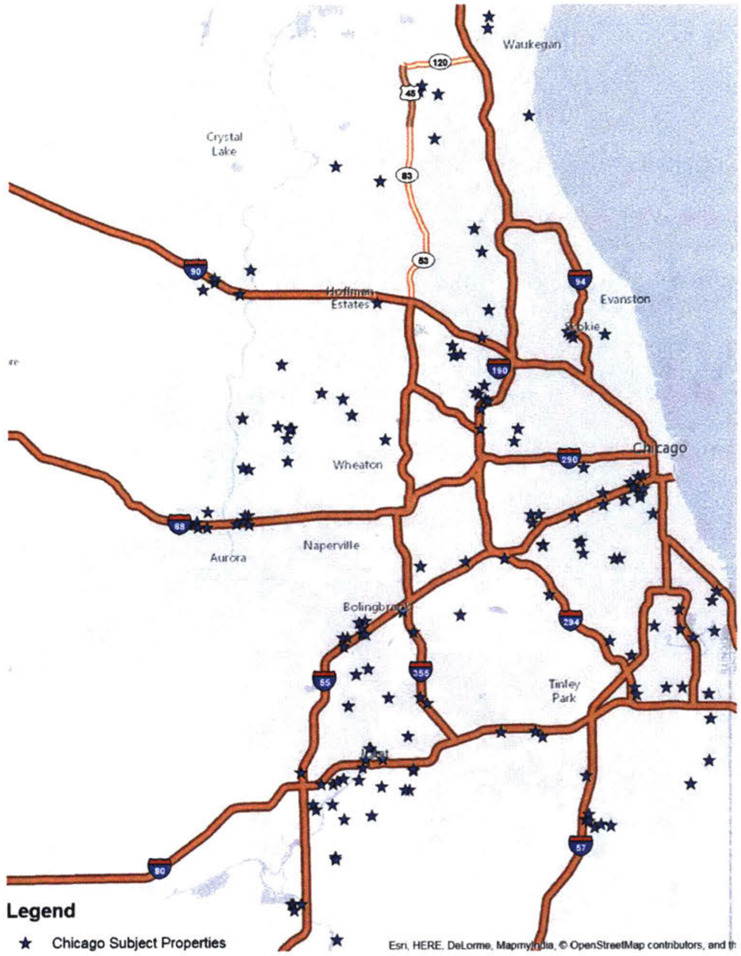

Figure 7 - Chicago Market Properties

According to JLL (2017), vacancy in the Chicago market stood at 7.2 percent in Q1 2017, with an average asking rent of $4.83 per square foot. Construction of new supply remained steady, with over 19 million square feet under construction halfway through 2017. Surprisingly, vacancy rates are up slightly, but JLL predicts vacancy to remain at its current level while rents continue to remain high.

3.4 Dallas

The Dallas-Fort Worth-Arlington, TX Metro Area is the fourth-largest metropolitan statistical area in the United States (US Census Bureau, 2016). The US Census Bureau estimated its 2016 population to be 7,233,323 people. The entire MSA spans an area of 9,280 square miles and includes 20 counties (US Census Bureau, 2015). There are approximately 2.48 million households, averaging 2.8 people per household. Dallas' median household income is $61,644, which is about 10 percent higher than the US average (US Census Bureau, 2015).

According to IHS Global Insight (2016), Dallas' gross metro product in 2016 was $545 billion. This ranks Dallas as the fourth largest US metro area by GMP. Major industries that operate in Dallas include technology, financial services, and manufacturing. The metropolitan area is home to over 10,000 corporate headquarters, making it the largest concentration of corporate headquarters in the United States (PR Newswire, 2015). According to the US Bureau of Labor Statistics (2017), the unemployment rate in Dallas was 3.8 percent in April 2017, below the national average of 4.1 percent. The BLS also reports that non-farm employment stands at 3,588,000 as of April 2017, up 3.0 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment numbers of 760,000 in April 2017, while Manufacturing reported 264,000.

Air freight in the Dallas area is served by the Dallas/Fort Worth International Airport, which ranks as the eleventh largest air cargo terminal in North America (Airports Council International, 2015). The area is also well connected to the interstate system for ground freight, and features the second largest number of freeway miles per capita in the US. There are eight interstate highways that run through the area: I-20, I-820, I-30, I35E, I35W, I-635, I-45, and I-345. This roadway system facilitates strong connections to Texas and beyond.

The Dallas data set from CBRE contains 122 properties. Sixty-seven were completed sales occurring between 2012 and 2017, while 55 were listings. The parcel sizes ranged from 5 to 70 acres, and a majority were zoned as industrial or manufacturing. The sales occurred in 26 different towns, with double-digit quantities of listings located in Dallas and Fort Worth. Prices ranged from $0.25 per square foot to $16.16 per square foot, with an average of $3.10. The Dallas subject property locations are shown on the map in Figure 8.

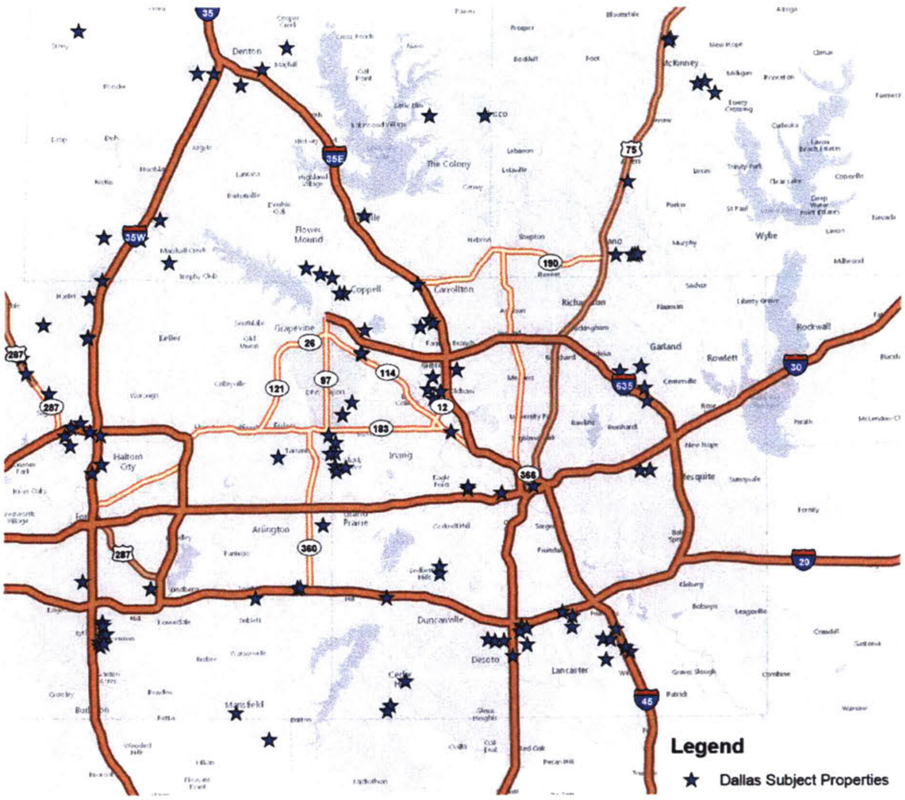

Figure 8 - Dallas Market Properties

According to JLL (2017), vacancy in the Dallas market stood at 6.1 percent in Q1 2017, with an average asking rent of $4.32 per square foot. The market has sustained high levels of net absorption over the past few years due to strong demand from e-commerce users. The entire Dallas industrial real estate market totals 575 million square feet. There are nine major submarkets, with four totaling well over 70 million square feet.

3.5 Houston

The Houston-The Woodlands-Sugarland, TX Metro Area has the fifth largest metropolitan statistical area population in the United States (US Census Bureau, 2016). The US Census Bureau estimated its 2016 population to be 6,772,470 people. The entire MSA spans an area of 8,260 square miles and covers ten counties (US Census Bureau, 2015). There are approximately 2.293 million households, averaging 2.9 people per household. Houston's median household income is $61,465, which is about 10 percent higher than the US average (US Census Bureau, 2015).

Houston's gross metro product in 2016 was $491 billion, according to IHS Global Insight (2016). This ranks Houston at #6 for total GMP among all US metro areas. Major industries that operate in Houston include energy, aerospace and defense, and equipment. There are 20 Fortune 500 companies headquartered in the city (Houston Business Journal, 2017). According to the US Bureau of Labor Statistics (2017), the unemployment rate in Houston is 3.5 percent as of April 2017. This is below the national average of 4.1 percent. The BLS also reports that nonfarm employment stands at 3,042,000 as of April 2017, up 1.4 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 640,000 in April 2017, while Manufacturing reported 230,000.

Air freight in the Houston area is served by the George Bush Intercontinental Airport, which ranks as the eighteenth largest air cargo terminal in North America (Airports Council International, 2015). Ground freight utilizes over 575 miles of freeways and expressways within the MSA. The major interstate highways running through Houston include I-10, I-45, and I-69. Nearby, Houston's port processed nearly 2.2 million containers (20-foot equivalent units/TEUs) in 2015, making it the tenth largest cargo port in North America (American Association of Port Authorities, 2016).

The Houston data set from CBRE contains 110 entries. Seventy were completed sales occurring between 2013 and 2016, while 40 were listings. The parcel sizes ranged from 5 to 70 acres, and a majority were zoned as industrial or manufacturing. The listings were located in eighteen different towns, with 64 of the total listings located within Houston. Prices ranged from $0.40 per square foot to $23.21 per square foot, with an average of $3.92. The Houston subject properties are mapped on Figure 9 below.

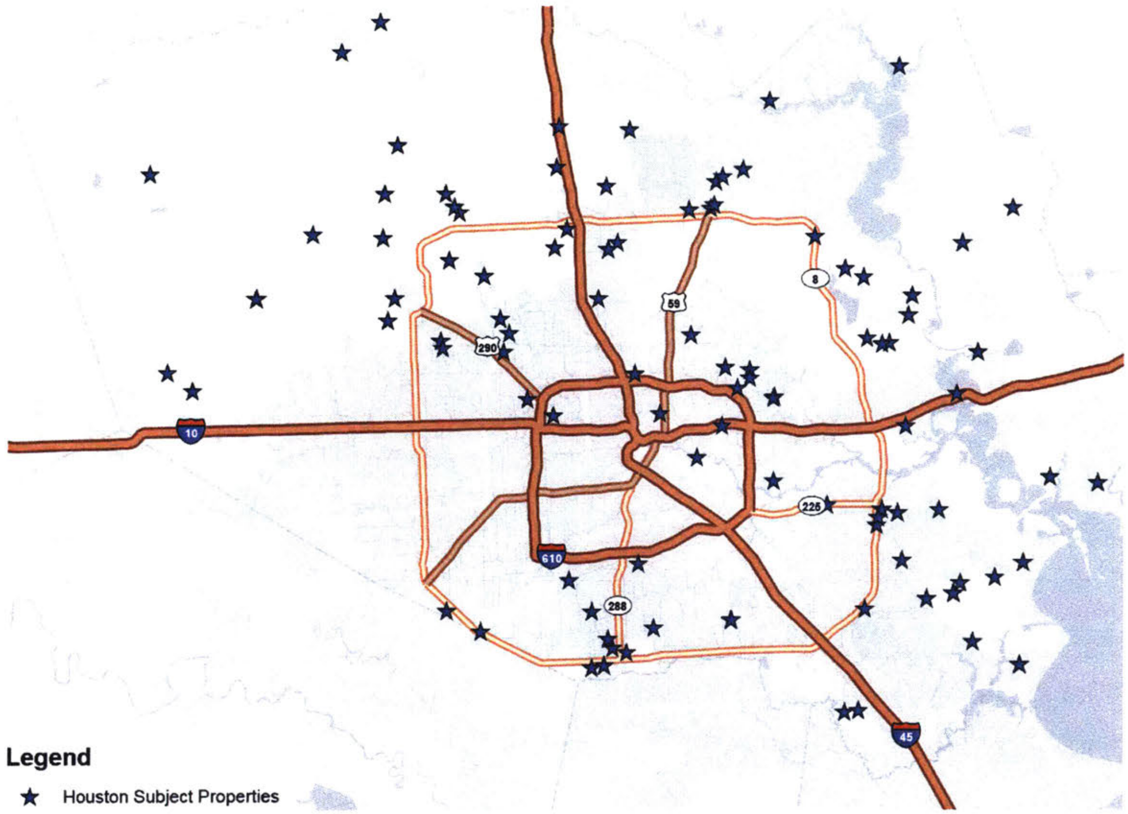

Figure 9 - Houston Market Properties

According to JLL (2017), vacancy in the Houston market was approximately 5.3 percent as of Q1 2017, with an average asking rent of $6.32 per square foot. Deliveries in the market have outpaced absorption, resulting in a slightly increased vacancy rate. The entire Houston industrial real estate market totals 421 million square feet. There are seven major submarkets, led by the Northwest region which contains over 118,000,000 square feet. Recently, the Southeast region has been driving growth in the market, accounting for 75 percent of the net absorption in the entire market in the first quarter of 2017.

3.6 Inland Empire

The Inland Empire (IE) is a region in Southern California that is located approximately 50 miles east of Los Angeles. It has emerged as one of the fastest growing industrial real estate markets in the country due to its proximity to Los Angeles and relatively lower land values. Lower land cost and proximity to Los Angeles ports and population make the IE an attractive location for many industrial users. The Inland Empire region generally corresponds to the area known as the Riverside-San Bernardino-Ontario MSA, which has the thirteenth-largest MSA population in the United States. The US Census Bureau (2016) estimated its 2016 population to be 4,527,837 people. The entire MSA spans an area of 27,263 square miles (US Census Bureau, 2015), while most of the population is concentrated in San Bernardino and Riverside counties. There are approximately 1.343 million households, averaging 3.3 people per household. The area's median household income is $56,087, which is about the same as the US average (US Census Bureau, 2015).

According to IHS Global Insight (2016), the Inland Empire's gross metro product in 2016 was $147 billion. This ranks the Inland Empire at #23 for total GMP for all US metro areas. Major industries in the Inland Empire include logistics, manufacturing, and healthcare. According to the US Bureau of Labor Statistics (2017), the unemployment rate in the IE was 4.7 percent in April 2017, which is above the national average of 4.1 percent. The BLS also reports that nonfarm employment stood at 1,444,000 in April 2017, up 3.0 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment at 349,000 in April 2017, which is by far the largest sector in the area. Air freight travel in the Inland Empire area is served locally by Ontario International Airport, which ranks as the fifteenth largest air cargo terminal in North America (Airports Council International, 2015). Ground freight is served by the main interstate highways: I-10, I-15, and I-215.

The Inland Empire data set from CBRE contains 144 entries. One hundred thirty-one were completed sales occurring between 2013 and 2017, while 13 were listings. The parcel sizes ranged from 1.73 to 95 acres, and a majority were zoned as industrial or manufacturing. The sales occurred in 30 different towns, with nineteen sales located in Perris and 17 in Fontana. Prices ranged from $0.26 per square foot to $52.42 per square foot, with an average of $9.68. The Inland Empire subject properties are mapped on Figure 10 below.

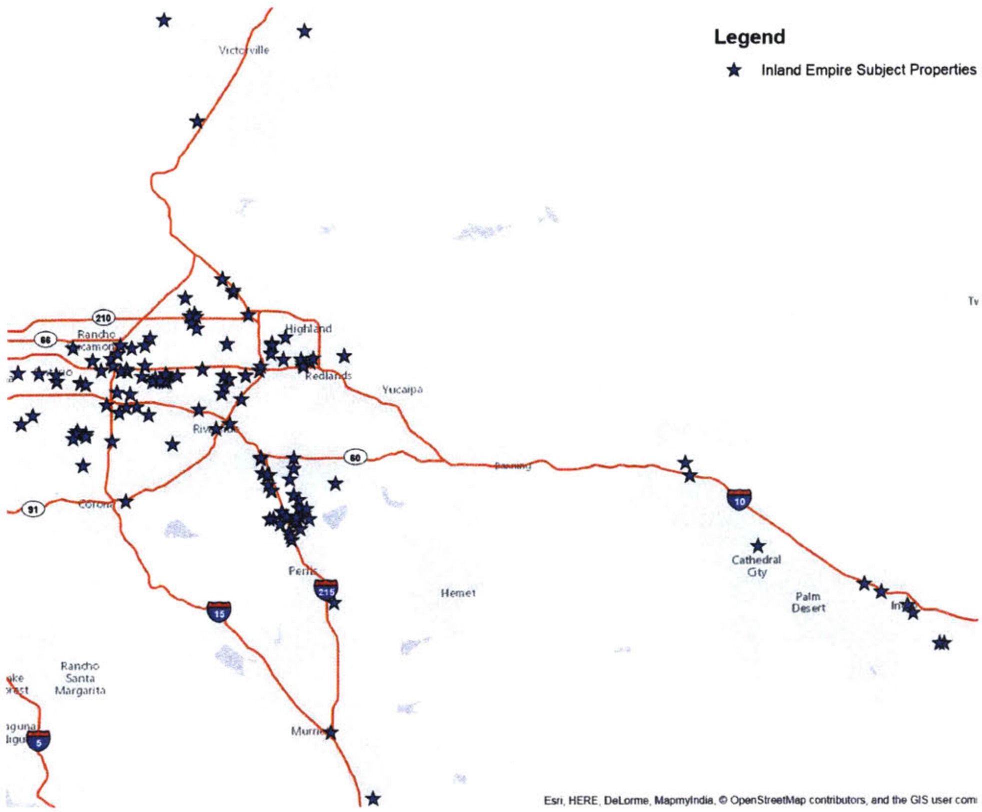

Figure 10 - Inland Empire Market Properties

According to JLL (2017), vacancy in the Inland Empire market stood at 3.4 percent in Q1 2017, with an average asking rent of $0.52 per square foot. There has been a large amount of speculative construction, with rents at all-time highs and vacancies at all-time lows. The entire Inland Empire industrial real estate market totals 498 million square feet. There are two major submarkets: East and West. The West submarket is more land-constrained, and has been built out more due to its location closer to Los Angeles. As a result, the West market has seen faster value appreciation relative to the East. Growth potential remains in the East market, as it catches up to the West.

3.7 Los Angeles

The Los Angeles-Long Beach-Anaheim, CA (LA) Metro Area has the second largest MSA population in the United States (US Census Bureau, 2016). The US Census Bureau estimated its 2016 population to be 13,310,447 people. The entire MSA spans an area of 4,849 square miles and includes two counties, Los Angeles and Orange (US Census Bureau, 2015). Land development is constrained by natural features, with the Pacific Ocean to the west and mountain ranges to the east. There are approximately 4.315 million households, averaging three people per household. Los Angeles' median household income is $62,544, which is about 10 percent higher than the US average (US Census Bureau, 2015).

Los Angeles' gross metro product in 2016 was $934 billion, according to IHS Global Insight (2016). This ranks LA at #2 for total GMP for all US metro areas. Major industries that operate in LA include entertainment, technology, healthcare, and trade. The city is also home to 13 Fortune 500 companies (Los Angeles Business Journal, 2016). According to the US Bureau of Labor Statistics (2017), the unemployment rate in Los Angeles was 3.9 percent in April 2017. The BLS also reported that non-farm employment stood at 6 million in April 2017, up 0.9 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment at 1,079,000 in April 2017, while Manufacturing reported 510,000.

One of Los Angeles' biggest strengths is its port. The Port of Los Angeles is the biggest container port in the United States and processed 8,856,783 shipping containers in 2016 (American Association of Port Authorities, 2016). The port serves as America's gateway to Asia. Air freight in the LA area is served by the Los Angeles International Airport, which ranks as the fifth largest cargo terminal in North America (Airports Council International, 2015). The area is also served by many interstate highways, connecting the region to the rest of California's large population.

The Los Angeles data set from CBRE contains 79 entries. Sixty-six were completed sales occurring between 2013 and 2016, while 13 were listings. The parcel sizes ranged from 5 to 73 acres, and all were zoned as industrial or manufacturing. The sales occurred in 38 different towns, with multiple entries in City of Industry, Lancaster, and Los Angeles. Prices ranged from $0.41 per square foot to $67.61 per square foot, with an average of $25.25. The Los Angeles subject properties are mapped in Figure 11 below.

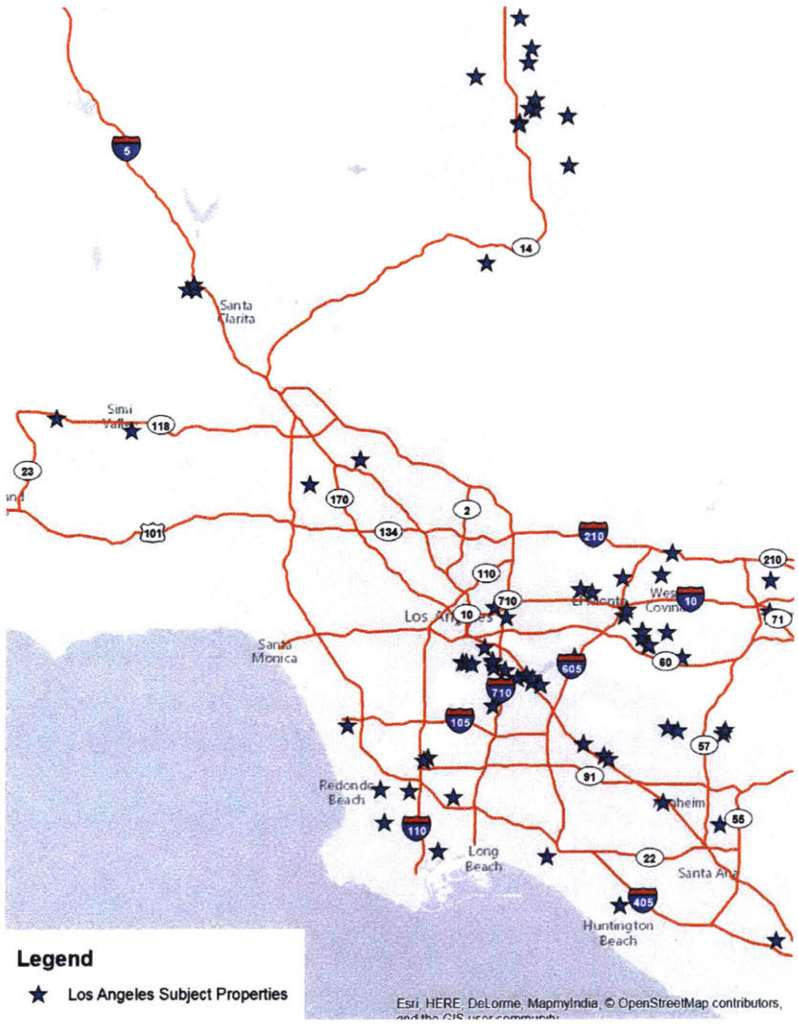

Figure 11 - Los Angeles Market Properties

According to JLL (2017), vacancy in the Los Angeles market stood at 0.9 percent in Q1 2017, with an average asking rent of $9.12 per square foot. The extremely low vacancy number highlights a very tight market for tenants. The lack of available land has continued to drive rents, and thus land values, upward. The entire LA industrial real estate market totals 791 million square feet. There are five major submarkets, including San Fernando Valley, Central, Mid-Counties, South Bath, and San Gabriel Valley.

3.8 Miami

The Miami-Fort Lauderdale-West Palm Beach, FL Metro Area is the eighth largest metropolitan statistical area in the United States. The US Census Bureau estimated its 2016 population to be 6,066,387 people. The entire MSA spans an area of 5,075 square miles and includes three counties (US Census Bureau, 2015). There are approximately 2.077 million households, averaging 2.9 people per household. Miami's median household income is $50,441, which is about 10 percent less than the US average (US Census Bureau, 2015).

According to IHS Global Insight (2016), Miami's gross metro product in 2016 was $329 billion. This ranks Miami at #11 for total GMP for all US metro areas. Major industries that operate in Miami include financial services, tourism, trade, and media. There are six Fortune 500 companies headquartered in the city. According to the US Bureau of Labor Statistics (2017), the unemployment rate in Miami was 4.4 percent in April 2017, above the national average of 4.1 percent. The BLS also reports that nonfarm employment stands at 2,647,000 as of April 2017, up 2.3 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 599,000 in April 2017, while Manufacturing reported 88,000.

Miami is a gateway city and features strong connectivity to the rest of the country. Air freight in Miami is served by Miami International Airport, which ranks as the fourth largest air cargo terminal in North America (Airports Council International, 2015). The Port of Miami also handles considerable container volume, ranked as the 17th largest port in North America (American Association of Port Authorities, 2016). Ground freight is facilitated by five interstate highways that connect Miami to the rest of Florida, as well as the southeastern United States. The major interstate highways running through Miami include I-75, I-95, I-195, I-395, and I-595.

The Miami data set from CBRE contains 49 entries. Forty-four were completed sales occurring between 2013 and 2017, while five were listings. The parcel sizes ranged from 3.3 to 71.9 acres, and a majority were zoned as industrial or manufacturing. The sales occurred in 22 different towns, with seven located in Miami and seven located in West Palm Beach. Prices ranged from $2.09 per square foot to $53.48 per square foot, with an average of $12.65. The Miami subject property locations are shown on the map in Figure 12 below.

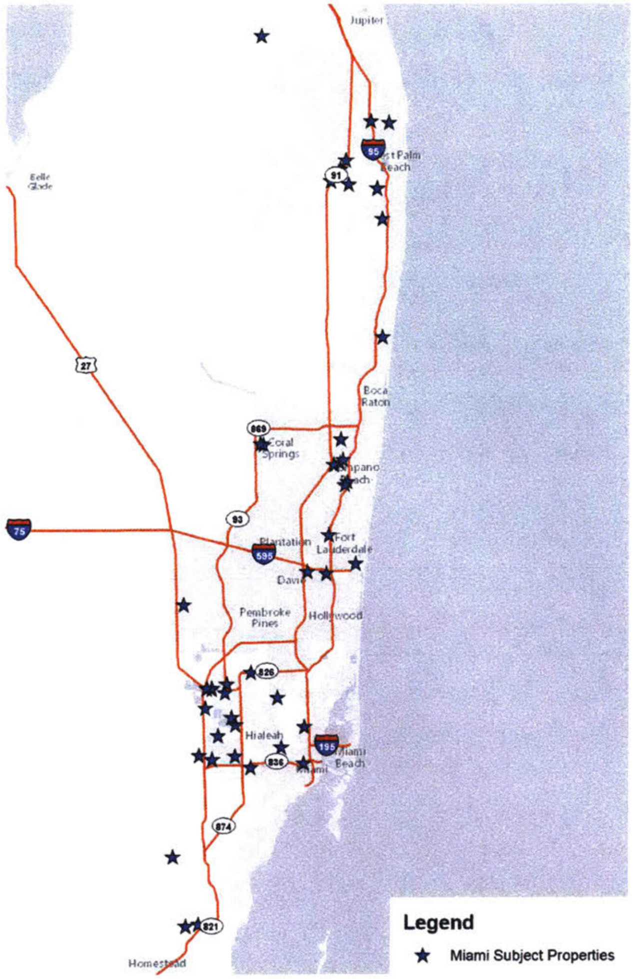

Figure 12 - Miami Market Properties

According to JLL (2017), vacancy in the Miami market stood at 3.8 percent in Q1 2017, with an average asking rent of $6.87 per square foot. The market has experienced nine straight years of declining vacancy rates, as more institutional investors have taken notice of the market. The entire Miami industrial real estate market totals 183 million square feet. There are eight major submarkets, led by the Airport West region with over 45,000,000 square feet.

3.9 New Jersey/New York

The New York-Newark-Jersey City, NY-NJ-PA Metro Area (NY/NJ) is the largest metropolitan statistical area in the United States. The US Census Bureau estimated its 2016 population to be 20,153,634 people. The entire MSA spans an area of 8,292 square miles and includes 25 counties (US Census Bureau, 2015). There are approximately 7.125 million households, averaging 2.8 people per household. The area's median household income is $68,743, which is about 25 percent higher than the US average (US Census Bureau, 2015).

NY/NJ's gross metro product in 2016 was $1.66 trillion, according to IHS Global Insight (2016). This is far and away the highest GMP value in the United States. Major industries that operate in NY/NJ include financial services, international trade, communications, manufacturing, and technology. It is considered one of the top business hubs in the world. In 2014, there were 72 Fortune 500 companies headquartered in the NY/NJ MSA (Charlotte Chamber of Commerce, 2014). According to the US Bureau of Labor Statistics (2017), the unemployment rate in NY/NJ was 3.9 percent in April 2017, which was below the national average of 4.1 percent. The BLS also reports that nonfarm employment stood at 9,586,000 in April 2017, up 0.9 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 1,705,000 in April 2017, while Manufacturing reported 363,000.

More than 30 percent of the United States' population lives within 500 miles of New York (Hofstra Department of Global Studies and Geography, 2017). This consumer base is easily reached by the network of interstate highways connecting the Tri-State Area to the rest of the northeast. In addition, the New York/New Jersey ports are the third busiest in the country, seeing over 6,250,000 TEU in shipping container volume in 2015 (American Association of Port Authorities, 2016). An extensive rail network also serves the area. Lastly, two of the nation's top ten airports by cargo volume are located within the MSA. New York's John F. Kennedy International Airport ranks as the seventh busiest airport by cargo volume, while New Jersey's Newark Liberty International Airport ranks 10th (Airports Council International, 2015).

The New Jersey data set from CBRE contains 33 entries, located in 27 towns across New Jersey. This is the smallest sample size of the focus markets, and one of the most spread out. Twenty-four entries were completed sales occurring between 2013 and 2017, while nine were listings. The parcel sizes ranged from 5 to 75 acres, and a majority were zoned as industrial. Prices ranged from $0.11 per square foot to $42.51 per square foot, with an average of $6.19. The New Jersey subject properties are mapped in Figure 13 below.

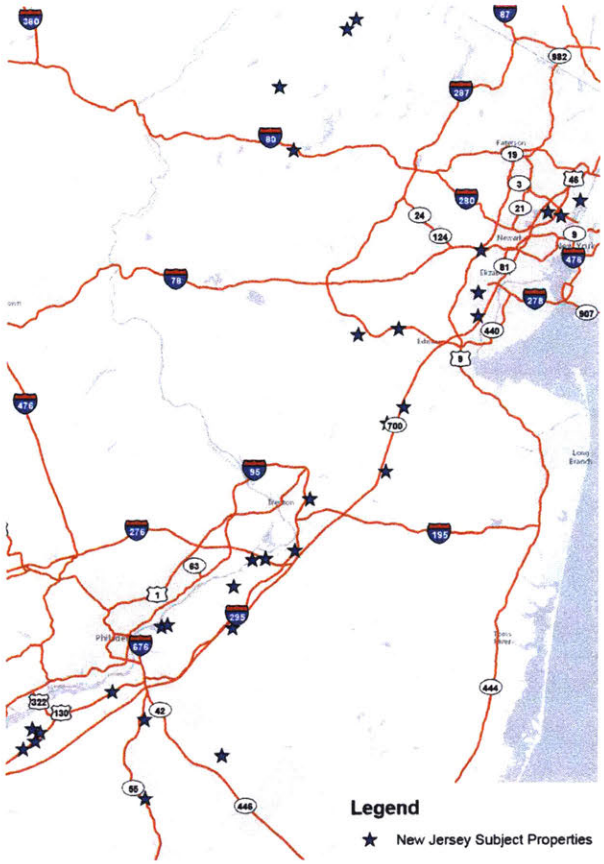

Figure 13 - New Jersey Market Properties

The CBRE data set includes locations within New Jersey only, so the current market conditions in New Jersey will be reviewed. According to JLL (2017), vacancy in the New Jersey market stood at 4.0 percent in Q1 2017, with an average asking rent of $6.76 per square foot. The New Jersey market has experienced historically low vacancy rates in 2017, in addition to rapidly growing rents. The demand from retailers to locate near population centers has driven the northern New Jersey market to unprecedented levels. The entire New Jersey industrial real estate market totals 343 million square feet. There are 12 major submarkets, led by the Port region with over 100,000,000 square feet of space and the Meadowlands with almost 76 million square feet.

3.10 San Francisco

The San Francisco-Oakland-Hayward, CA Metro Area is the 11th largest metropolitan statistical area in the United States. The US Census Bureau estimated its 2016 population to be 4,679,166 people. The entire MSA spans an area of 2,477 square miles and includes five counties (US Census Bureau, 2015). There are approximately 1.689 million households, averaging 2.7 people per household. San Francisco's median household income is $88,518, which is about 50 percent higher than the US average (US Census Bureau, 2015).

San Francisco's gross metro product in 2016 was $456 billion, according to IHS Global Insight (2017). This ranks San Francisco at #7 for total GMP for all US metro areas. Major industries that operate in San Francisco include tourism, technology, and life science. The total number of Fortune 500 companies headquartered in the area is second only to New York City. According to the US Bureau of Labor Statistics (2017), the unemployment rate in San Francisco was 3.1 percent in April 2017. This was well below the national average of 4.1 percent. The BLS also reports that nonfarm employment stands at 2,377,000 as of April 2017, up 2.0 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 375,000 in April 2017, while Manufacturing reported 131,000.

The San Francisco area is served by multiple interstate highways. Air freight in the area is served by the San Francisco Intercontinental Airport, which ranks as the 16th largest air cargo terminal in North America (Airports Council International, 2015). The Port of Oakland is the ninth busiest cargo terminal in North America (American Association of Port Authorities, 2016). The area features many natural barriers that restrict land development, as San Francisco itself is located on a peninsula and the remainder of the MSA borders San Francisco Bay.

The San Francisco data set from CBRE contains 33 entries. Twenty-eight were completed sales occurring between 2013 and 2016, while five were listings. The parcel sizes ranged from 5 to 55.6 acres, and a majority were zoned as industrial. The listings were located in 11 different towns, with a majority located in Fremont, Livermore, and Richmond. Prices ranged from $2.00 per square foot to $140 per square foot, with an average of $16.07 and a median of $9.55. The San Francisco subject property locations are shown on the map in Figure 14 below.

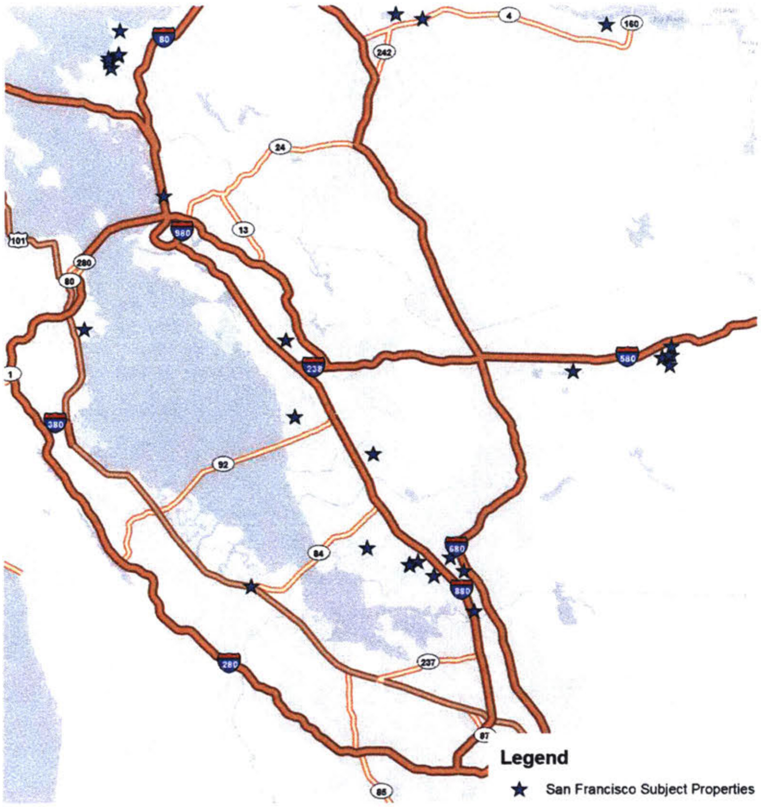

Figure 14 - San Francisco Market Properties

According to JLL (2017), vacancy in the San Francisco market stood at 3.9 percent in Q1 2017, with an average asking rent of $6.77 per square foot. The market has experienced strong tenant demand, while also experiencing very low vacancy levels, similar to several other focus markets. Increasing rents have resulted in more speculative building, which has been sustainable by the market into 2017. The entire San Francisco industrial real estate market totals 67 million square feet. There are 14 major submarkets, led by the Fairfield region with over 12,000,000 square feet.

3.11 Seattle

The Seattle-Tacoma-Bellevue, WA Metro Area has the 15th largest metropolitan statistical area population in the United States. The US Census Bureau estimated its 2016 population to be 3,798,902 people. The entire MSA spans an area of 5,872 square miles and includes three counties (US Census Bureau, 2015). There are approximately 1.437 million households, averaging 2.6 people per household. Seattle's median household income is $75,331, which is about 40 percent higher than the US average (US Census Bureau, 2015).

Seattle's gross metro product in 2016 was $324 billion, according to IHS Global Insight (2016). This places Seattle at #12 for total GMP for all US metro areas. Major industries that operate in Seattle include clean energy, aerospace & defense, and technology. According to the US Bureau of Labor Statistics (2017), the unemployment rate in Seattle was 3.4 percent in April 2017. This was well below the national average of 4.1 percent. The BLS also reports that nonfarm employment stood at 1,989,000 in April 2017, up 2.7 percent over the previous year. The Trade/Transportation/Utilities industry reported total employment of 375,000 in April 2017, while Manufacturing reported 179,000.

The Seattle area is served by multiple interstate highways. Its major airport, Seattle-Tacoma International, is the 20th busiest airport for air freight in North America (Airports Council International, 2015). Even more significant is its major port, Seattle/Tacoma Alliance, which is the fifth busiest container terminal by volume in North America (American Association of Port Authorities, 2016).

The Seattle data set from CBRE contains 51 entries. Thirty-five were completed sales occurring between 2013 and 2017, while 16 were listings. The parcel sizes ranged from 3 to 61.7 acres, and a majority were zoned as industrial. The listings were located in 18 different towns, with multiple locations in Arlington, Everett, Fife, Kent, Seattle, Sumner, and Tacoma. Prices ranged from $1.06 per square foot to $59.55 per square foot, with an average of $10.90 and a median of $7.80. The Seattle subject property locations are mapped on Figure 15 below.

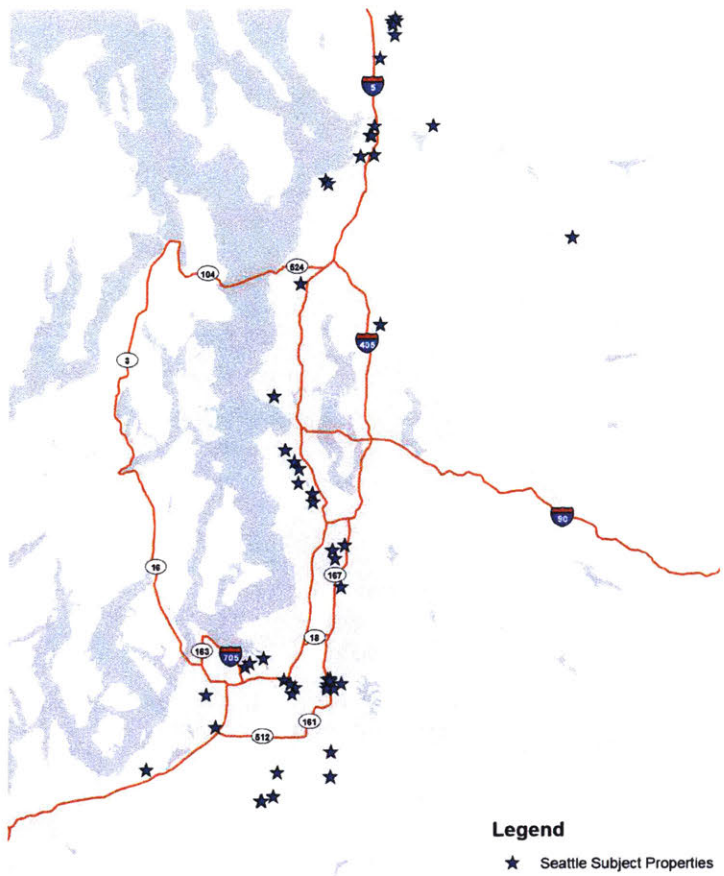

Figure 15 - Seattle Market Properties

According to JLL (2017), vacancy in the Seattle market stood at 2.7 percent as of Q1 2017, with an average asking rent of $9.70 per square foot. At that time, the market had experienced 25 straight quarters of positive absorption. Supply constraints continue to place upward pressure on rents. The entire Seattle industrial real estate market totals 283 million square feet. There are 31 major submarkets, led by the Kent region with over 49,000,000 square feet.

The commonalities across all 10 focus markets are evident after reviewing their local demographics, economies, locations, and infrastructure. The next chapter will evaluate the specific subject properties and their characteristics within each of the focus markets. The additional variables (WRLURI and GIS) and their derivation are also described in detail.

Chapter 4: Data Sources

Three sources of data were combined to create the data set for the analysis. The property transaction database from CBRE served as the foundation. In addition, index values from the Wharton Residential Land Use Regulatory Index were added to the properties in each of the 10 focus markets. Finally, spatial data for each property was obtained using GIS software. These three sources are detailed in Sections 4.1, 4.2, and 4.3.

4.1 CBRE Data

4.1.1 Data Source

The main source of data for this analysis is a database of land sale transactions provided by CBRE. CBRE is the world's largest commercial real estate services firm. It serves owners, investors, and occupiers with seven business lines across a variety of real estate sectors. The CBRE Research team covers markets all over the world and provides insight and data to its customers.

The land transaction database initially consisted of approximately 1,000 land sale transactions in the 10 focus markets. Most of the entries are actual sales transactions that have closed and have been verified by at least one source. Other entries are classified as "Available/Listing" or "Under Agreement." For the purposes of this analysis, the listing price for these entries was assumed as the sale price in order to maximize the number of data points. It is possible that final sale prices for these land parcels is higher or lower than the listing price. The distribution of the sale/listing data points across the ten markets is summarized in Figure 16.

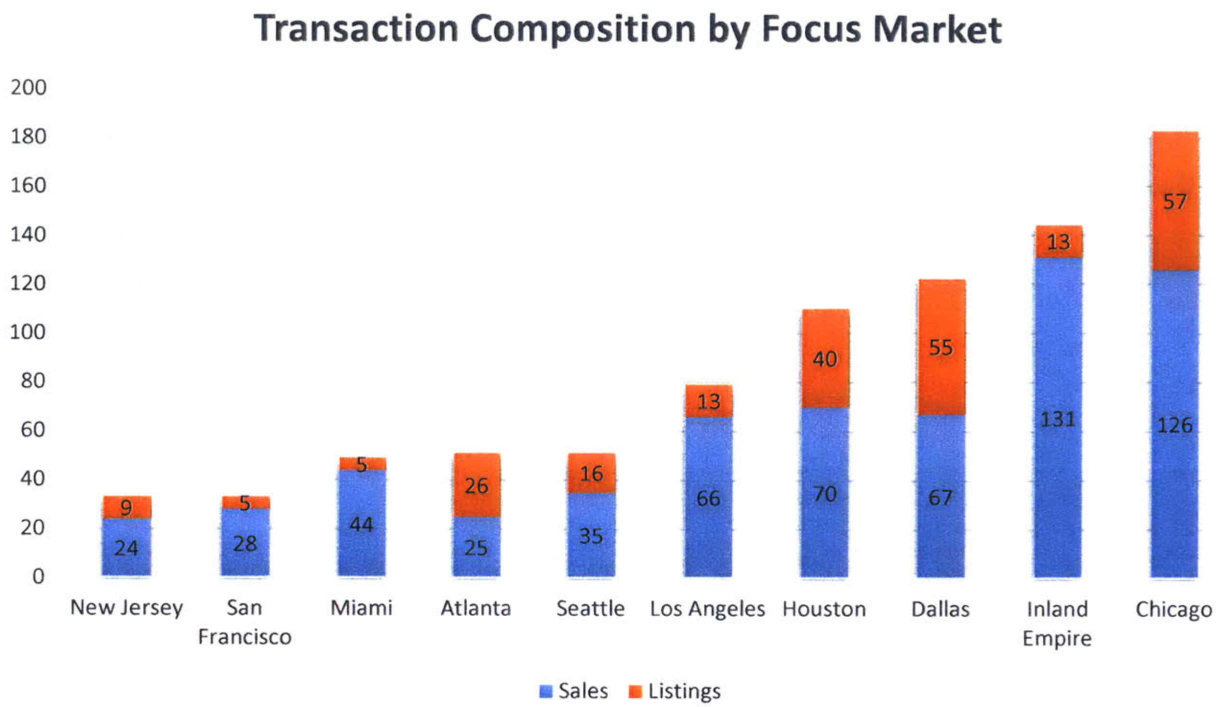

Figure 16 - CBRE Data Transaction Composition

4.1.2 CBRE Data Review

The raw data was evaluated and pared down based on completeness. Some entries had data marked as confidential or did not include an address or sale price, and they were eliminated. Any transaction without a specific address was reviewed, and verification was attempted. For example, many transactions provide only cross streets for a given parcel's location (i.e., "northwest corner of Highway 128 and Main Street"). A number and street address was assigned to these entries (if possible) in order to later calculate distances from points of interest via GIS software analysis. While this may not have produced a 100 percent accurate address, it was preferable to have an approximate address rather than eliminate the data point. After the review process, 855 entries remained. All of the entries contained a sale price, parcel size, and address, which established the baseline for the data points. Most of the entries contained details about the site geography, such as parcel shape, topography, development status, and zoning classification. Many of the entries also contained a sale date. Some entries contained information about street frontage, buyer and seller identification, financing, and other details. However, these variables were not consistent enough across the data set to be included in the analysis.

The data points were all classified by CBRE as "Industrial Land", which is the focus of this thesis. However, some subject properties were zoned for other land uses, which is detailed later in this chapter. Most of the transactions were land-only transactions. The remaining data points had either negligible improvements on them or contained a deduction for demolition to obtain a land only value, as mentioned previously. Figure 17 represents a typical entry from the CBRE data set.

Sale | **Land - Industrial** | **No. 23**

Property Name	Industrial Land
Address	41100 Boyce Road Fremont, CA 94538 United States
Government Tax Agency	Alameda
Govt./Tax ID	531-0165-004-04 and 531-0165-029-03

Site/Government Regulations

	Acres	Square feet
Land Area Net	33.060	1,440,094
Land Area Gross	33.060	1,440,094

Site Development Status	N/A
Shape	Rectangular
Topography	Generally Level
Utilities	To Site
Maximum FAR	N/A
Min Land to Bldg Ratio	N/A
Maximum Density	N/A
Frontage Distance/Street	1,286 ft Boyce
General Plan	N/A
Specific Plan	N/A
Zoning	Industrial
Entitlement Status	N/A

Sale Summary

Recorded Buyer	41100 Boyce Road LLC	Marketing Time	12 Month(s)
True Buyer	Prologis	Buyer Type	Developer
Recorded Seller	Borden Chemical Inc	Seller Type	Corporation
True Seller	Hexion Inc.	Primary Verification	Broker
Interest Transferred	Fee Simple/Freehold	Type	Sale
Current Use	Vacant Land	Date	10/20/2014
Proposed Use	Industrial Building	Sale Price	$20,172,194
Listing Broker	Michael Walker 510-874-1979, CBRE	Financing	Market Rate Financing
Selling Broker	N/A	Cash Equivalent	$20,172,194
Doc #	259553	Capital Adjustment	$0
		Adjusted Price	$20,172,194

Transaction Summary plus Five-Year CBRE View History

Transaction Date	Transaction Type	Buyer	Seller	Price	Price/ac and /sf
10/2014	Sale	41100 Boyce Road LLC	Borden Chemical Inc	$20,172,194	$610,169 / $14.01

Figure 17 - Sample CBRE Data Entry

4.1.3 CBRE Data – Category Descriptions

The categories from the CBRE data entries are described below:

Sale Price – This category contained the price paid for the land in a given transaction. For "Listing" or "Under Agreement" data points, it represents the listing price. The price is given in absolute terms, as well as dollars per acre and dollars per square foot. As detailed in the next chapter, the log of the land price per square foot was utilized for the regression analysis.

Physical Land Features – This category includes the physical attributes of each property provided by CBRE. First, each parcel's size is given in acres. Parcel size was converted to square feet for the regression analysis. The relationship between land value and parcel size was observed by several of the studies featured in the literature review. Typically, there is an inverse relationship between price per acre and parcel size. The large footprints of many industrial buildings require larger plots of land, which is reflected by the parcel sizes in this data set. The parcel sizes range from just under 2 acres to 95 acres, with an average of 18.4 acres and a median of 12.36 acres.

Each parcel's shape is classified into the following groups: rectangular, triangular, L-shaped, and irregular. It is assumed that regular, rectangular plots of land are most valuable because they can be used most efficiently. Conversely, it is assumed that triangular plots of land result in less total usable acreage. Regular shaped parcels of land have higher efficiency of use than irregular shapes. Each land parcel is also assigned a development status: finished, semi-finished, and raw. It is assumed that finished parcels are most valuable because they require little site preparation in order to begin construction of a new building. Raw land increases construction costs due to the site work required to prepare the land for construction. In the same vein, each parcel is also classified into a topography category: generally level, moderate slope, or rolling. Similar to site development status, level plots of land require less site preparation and are easier to build on. Higher land use efficiency is implied for flat plots of land, whereas varying topography may limit an owner's ability to utilize all of the site acreage. The distribution of the data points across the land feature categories is detailed in Figure 18.

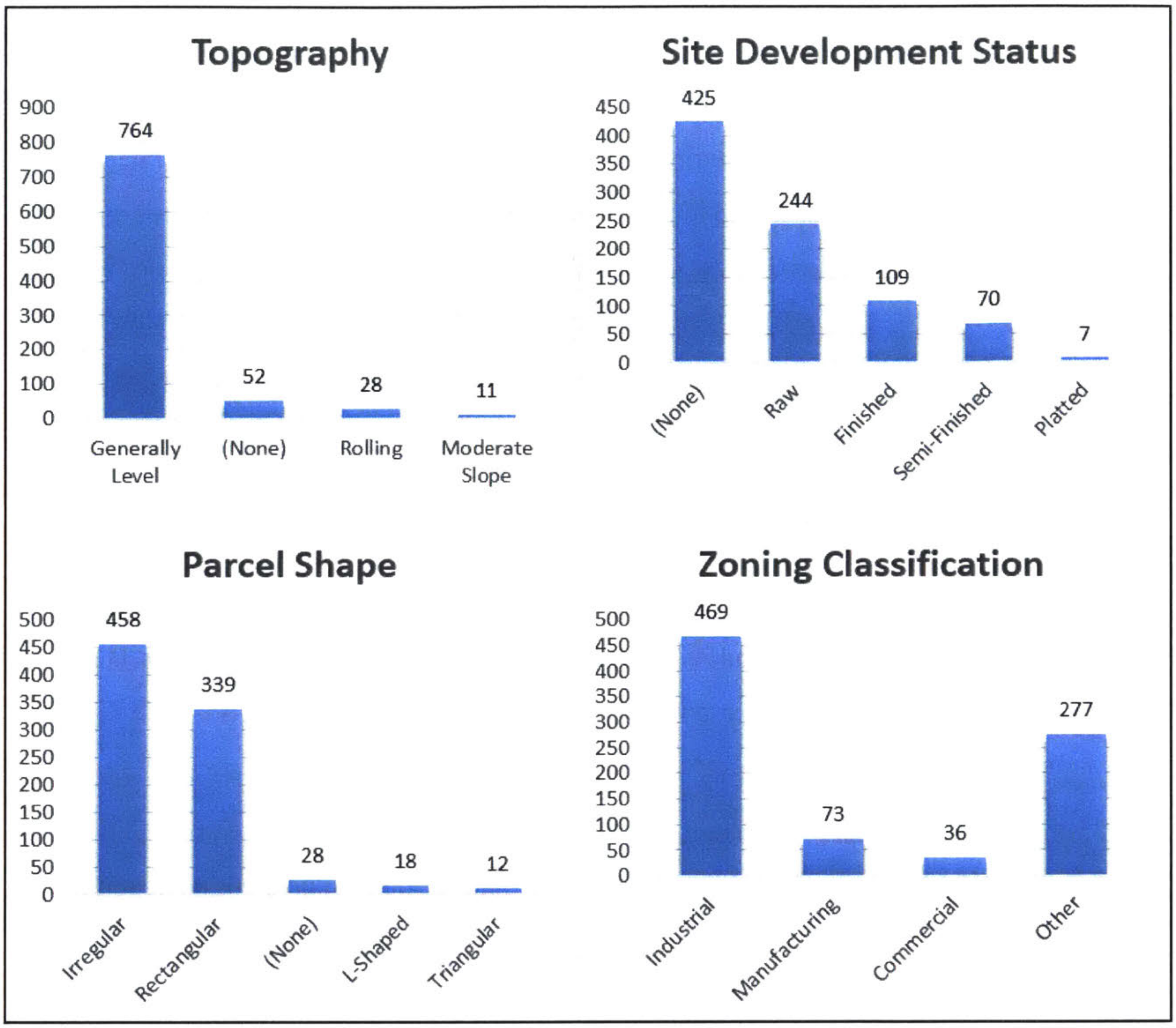

Figure 18 - Land Characteristics Data

<u>Current Zoning Status</u> – Each parcel is also classified based on its current zoning status (where available). Zoning is a legal restriction on the way the land can be used. Local governments use zoning, among other reasons, to segregate uses that are not compatible. Industrial is a land use that is often segregated due to its incompatibility with residential and some commercial uses. For this study, each parcel's zoning was classified into one of four categories. Zoning varies broadly across different regions and there are no standard classifications. Within one municipality, there might be two types of industrial uses, whereas in another there might be six different types. The naming conventions also vary widely, for example: "Light Industrial" and

"Limited Industrial" could mean the same thing in different municipalities. For the purposes of this analysis, both of the properties with those names were be classified as "Industrial." That is how the four broader zoning categories were assigned: industrial, manufacturing, commercial, and other. This allows for comparison of industrial and its closely related uses. The "Other" category contains properties that were listed as office, residential, mixed use, other, or left blank. Of the 855 land parcels in the analysis, zoning information was not available for 197 of the parcels, which were classified as "Other."

Sale Timing

Each transaction occurs over a period of six years, 2012 through 2017. Each entry is categorized based on the quarter it was sold in, in order to lessen the effect of timing on the sale price. The 616 sold properties were distributed over the quarterly time periods as summarized in Figure 19.

Figure 19 - CBRE Data Set Sale Timing

4.1.4 Limitations

While the data set is unique in that it contains mostly land-only transactions and focuses on industrial uses, it does have some limitations. First, while large enough to be statistically significant, it would be preferable to have more data points, especially in the markets that have smaller amounts of transactions, such as New Jersey (33) and San Francisco (33). This is also important considering the six-year time span that the sales occur within. Second, while the data is supplied by a very reputable provider, there is still the potential for human error in the details. For example, while the most accurate source for sales price is in the public record, some transactions were verified through one of the brokers involved in the transaction according to the notes in the CBRE entry. Also, for the sales that do include a deduction for the demolition of existing structures on the property, some of these values are estimated. While it would be best to obtain actual demolition numbers after the work has been completed, estimates are the best available option at properties that have not completed the process of preparing the site for new construction. Lastly, there are no definitions or parameters provided for the classifications within each variable. For example, there is no specification for the difference between a site classified as "Generally Level" and one that has "Moderate Slope." Presumably, one person did not compile all 1,000 data points, making the inputs subject to interpretation.

4.2 Wharton Residential Land Use Regulatory Index (WRLURI) Data

4.2.1 WRLURI Index Values

The WRLURI Index Values and their derivation are detailed in Chapter 2.4 of the literature review. Although the WRLURI study focused on residential real estate, the results have been applied to this analysis of industrial land value. It is assumed that within a given metro area, the regulation of the residential market is comparable to the regulation of the industrial real estate market. Land regulation is one of the hardest variables to define, while also being very unpredictable. However, it is also one of the most important, due to its potential impact on financial feasibility and schedule. The inclusion of this variable will account for differences in regulation across the focus markets. While it would be ideal to have index values corresponding to the individual communities that each subject property is located within, that data is not available.

4.2.2 WRLURI Index Values Assigned by Focus Market

Nine of the 10 focus markets are US Metropolitan Statistical Areas (MSA), and the corresponding WRLURI index value was assigned to each property within that market. The only exception for the data set is the New Jersey properties. The New Jersey data points are located throughout the state, and not concentrated within one MSA. For this reason, the corresponding WRLURI index value was assigned to each property based the location of the nearest Primary Metropolitan Service Area (PMSA). Within New Jersey, there were five PMSAs that the data points fell within. A PMSA is a subarea that fulfills the requirements of an MSA, but total population is over one million people. The five New Jersey PMSA's are: Jersey City PMSA

(WRLURI = 0.28826), Newark PMSA (0.67816), Philadelphia, PA-NJ PMSA (1.12667), Vineland-Millville-Bridgeton, NJ PMSA (1.18877), and Trenton PMSA (1.7537). Table 3 is from the WRLURI paper and shows the average WRLURI values by metropolitan areas.

Average WRLURI Values by Metropolitan Areas with Ten or More Observations

Metropolitan Area	WRLURI	Number of Observations	Metropolitan Area	WRLURI	Number of Observations
1. Providence-Fall River-Warwick, RI-MA	1.79	16	25. Milwaukee-Waukesha, WI	0.25	21
2. Boston, MA-NH	1.54	41	26. Akron, OH	0.15	11
3. Monmouth-Ocean, NJ	1.21	15	27. Detroit, MI	0.12	46
4. Philadelphia, PA	1.03	55	28. Allentown-Bethlehem-Easton, PA	0.10	14
5. Seattle-Bellevue-Everett, WA	1.01	21	29. Chicago, IL	0.06	95
6. San Francisco, CA	0.90	13	30. Pittsburgh, PA	0.06	44
7. Denver, CO	0.85	13	31. Atlanta, GA	0.04	26
8.. Nassau-Suffolk, NY	0.80	14	32. Scranton-Wilkes-Barre-Hazelton, PA	0.03	11
9. Bergen-Passaic, NJ	0.71	21	33. Salt Lake City-Ogden, UT	-0.10	19
10. Fort Lauderdale, FL	0.70	16	34. Grand Rapids-Muskegon-Holland, MI	-0.15	16
11. Phoenix-Mesa, AZ	0.70	18	35. Cleveland-Lorain-Elyria, OH	-0.16	31
12. New York, NY	0.63	19	36. Rochester, NY	-0.17	12
13. Riverside-San Bernardino, CA	0.61	20	37. Tampa-St. Petersburg-Clearwater, FL	-0.17	12
14. Newark, NJ	0.60	25	38. Houston, TX	-0.19	13
15. Springfield, MA	0.58	13	39. San Antonio, TX	-0.24	12
16. Harrisburg-Lebanon-Carlise, PA	0.55	15	40. Fort Worth-Arlington, TX	-0.27	15
17. Oakland, CA	0.52	12	41. Dallas, TX	-0.35	31
18. Los Angeles-Long Beach, CA	0.51	32	42. Oklahoma City, OK	-0.41	12
19. Hartford, CT	0.50	28	43. Dayton-Springfield, OH	-0.50	17
20. San Diego, CA	0.48	11	44. Cincinnati, OH-KY-IN	-0.56	27
21. Orange County, CA	0.39	14	45. St. Louis, MO-IL	-0.72	27
22. Minneapolis-St. Paul, MN-WI	0.34	48	46. Indianapolis, IN	-0.76	12
23. Washington, DC-MD-VA-WV	0.33	12	47. Kansas City, MO-KS	-0.80	29
24. Portland-Vancouver, OR-WA	0.29	20			

Table 3 - Average WRLURI Values by Metropolitan Areas with Ten or More Observations from "A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index," Gyourko, Saiz, and Summers (2007).

The WRLURI Values assigned to each focus market for this study are summarized in Table 4.

Market	*WRLURI Index Value*
Atlanta	0.03493
Chicago	0.01929
Dallas	-0.22868
Houston	-0.39815
Inland Empire	0.52589
Los Angeles	0.49499
Miami	0.94485
New Jersey	0.28826, 0.67816, 1.12667, 1.18877, 1.7537
San Francisco	0.72492
Seattle	0.92344

Table 4 - WRLURI Values Assigned to Each Focus Market

Review of the WRLURI Index Values for the focus market reveals some interesting patterns. Based on Table 3, which was taken from the original WRLURI paper, the following index ranges can be used to compare land use regulation in different communities: Lightly Regulated (<-0.55), Average Regulated (-0.55<x<0.74), and Highly Regulated (>0.74). These ranges were determined by the distribution of all WRLURI index values established by the study. The bottom quartile is considered lightly regulated, the middle 50 percent is average regulated, and the top quartile is highly regulated. By applying these ranges to the focus markets, we find that Seattle, Miami, and three of the five New Jersey PMSAs are considered "highly regulated." Meanwhile, with the exception of the Texas markets the remaining markets are considered to be "average regulated." One of the authors of the WRLURI paper (Saiz) suggested that Houston and Dallas be classified as low regulation due to their proximity to the "low" range and the characteristics of each market. Table 5 (below) ranks each market by WRLURI index value and also includes the average sale price per square foot from the CBRE dataset. Although the data set is limited, it still shows a trend reflecting higher land values in highly regulated markets.

Market	WRLURI Index	Degree Of Regulation	Mean Sale Price/SF
Houston	-0.39815	Low	$ 3.92
Dallas	-0.22868	Low	$ 3.10
Chicago	0.01929	Average	$ 5.32
Atlanta	0.03493	Average	$ 3.23
Los Angeles	0.49499	Average	$ 25.25
Inland Empire	0.52589	Average	$ 9.68
San Francisco	0.72492	Average	$ 16.07
Seattle	0.92344	High	$ 10.90
Miami	0.94485	High	$ 12.65

Table 5 - WRLURI Value & Price/SF for Each Focus Market

Table 5 also reveals patterns about local traits within the markets when grouped by the stringency of regulation. The highly regulated markets tend to have higher median family income, higher home values, and less population density. These traits decrease as market regulation decreases. This can be linked to the MSA demographics discussed in Chapter 3.

4.3 GIS Data

As evidenced by Bernknopf *et al.* (2008) and Shim & Kim (2016), the introduction of data obtained from geographic information system (GIS) software can greatly enhance the quality of hedonic pricing models. GIS allows for the accurate calculation of distance-related location and explanatory variables. The addition of these distance-related variables to each property within the data set will provide insight regarding how spatial variability affects industrial land values.

4.3.1 GIS Data Processing

All 855 property addresses were geocoded based on the addresses provided by CBRE. As previously described, not all of the entries included complete addresses with street number, street name, city, and zip code. This information was added, when possible. Three of the variables obtained through GIS were distances to points of interest. The data was derived using Network Analyst tool in ArcMap 10 software. The property locations were input into the tool as origination points, while destination points were defined below. Utilizing the current street network in each market, the shortest distance to the given destination points were obtained and assigned to each origination point (subject property) as a new variable. This result is preferred over the straight-line distances utilized in earlier studies to measure location. By accounting for the street grid, the most accurate location measures are obtained. The fourth variable was obtained by defining a 2-mile radius around each subject property and joining it to the income data within the given radius as a variable.

4.3.2 Distance to Central Business District

The distance to the central business district, or CBD, is one of the most common variables used to link a property's location to its value. As Kowalski and Paraskevopulos (1990) wrote, this is based on the assumption of the inverse relationship between land values and the center of the metropolitan area. While this holds true for many types of real estate, the same may not be true for industrial real estate. Kowalski and Paraskevopulos believed that industrial land did not follow the radial price gradient from the CBD, but instead is based on origination points within submarkets for industrial land. The results of their study supported this hypothesis for their sample. Peiser (1987) also found that distance to CBD was not a significant determinant of industrial land value in his study.

Nevertheless, the distance to CBD variable is included in this study in order to observe what pattern will hold. As previously mentioned, structural changes in the industrial market have led to changing patterns of industrial development. Assuming high population density in the CBD, it may be true that industrial real estate users, especially those in logistics, would value proximity to the CBD as a response to the last mile issue to be closer to customers. It is expected that the land values will maintain a negative relationship with distance to CBD. As distance increases, land values on a unit price basis should decrease.

4.3.3 Distance to Airport

The distance to airport is anticipated to be a driver of industrial land value. Any industrial real estate user that utilizes air freight will value the decreased transportation costs associated with closer proximity to the airport. The major freight airports highlighted in Chapter 3 and Appendix B were used as the airport destination points in the Network Analyst Tool.

4.3.4 Distance to Nearest Highway Exit

Similar to the distance to airport, the distance to the nearest highway exit is an important factor in the transportation cost equation for many industrial real estate users. Ground freight is generally less expensive than air freight, and is the only solution for local trips. As detailed previously, the focus markets all have access to multiple interstate highways. The closer a property is located to the interstate system, the faster a truck can get to its destination. By using the Network Analyst Tool, each property was linked to the nearest highway exit on the US Interstate System.

4.3.5 Cumulative Income Weighted Population

The last variable obtained using GIS software was cumulative income-weighted population. The data derivation started with the goal of estimating the total income within each US Census block group. According to Census.gov, a block group is defined as "statistical divisions of census tracts, are generally defined to contain between 600 and 3,000 people, and are used to present data and control block numbering" (United States Census Bureau, 2016, *Geographic Terms and Concepts - Block Groups,* Paragraph 1). The American Community Survey (ACS) provides income data based on the number of households within defined income brackets. In order to estimate the cumulative population income for each block group, the number of households within a given income bracket was multiplied by the average of the top and bottom limits of the bracket. For example, if there were 100 households in the $60,000 to $74,999 bracket, the estimated total income for that bracket would be 100*$67,499=$6,749,900. The products of each income bracket were added together to create the estimated cumulative income within that block group. This method of estimation is limited for bracket of highest earners, which is defined by ACS as $200,000+. There could be high levels of variation in this top bracket, especially in high-income markets like San Francisco.

A 2-mile radius was then defined around each subject property in Arc Map 10. Next, the sum of the total household income of all block groups located within that radius was determined. This cumulative income within the 2-mile radius was then added as a variable to its corresponding subject property. This variable can be interpreted as a measure of density and as a measure of "infill-ness." Infill is the re-dedication of land within an already developed area. "Infill-ness" is a term used to describe where on the scale a given property falls. Larger cumulative incomes are interpreted as more developed block groups than those with smaller cumulative incomes. These high income areas could be potentially negative locations for industrial users, based on the ability to obtain permitting and entitlement approvals. The WRLURI study found high population areas to be correlated with more stringent permitting and entitlement environments. Also, larger incomes could also mean higher population density within the block group. This variable could also be viewed as a positive for logistics users wanting to locate closer to higher income populations and/or larger population densities in order to serve them faster. One could assume that higher income populations purchase more goods and that larger populations would have larger quantities of purchases. Locations within higher cumulative income areas would minimize transportation costs to customers for the last mile.

The maps below illustrate the data for household income summation within each block group for the focus markets. The legend for each map defines the quintile breakdown of estimated cumulative block group incomes within each focus market. Block groups that are colored red are the bottom 20 percent of cumulative population income for all the block groups in that market. Block groups colored green represent the top 20 percent of cumulative income.

On average most of the subject properties are located in lower population income block groups.

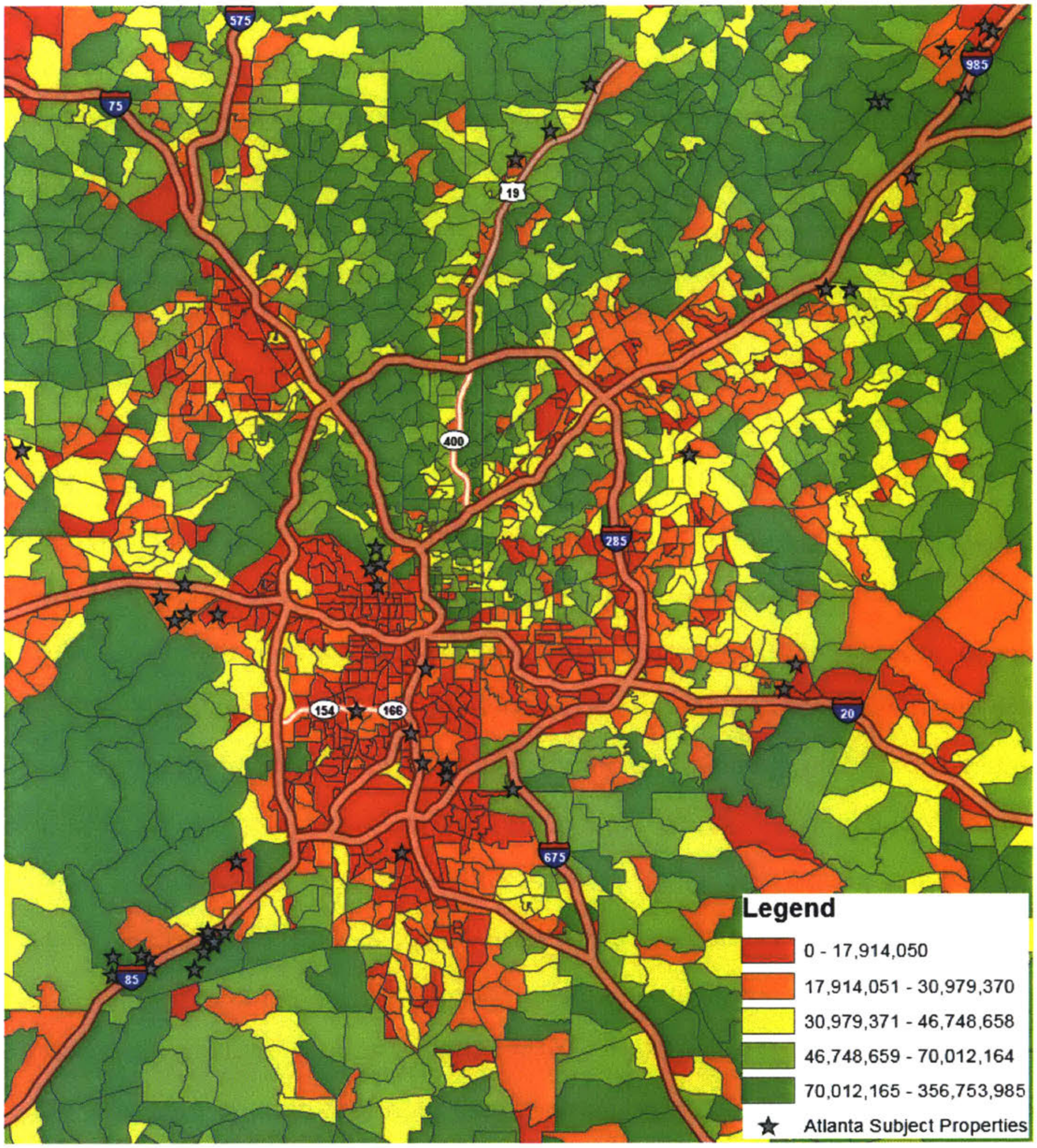

Figure 20 - Atlanta Income Data

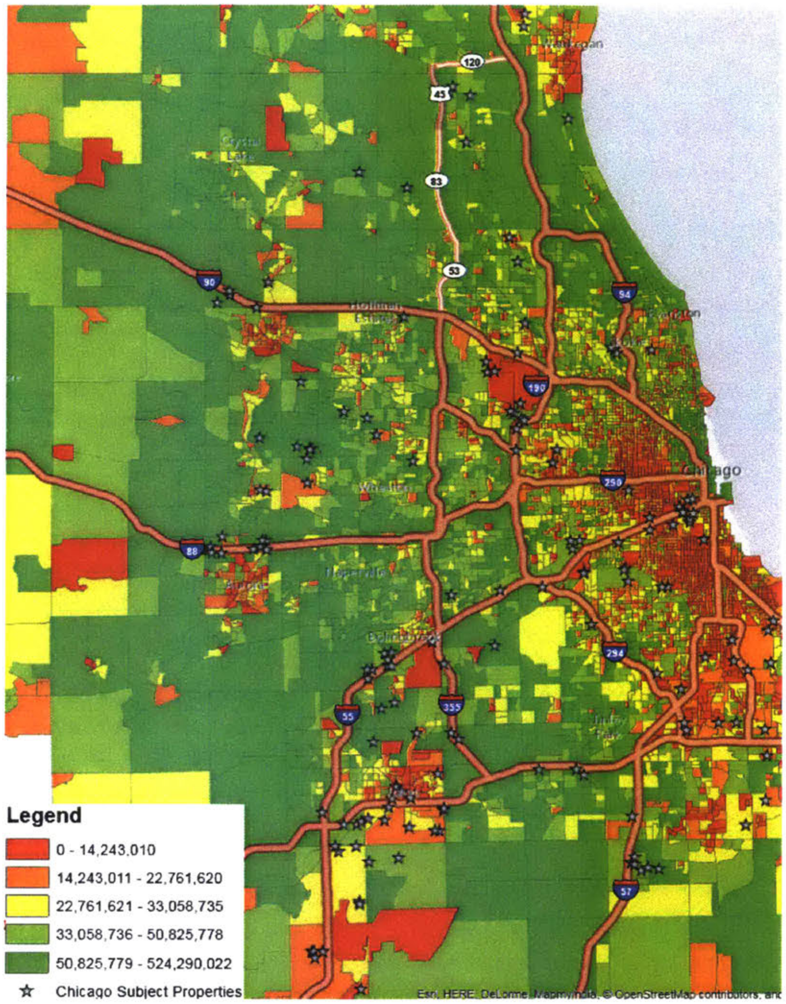

Figure 21 - Chicago Income Data

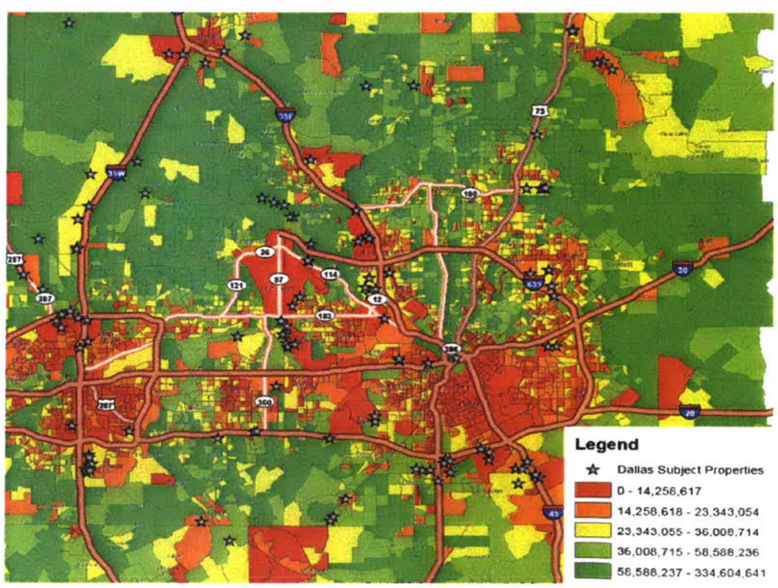

Figure 22 - Dallas Income Data

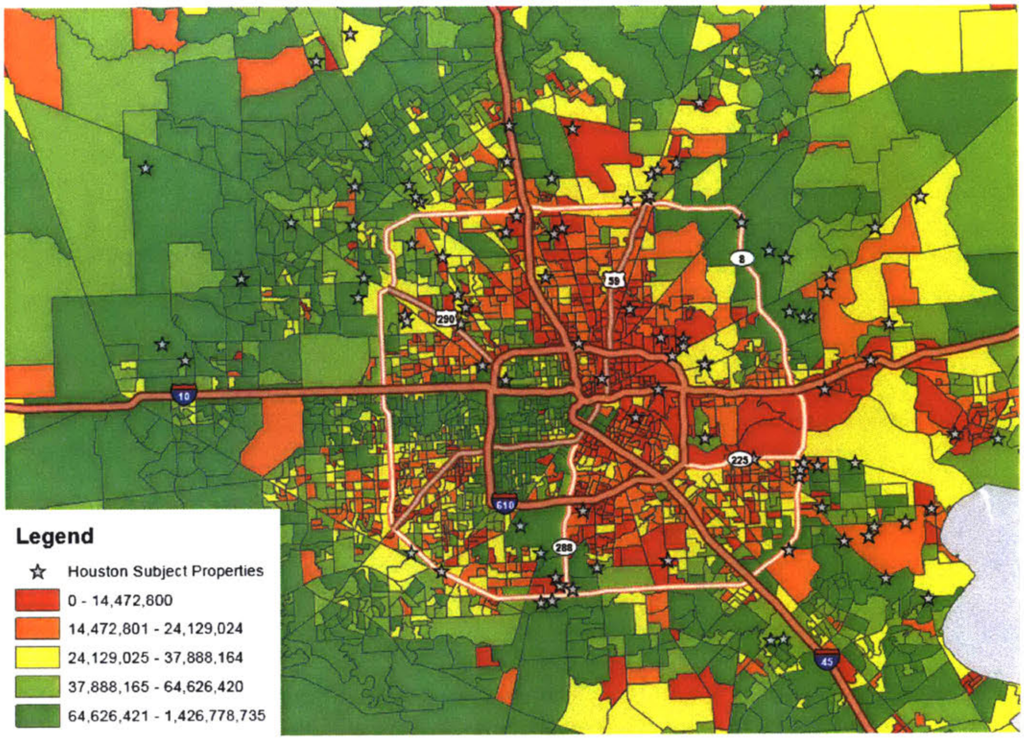

Figure 23 - Houston Income Data

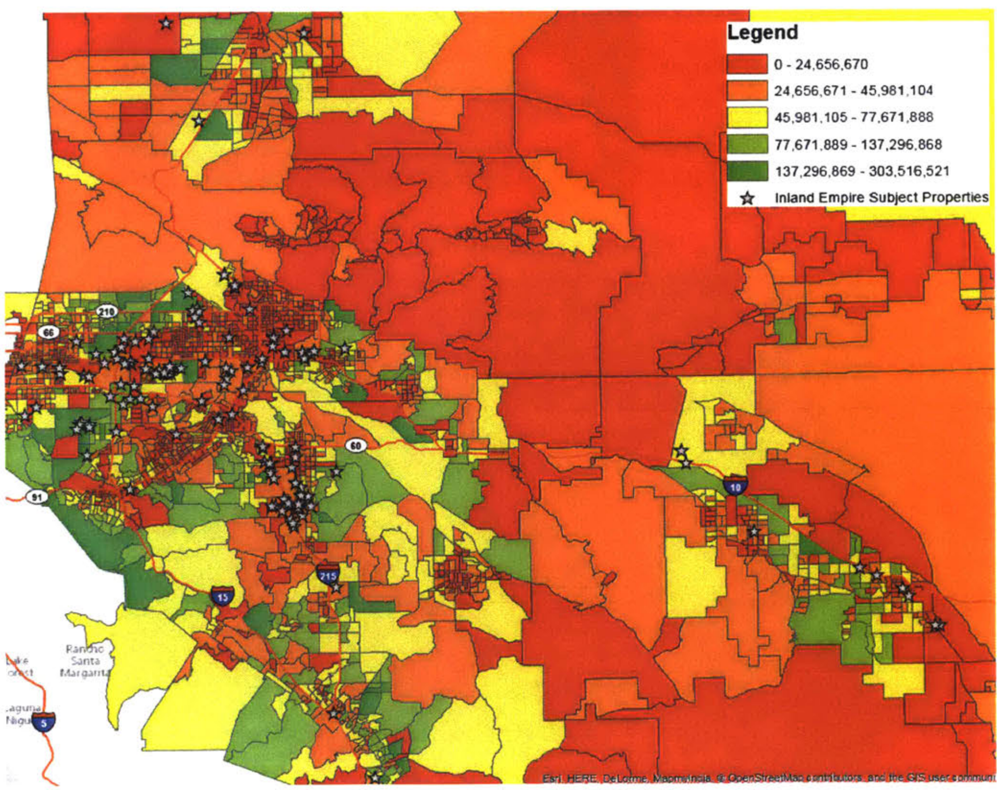

Figure 24 - Inland Empire Income Data

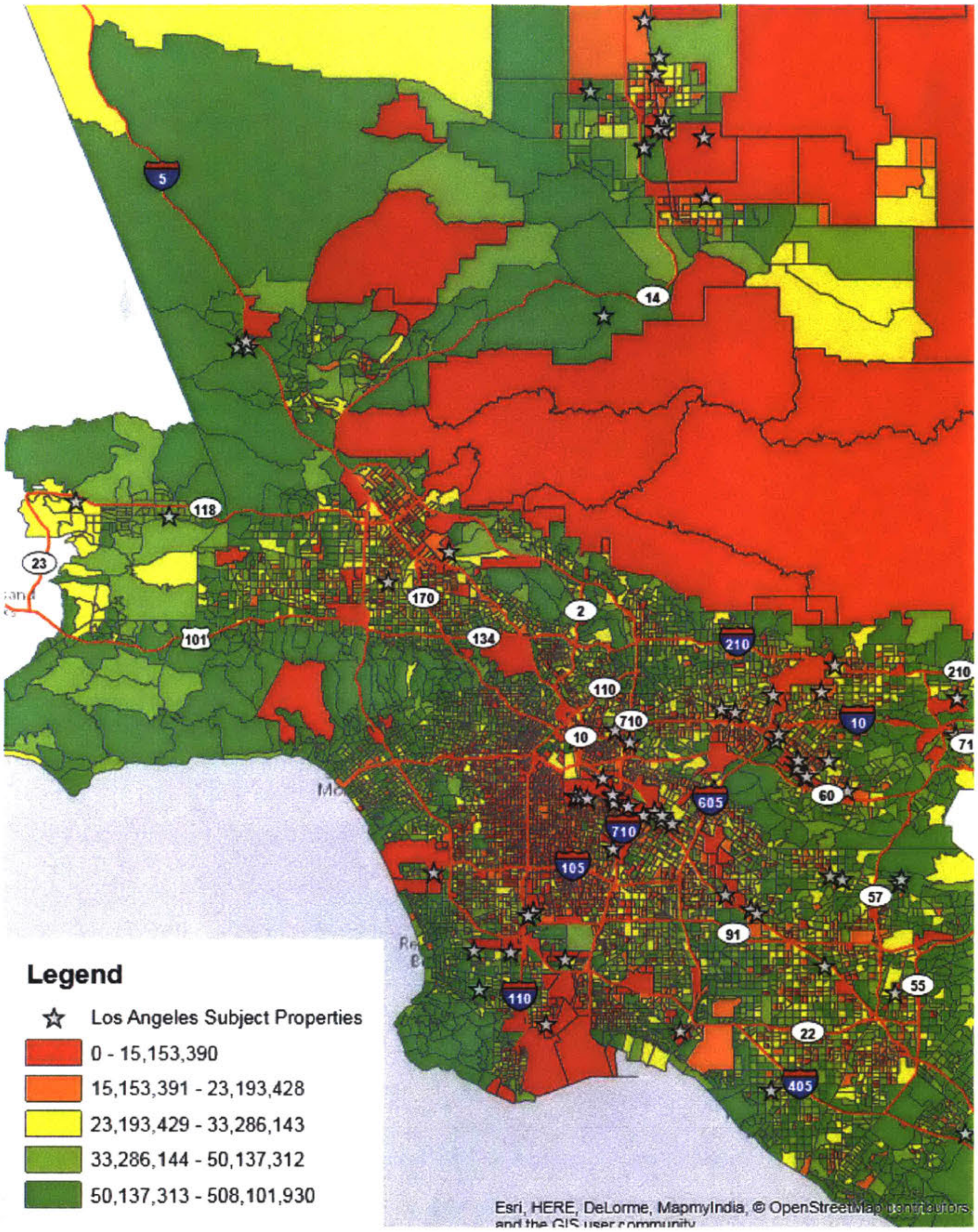

Figure 25- Los Angeles Income Data

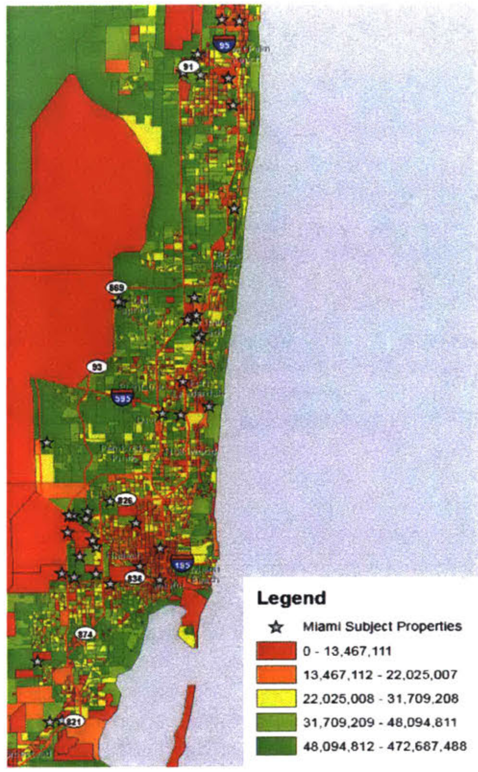

Figure 26 - Miami Income Data

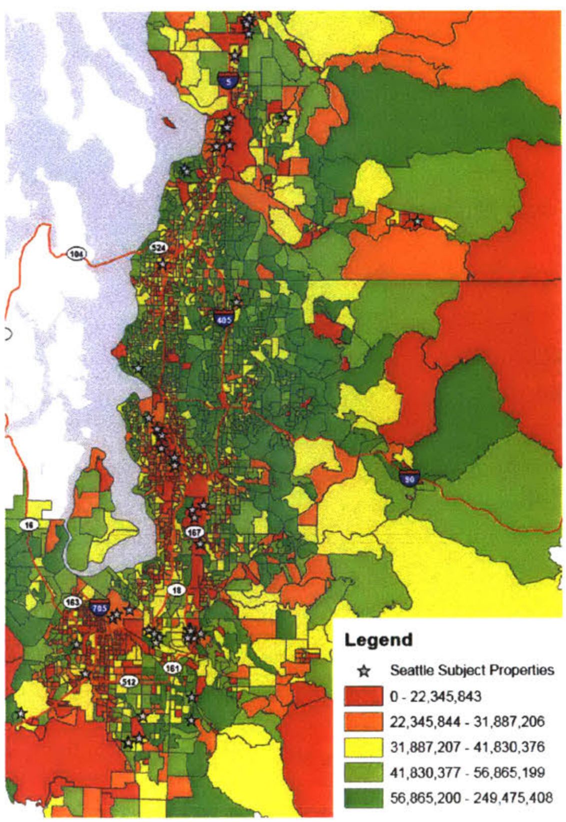

Figure 27 - Seattle Income Data

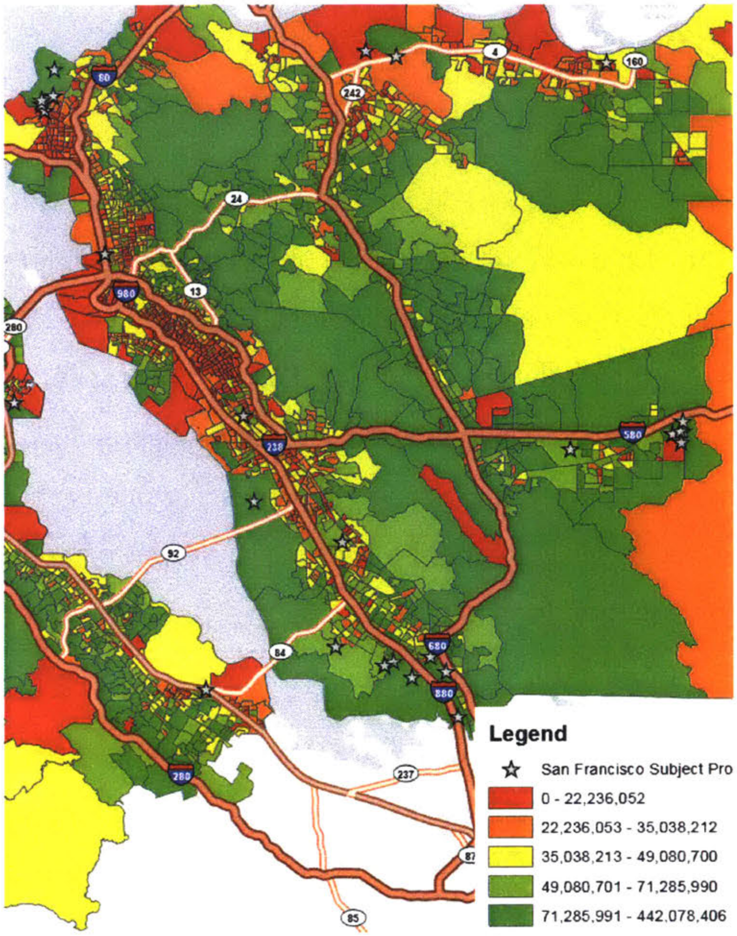

Figure 28 - San Francisco Income Data

4.3.6 GIS Data Summary

The four GIS variables were added to each of the 855 entries in the data set. The statistical summary of all of the GIS variables are included below in Table 6, along with sale price per square foot and lot size.

	Sale Price per square foot	Lot Size (sf)	Distance CBD	Distance Airport	Distance HW	Cumulative Income 2 mi radius
Observations	855	855	855	855	855	855
Mean	$ 8.48	802,457	25.5	27.8	2.3	$ 1,090,630,403
Std. Dev.	$ 10.34	676,575	17.9	17.3	1.9	$ 647,062,830
Min	$ 0.11	75,359	0.1	0.9	0	$ 6,207,033
Max	$ 140.04	4,178,275	113.8	98.9	21.3	$ 5,501,869,871

Table 6 - Spatial Variable Summary Statistics

Chapter 5: Regression Analysis and Results

5.1 Hedonic Regression Methodology

A hedonic regression model was set up to analyze the different variables affecting the industrial land values from the data set. The model breaks down the different factors of land value (independent variables) as well as their individual contribution to the overall value (dependent variable). For the model used in this analysis, the dependent variable is land price per square foot. The independent variables were detailed in Chapter 4. The output of the model will provide insight regarding the magnitude that each property characteristic influences the overall property value on a square foot basis. The analysis was based on the following multivariate regression equation form:

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 \ldots + \beta_n x_n$$

In the equation above, an increase in each unit of an independent variable such as x_1 will result in an incremental increase in the dependent variable (Y) based on the independent variable's coefficient(β_1).

5.2 Sale Price per Square Foot Model

The regression model used for this analysis followed the form below:

$$\begin{aligned}\ln(PriceSF) = \; & \alpha + \beta_1(WRLURI\_Index) + \beta_2 ln(DistanceCBD) + \beta_3 ln(DistanceAirport) \\ & + \beta_4 ln(DistanceHW) + \beta_5 ln(LotSize) + \beta_6 ln(IncomeSum2mi) \\ & + \beta_7(SiteDevelopmentStatus) + \beta_8(Shape) + \beta_9(Topo) + \beta_{10}(Zoning) \\ & + \beta_{11}(SalePeriod)\end{aligned}$$

A log transformation was conducted on the dependent variable (sales price per square foot) and on the following independent variables: distance variables (highway, CBD, airport), lot size, and cumulative population income 2-mile radius. In the model above, a 1 percent increase in each of the log-transformed independent variables (i.e., *DistanceCBD)* results in a β_i percent increase in the dependent variable (*PriceSF).* Alternatively, this can be interpreted as the doubling of a log-transformed variable (i.e. *DistanceCBD**2) will result in a $(\beta_2 * 100)$ percent increase in *PriceSF*. The WRLURI Index values are standardized, meaning that a one standard deviation increase in WRLURI Index Value will result in a β_1 percent increase in *PriceSF.*

The model output was generated using Stata 14.0 software by entering the input below:

```
regress LogLandPriceSF LogLotSizeSF LogDistCBD LogDistAirport LogDistHW LogIncomeSum2mi LogDistCBDSq LogDistAirSq LogDistHWSq WRLURI_Index i.SiteDevtStatus i.Shape i.Topography i.Zoning P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21, cluster(MetroNumber)
```

For the Stata input, the Site Development Status, Site Shape, Site Topography, and Site Zoning variables were included using the "i.*variablename*" syntax. This establishes each set of categorical variables as indicator variables. With this syntax, Stata fits the regression on indicators for each level of the groups included as a separate covariate. The group 1 variable is used as the base level and omitted from the results. The coefficients calculated for the other groups will measure their difference from the group 1 variable. Essentially, the other variables within each category are related by the regression output to the group 1 variable. The groupings are summarized in Table 7.

Site Development Status		**Shape**	
Group 1	Finished	Group 1	Rectangular
Group 2	Semi-Finished	Group 2	L-Shaped
Group 3	Raw	Group 3	Triangular
Group 4	Platted	Group 4	Irregular
Group 5	(blank)	Group 5	(blank)
Topography		**Zoning**	
Group 1	Generally Level	Group 1	Industrial
Group 2	Moderate Slope	Group 2	Manufacturing
Group 3	Rolling	Group 3	Commercial
Group 4	(blank)	Group 4	Other

Table 7 - Indicator Variable Groupings

The "MetroNumber" variable was established by assigning a number (1-10) to each focus market, corresponding to its location. This allowed the cluster analysis capability in Stata to account for the natural groupings of the observations.

The variable names are defined in Table 8 below:

Variable	Definition
PriceSF	Land price per square foot.
MetroNumber	Number representing which of the ten focus markets the property is located in. Included for CLUSTER consideration in Stata.
WRLURI_Index	WRLURI Index value for the MSA that the property is located in.
Lot Size	Parcel size of the subject property in acres.
DistCBD	Distance (in miles) from the subject property to MSA Central Business District via road network.
DistAirport	Distance (in miles) from the subject property to major airport via road network.
DistHW	Distance (in miles) from the subject property to interstate highway on-ramp via road network.
IncomeSum2mi	Cumulative household income for all block groups in a 2-mile radius of the subject property.
SiteDevNone	Site Development Status: None
SiteDevRaw	Site Development Status: Raw
SiteDevFinished	Site Development Status: Finished
SiteDevSemiFinished	Site Development Status: Semi-Finished
SiteDevPlatted	Site Development Status: Platted
ShapeNone	Parcel Shape: None Provided
ShapeRectangular	Parcel Shape: Rectangular
ShapeIrregular	Parcel Shape: Irregular
ShapeTriangular	Parcel Shape: Triangular
ShapeLShape	Parcel Shape: L-shape
TopoNone	Site Topography: None Provided
TopoGenLevel	Site Topography: Generally Level
TopoRolling	Site Topography: Rolling
TopoModSlope	Site Topography: Moderate Slope
ZoneCommercial	Zoning Classification: Commercial
ZoneIndustrial	Zoning Classification: Industrial
ZoneManuf	Zoning Classification: Manufacturing
ZoneOther	Zoning Classification: Other, None Provided, Mixed-use, Office, Residential
P1	Sale closed in 2012 - Quarter 1
P2	Sale closed in 2012 - Quarter 2
P3	Sale closed in 2012 - Quarter 3
P4	Sale closed in 2012 - Quarter 4
P5	Sale closed in 2013 - Quarter 1
...	...
P21	Sale closed in 2017 - Quarter 1

Table 8 - Regression Variable Definitions

5.3 Sale Price per Square Foot Model Results

The regression analysis resulted in an R^2 value of 0.5185. This means that the variables in the model accounted for approximately 51.85 percent of the price variability in the land transaction data set from CBRE. The results for each category are discussed in the following sections.

5.3.1 Spatial Variable Results

The three distance-related variables (CBD, highway, and airport) all had negative coefficients. This result reflects the intuition that land value decreases the farther the location is from each given point of interest. In relation to each focus market's central business district, each time distance from the CBD was doubled, land value decreased by 30 percent. The negative relationship for distance from CBD follows the initial hypothesis along with many other land value studies. The distance from each focus market's airport and nearest highway exit followed a similar pattern, with each 1 percent increase in distance resulting in .19 percent and .08 percent decreases in land value, respectively. The distance from CBD was the most significant determinant of land value of the three.

The impact of the cumulative income of the surrounding population had a surprising effect on land value in the data set. The coefficient was 0.4697, meaning that each 1 percent increase in cumulative population income resulted in an approximately 0.47 percent increase in land value per square foot. Based on this result, if the cumulative population income in an area doubled, industrial land value would increase by 47 percent. Appendix C contains scatterplot graphs for each market. Each graph shows the land price per square foot and the cumulative population income for each property. All 10 markets show a clear positive relationship between the two variables. New Jersey and Seattle exhibit especially strong relationships in this regard.

Overall, the spatial variables obtained through GIS software had a large impact on the overall model. When the analysis was conducted without the four spatial variables, the R^2 value was 0.3076. Without the GIS data included, the CBRE data and WRLURI Index data only explained approximately 30 percent of the variability of land price in the data set.

5.3.2 WRLURI Index Results

The results for each market's WRLURI Index values were the most statistically significant of all the model variables. The WRLURI Index is standardized to have a mean of zero and a standard deviation of one. As a result, the interpretation of the index variable's coefficient in the regression results represents the increase in land value by increasing the land use regulation by one standard deviation. By this metric, a one standard deviation increase in regulation will result in a 78 percent increase in land prices. This relationship follows the initial assumption about higher land values in areas with more land regulation. Put another way, if one could relocate a piece of land from an average regulatory market (as defined in WRLURI) to a very stringent regulatory market, the land's value would increase by 78 percent.

5.3.3 Physical Land Features and Zoning Results

The regression results for site development status followed those hypothesized earlier in this report. Semi-finished and raw sites were 40 percent and 55 percent less valuable than finished sites, respectively. The result for raw sites was most significant of all types in this category. The topography results also followed this pattern, with all other categories contributing less value than a generally level site. All else equal, the same site with rolling topography is approximately 48 percent less valuable than a site with level topography. The results for parcel shape were not significant, nor were they intuitive. The results for zoning classification revealed that industrial zoning is the least valuable zoning classification, relative to the other three categories: manufacturing, commercial, and other.

Chapter 6: Conclusion

6.1 Industry Professional Suggestions for Further Research

Three industrial real estate industry professionals were interviewed to discuss the topic of this paper. Each had the opportunity to review the regression results and share their reactions, as well as comment on industrial land values in general. The three people interviewed were focused in the following industrial markets: Chicago, Inland Empire, San Francisco, and Seattle. Each has many years of experience in the industry and were well qualified to comment on the results. They were able to describe different features unique to their focus markets, as well as discuss the changes in their markets over time. The results of the analysis were well received and the most interesting comments follow below. Their real world experience confirmed many of the results from the analysis. The comments are focused on validating results and also suggesting topics for future research.

All three professionals ranked permitting and entitlements among the top influencers of land value. One of the interviewees described the regulatory process as "the most challenging thing we do." The uncertainty that surrounds the permitting process is one of the biggest risks in developing industrial land. It is not an easily quantifiable risk, and often leaves projects at the mercy of city councils or town boards. In addition, litigation from outside interest groups is also a significant concern. One personal anecdote included a project that was held up in court by a group that was not even part of the community that the proposed project was located in. For this reason, all of the contacts were very interested in the makeup of the WRLURI Index. These opinions correlate strongly with the impact of the WRLURI Index on the regression model. However, as one of the interviewees stated, if underwritten correctly, higher regulatory hurdles can produce projects with higher yields. This also agrees with the model's result of increased regulation in markets with increased land values.

Another comment raised about local municipalities and their impact on land value was the significance of local tax rates. One particular example discussed included two adjacent counties in the Chicago area that have different taxation requirements. This difference could result in up to an extra dollar per square foot saved in taxes for a given tenant. All else equal, a potential tenant would prefer the location with less tax liability. The owner of the property with less tax liability is then able to charge an increased rent, as long as the premium is less than the amount saved in taxes for the tenant. This results in greater rents for the land owner and thus makes the land more valuable. Tax implications were not included in this paper, but could be a topic for further study.

An interesting consequence of local zoning policy was raised by one of the interviewees. He discussed the issue facing many municipalities looking to rezone particular areas to accommodate future growth. While industrial is typically considered one of the first land uses considered for an underutilized area that is being targeted for development, it is not the most profitable to the municipality in terms of long-term tax base. Residential uses take longer to develop in newly developing areas, but they carry greater tax revenues for the municipality in the long term. However, this future development is not a guarantee. At the same time, residential land allocation may be required to accommodate future population growth. This puts municipalities in a situation where they face a tradeoff: rezone for industrial now and realize a smaller increase in tax base sooner, or wait for residential development to reach the given area in the future for a larger increase in tax base. This tradeoff was not discovered in the research for this analysis, nor would it be easy to quantify and include. However, it is an important factor to consider when evaluating land values and opportunities in certain communities. Future research could analyze the change in land value when zoning designations or tax liabilities change.

The time to obtain entitlements was a specific variable of interest for one interviewee. He suggested that length of time to obtain all approvals was the most important of all land regulation variables from the WRLURI study. Depending on the particular location in his region, projects typically take one to two years to fully permit. He suggested that this variable would be an accurate representation of regulation overall in a particular location. This exact variable was not included in this analysis. However, time delay was one of the inputs to the Approval Delay Subindex from the WRLURI Study.

Due to the uncertainty and schedule concerns surrounding entitlements, one interviewee discussed a common practice for development projects: contingent sale agreements. This arrangement involves two parties coming to terms on a sale agreement that is contingent upon the receipt of all necessary approvals from local and state jurisdictions. This mitigates risk for the land purchaser/developer, and allows the land owner to maximize the value of the parcel. This can also be set up on a scale, whereby the final sale price is determined by the amount of square footage (or some other metric) of development eventually approved. This practice brings up an important concern regarding the properties from the CBRE database classified as "listings" or "under agreement." While the analysis assumed that these were actual sale prices, the final value upon sale could vary significantly. This is also an important consideration when addressing regulatory risk.

One important observation emerged regarding the derivation of the distance variables. While it was valuable to obtain distances based on the street grid, the model did not account for traffic or other impacts on the potential route not contained in the singular mile measurement. For example, a property that is two miles from a highway exit could potentially be preferable to a property that is one mile from the same highway exit due to traffic patterns and/or the ability of a semi-truck to make a particular turn to get to the one-mile property.

6.2 Conclusion

This thesis set out to evaluate specific drivers of industrial land value, an under-studied subject matter. Previous studies focused mainly on individual variables in individual markets. This thesis included a wider variety of variables in multiple markets across the US. The study of each market's demographics, infrastructure, location, and economy provided a framework to evaluate industrial properties located within each market, as well as link characteristics of the top industrial markets in the US. The unique transaction database from CBRE then provided the foundation that the analysis built upon. With a significant number of transactions in 10 of the top industrial markets in the United States, it was possible to evaluate multiple characteristics of industrial land value. Additional variables were added to the original data in order to address factors of value outside of the land characteristics provided by CBRE. The WRLURI values allowed for the inclusion of land regulation impacts, while the GIS data introduced accurate spatial variables that determine locational quality.

The regression analysis produced results that were both intuitive and interesting. It was not a surprise that industrial land values increased as the distance to the nearest highway, airport, and central business district decreased. By locating closer to these points of interest, industrial users minimize transportation costs. Doubling the distance to the airport from a given parcel resulted in a 19 percent decrease in land value. Similarly, doubling the distance from the nearest highway exit decreased land value by 8 percent. Distance from the central business district has the largest impact on value, decreasing land value by 30 percent as the distance doubled. The spatial data obtained through GIS had a very large impact on the overall reliability of the model, increasing the R-squared value from 0.31 to 0.52.

Perhaps the most compelling result from the regression analysis was the impact of cumulative population income within a 2-mile radius of the subject properties. An increase in cumulative income correlates to an increase in industrial land value. A 1 percent increase in cumulative income corresponds to a 0.47 percent increase in land value. The causation of this effect is unclear. It is possible that industrial real estate owners value proximity to high incomes or high population densities. It is more likely that the increase in value in these areas represents an option premium. This represents speculative value for the opportunity to develop the land for a more valuable use in the future. In this case, the future use would not even be industrial because the higher land price could not be supported by industrial use. A higher land price would require a more intensive use, such as residential or office, in order to produce returns that justify the investment. This option premium represents the speculation that land values in the area will appreciate (for one of many possible reasons) and that changes in land use may occur. This is related to the rezoning dilemma that many municipalities face, as discussed in Section 6.1. Speculative buyers also increase the competition for industrial land users, putting more pressure on land values.

By including the WRLURI Values, the model accounted for variance in land use regulation between the 10 focus markets. This demonstrated the impact that regulation can have on land values. Stricter regulatory environments are associated with higher industrial land values. This variable was the most statistically significant aspect of the regression model. This is also the factor of land values deemed most important and most unpredictable by the industry experts that reviewed the results. These results were useful for comparing market to market, but they did not account for differences between submarkets within a given market. This is perhaps where the most valuable result could be found, if the information was available.

The industrial real estate sector continues to evolve and attract more and more investment. The shift from retail to e-commerce will continue to fuel this evolution. This fundamental change coupled with institutional investment will drive continued growth and the attention paid to this sector. As this continues, additional research will be conducted to uncover more of the underlying drivers for land value in this sector.

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Appendix A – Full Regression Output

```
Linear regression                          Number of obs     =        853
                                           F(8, 9)           =          .
                                           Prob > F          =          .
                                           R-squared         =     0.5185
                                           Root MSE          =     .73988

                              (Std. Err. adjusted for 10 clusters in MetroNumber)
```

LogLandPriceSF	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
LogLotSizeSF	-.1153497	.0453767	-2.54	0.032	-.2179989	-.0127006
LogDistCBD	-.3007748	.0904709	-3.32	0.009	-.5054342	-.0961154
LogDistAirport	-.198921	.1063579	-1.87	0.094	-.4395192	.0416772
LogDistHW	-.080482	.0499654	-1.61	0.142	-.1935116	.0325476
LogIncomeSum2mi	.4696938	.1592769	2.95	0.016	.1093844	.8300031
LogDistCBDSq	0	(omitted)				
LogDistAirSq	0	(omitted)				
LogDistHWSq	0	(omitted)				
WRLURI_Index	.7830246	.190724	4.11	0.003	.3515768	1.214472
SiteDevtStatus						
2	-.3985537	.2135542	-1.87	0.095	-.8816468	.0845394
3	-.5450677	.1845165	-2.95	0.016	-.962473	-.1276624
4	-.3273788	.3041233	-1.08	0.310	-1.015354	.3605958
5	-.3273623	.1315562	-2.49	0.035	-.6249632	-.0297615
Shape						
2	.1600963	.1347593	1.19	0.265	-.1447504	.464943
3	.0522892	.1870482	0.28	0.786	-.3708432	.4754216
4	-.0414571	.0570142	-0.73	0.486	-.1704321	.0875179
5	.0754941	.1332098	0.57	0.585	-.2258474	.3768356
Topography						
2	-.3022353	.2402903	-1.26	0.240	-.8458096	.241339
3	-.476667	.195602	-2.44	0.038	-.9191493	-.0341846
4	-.0001542	.1211092	-0.00	0.999	-.2741222	.2738138
Zoning						
2	.1703134	.0801492	2.12	0.063	-.0109968	.3516236
3	.1416529	.1030216	1.37	0.202	-.0913982	.3747039
4	-.0673176	.0987402	-0.68	0.513	-.2906835	.1560483

P1	-1.286448	.1548563	-8.31	0.000	-1.636757	-.9361384
P2	0	(omitted)				
P3	0	(omitted)				
P4	0	(omitted)				
P5	-.1768008	.1112335	-1.59	0.146	-.4284285	.0748269
P6	-.0624039	.1769396	-0.35	0.732	-.4626691	.3378614
P7	.2621682	.1327245	1.98	0.080	-.0380754	.5624118
P8	.0057288	.135478	0.04	0.967	-.3007437	.3122014
P9	.1349467	.1161998	1.16	0.275	-.1279155	.3978088
P10	-.1274266	.1106477	-1.15	0.279	-.3777292	.1228759
P11	-.1390674	.1484957	-0.94	0.373	-.4749879	.1968531
P12	.3107821	.1028648	3.02	0.014	.0780857	.5434785
P13	.2733942	.0944017	2.90	0.018	.0598428	.4869457
P14	.3027909	.1929937	1.57	0.151	-.1337912	.739373
P15	.2764699	.1456037	1.90	0.090	-.0529085	.6058483
P16	.3202348	.0927714	3.45	0.007	.1103714	.5300982
P17	.009904	.1607245	0.06	0.952	-.3536801	.3734882
P18	.2279618	.2011283	1.13	0.286	-.227022	.6829456
P19	.2925636	.180368	1.62	0.139	-.1154571	.7005843
P20	.4677594	.1634498	2.86	0.019	.0980103	.8375085
P21	-.1865819	.1967663	-0.95	0.368	-.6316982	.2585343
_cons	-4.859913	3.134182	-1.55	0.155	-11.94993	2.230099

Appendix B – Population, Airport, Port Rankings by Market

The focus markets are denoted by double asterisks (**).

Population Rankings from the United States Census Bureau by MSA

2016 Rank	MSA	Population (2010 Census)	Population (Est as of 7/1/16)
1	New York-Newark-Jersey City, NY-NJ-PA Metro Area**	19,567,410	20,153,634
2	Los Angeles-Long Beach-Anaheim, CA Metro Area**	12,828,837	13,310,447
3	Chicago-Naperville-Elgin, IL-IN-WI Metro Area**	9,461,105	9,512,999
4	Dallas-Fort Worth-Arlington, TX Metro Area**	6,426,214	7,233,323
5	Houston-The Woodlands-Sugar Land, TX Metro Area**	5,920,416	6,772,470
6	Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area	5,636,232	6,131,977
7	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area	5,965,343	6,070,500
8	Miami-Fort Lauderdale-West Palm Beach, FL Metro Area**	5,564,635	6,066,387
9	Atlanta-Sandy Springs-Roswell, GA Metro Area**	5,286,728	5,789,700
10	Boston-Cambridge-Newton, MA-NH Metro Area	4,552,402	4,794,447
11	San Francisco-Oakland-Hayward, CA Metro Area**	4,335,391	4,679,166
12	Phoenix-Mesa-Scottsdale, AZ Metro Area	4,192,887	4,661,537
13	Riverside-San Bernardino-Ontario, CA Metro Area**	4,224,851	4,527,837
14	Detroit-Warren-Dearborn, MI Metro Area	4,296,250	4,297,617
15	Seattle-Tacoma-Bellevue, WA Metro Area**	3,439,809	3,798,902

2015 Airport Traffic Report from Airports Council International

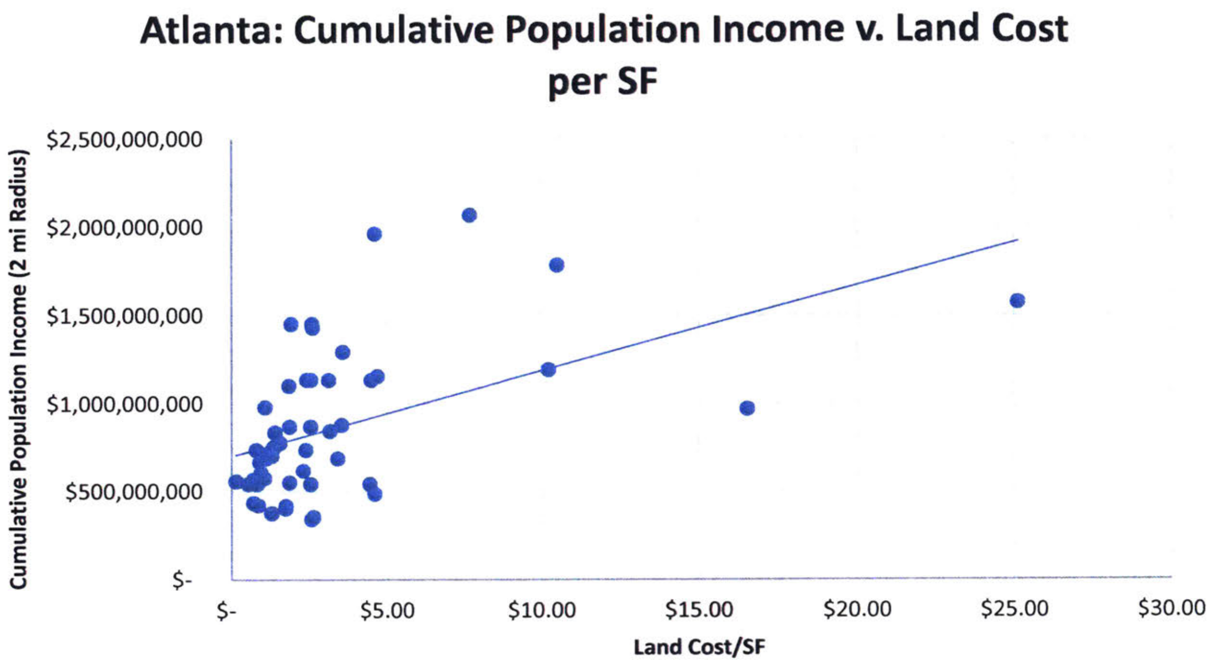
2015 North American Airport Traffic Summary (Cargo)				
World Ranking	NAM Ranking	City/State	Airport Code	Total Cargo
2	1	Memphis TN	MEM	4,290,638
4	2	Anchorage AK	ANC	2,630,701
7	3	Louisville KY	SDF	2,350,656
12	4	Miami FL**	MIA	2,005,175
13	5	Los Angeles CA**	LAX	1,938,624
17	6	Chicago IL**	ORD	1,592,826
21	7	New York NY**	JFK	1,286,484
24	8	Indianapolis IN	IND	1,084,857
35	9	Cincinnati OH	CVG	729,309
38	10	Newark NJ**	EWR	683,760
40	11	Dallas/Fort Worth TX**	DFW	670,029
42	12	Atlanta GA**	ATL	626,202
47	13	Oakland CA	OAK	511,368

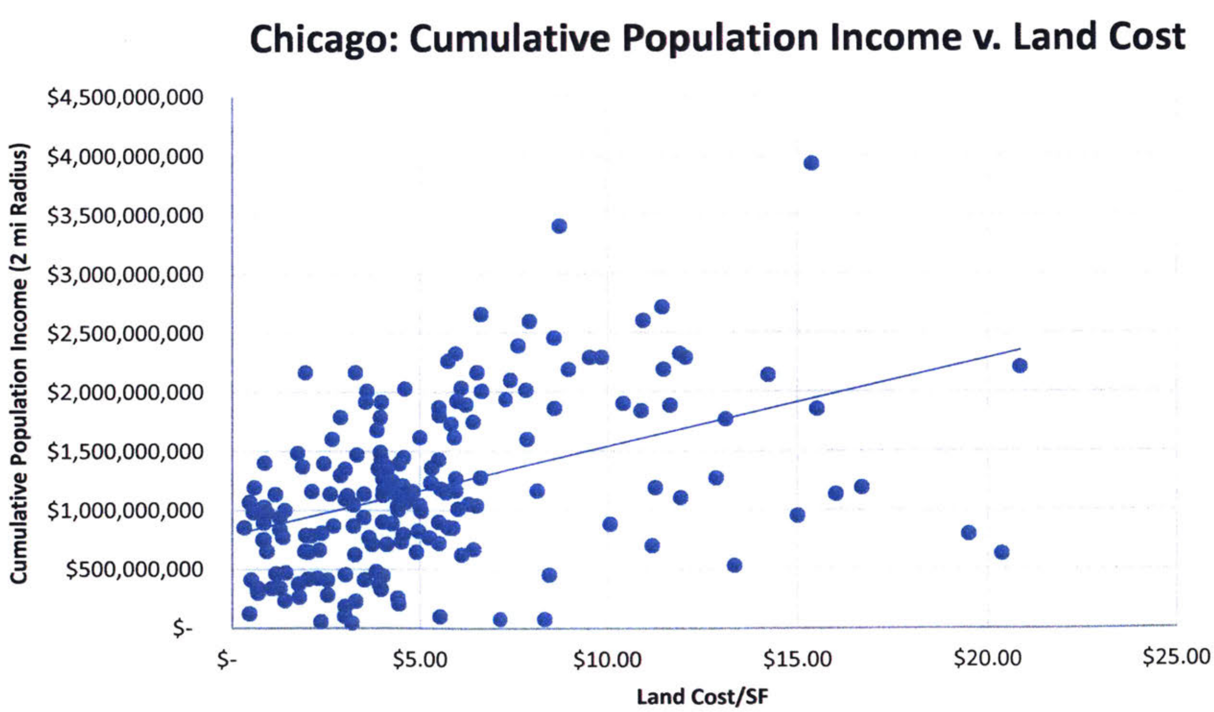
51	14	Honolulu HI	HNL	464,464
52	15	Ontario CA**	ONT	463,463
53	16	San Francisco CA**	SFO	459,467
56	17	Toronto ON	YYZ	434,777
59	18	Houston TX**	IAH	429,785
60	19	Philadelphia PA	PHL	427,645
68	20	Seattle WA**	SEA	332,636

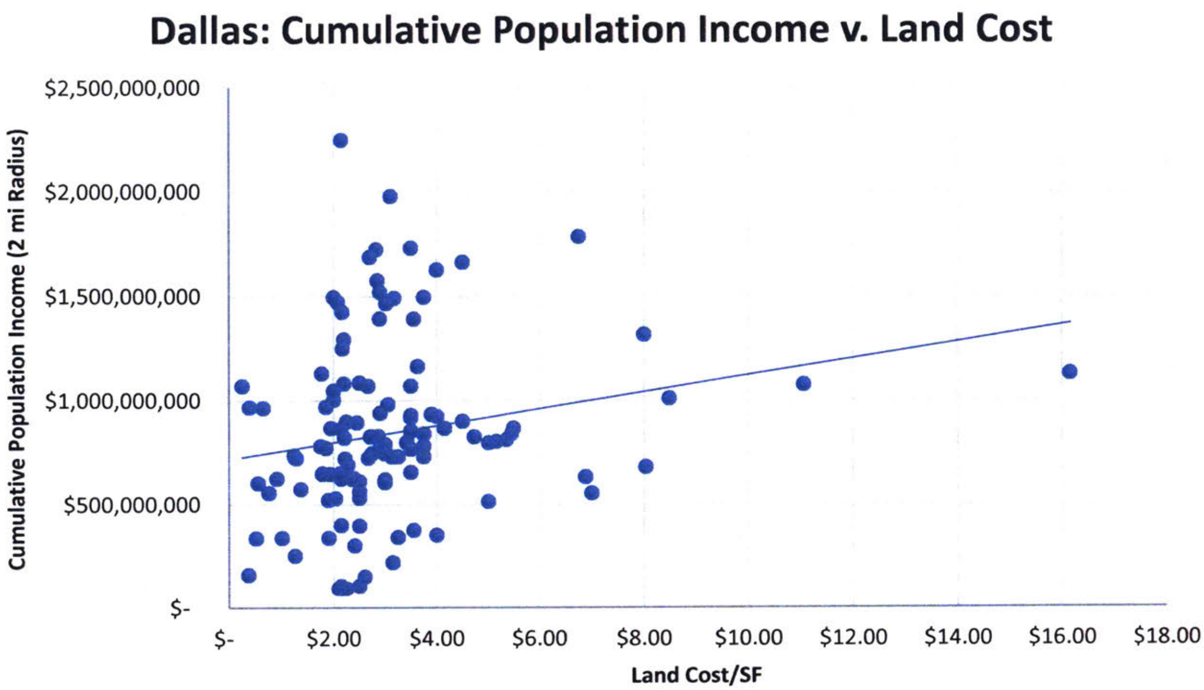
2016 NAFTA Region Container Traffic from American Association of Port Authorities

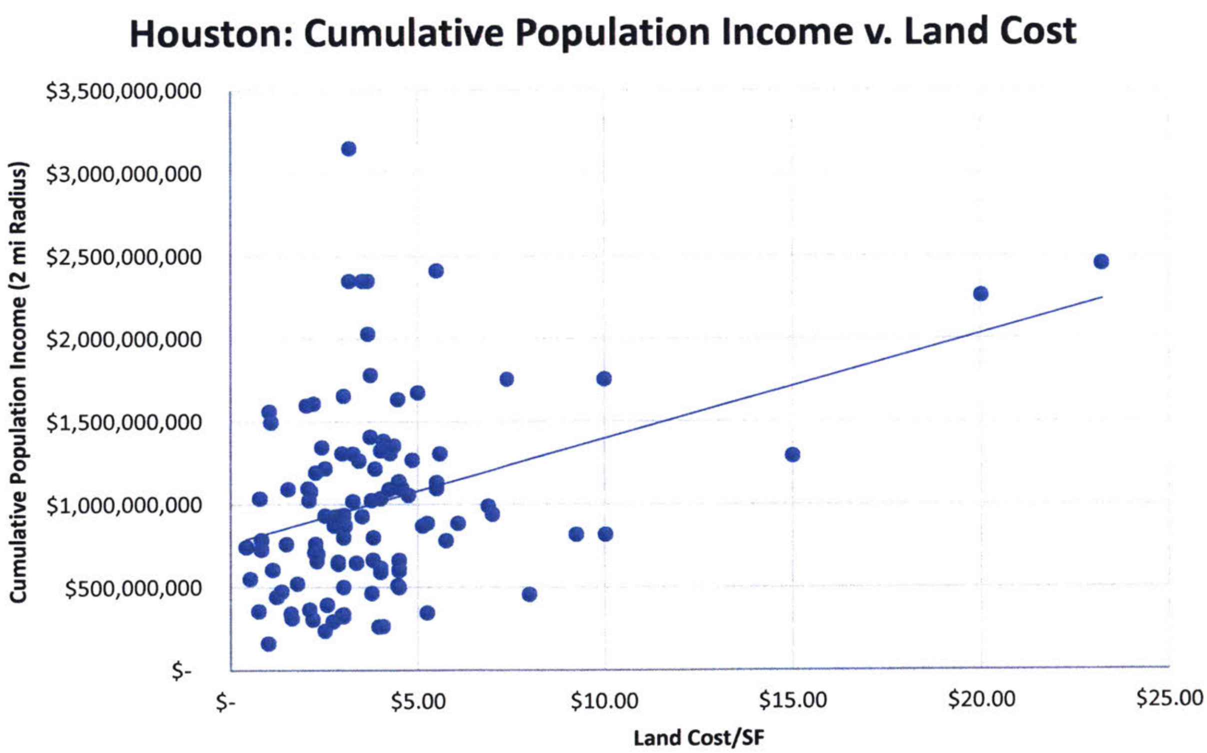
North American Container Traffic 2016 - Port Ranking by TEUs		
Rank	**Port**	**2016**
1	Los Angeles**	8,856,783
2	Long Beach	6,775,170
3	New York/New Jersey**	6,251,953
4	Savannah	3,644,521
5	Seattle/Tacoma Alliance**	3,615,752
6	Metro Port Vancouver (BC)	2,929,585
7	Hampton Roads	2,655,707
8	Manzanillo	2,580,660
9	Oakland**	2,369,641
10	Houston**	2,182,720
11	Charleston	1,996,276
12	Montreal	1,447,566
13	Honolulu	1,211,997
14	San Juan	1,200,000
15	Lazaro Cardenas	1,115,452
16	Port Everglades	1,037,226
17	Miami**	1,028,156
18	Jacksonville	968,279
19	Veracruz	965,294
20	Baltimore	869,485

Appendix C – Cumulative Population Income Graphs

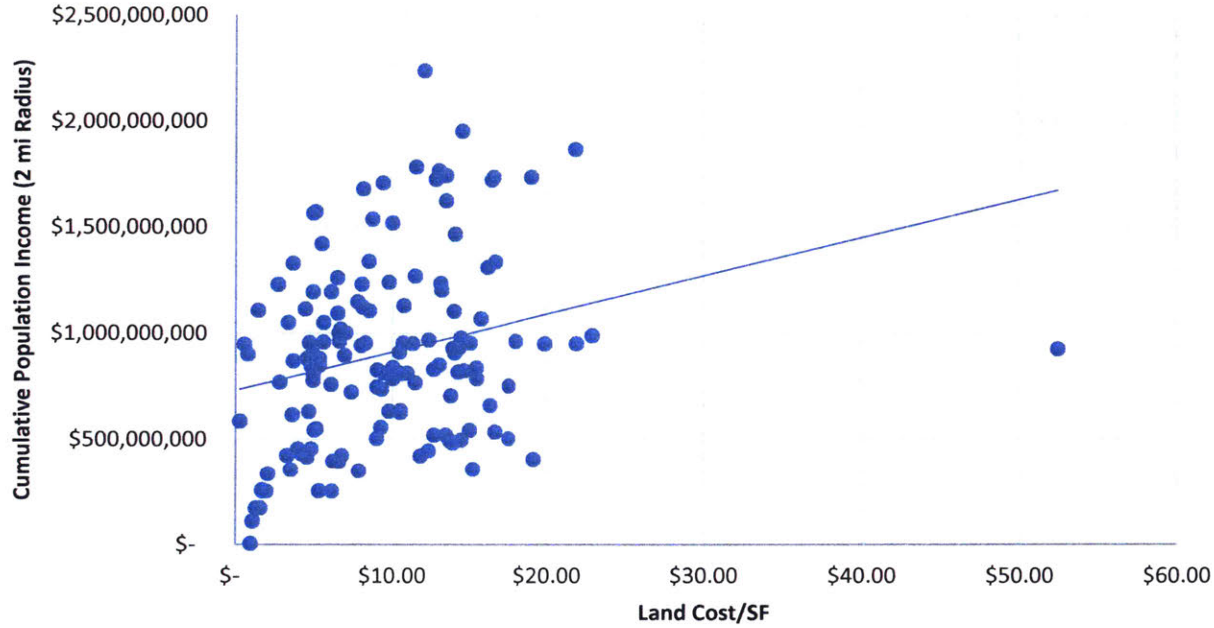




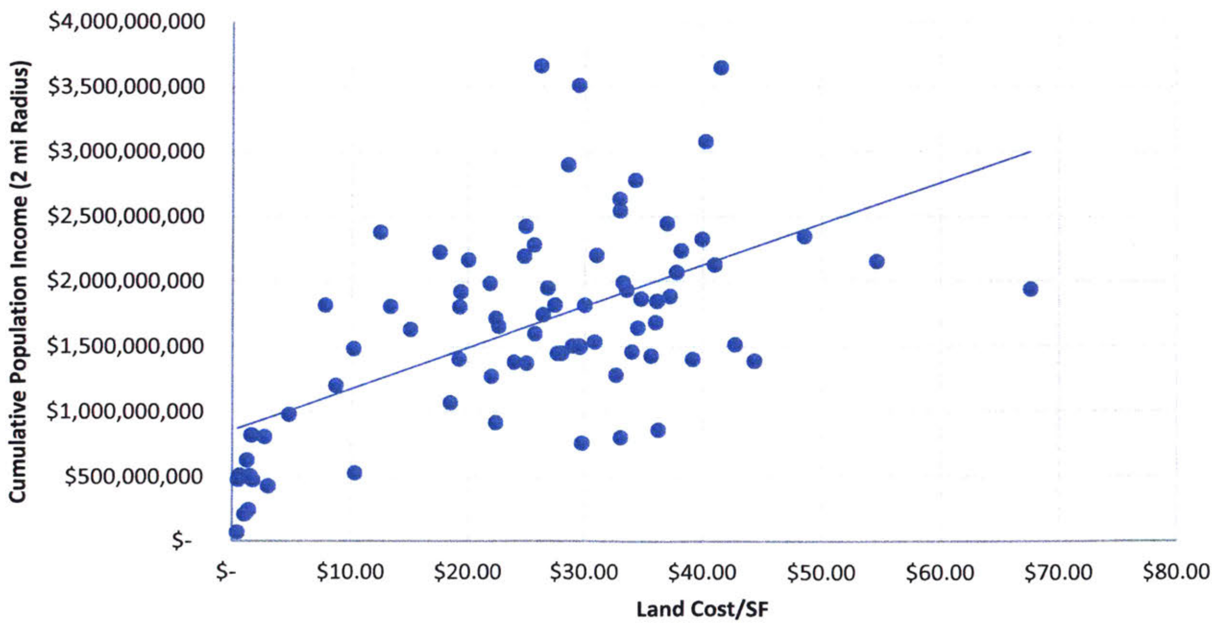

Dallas: Cumulative Population Income v. Land Cost
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$-
Cumulative Population Income (2 mi Radius)
$-
$2.00
$4.00
$6.00
$8.00
$10.00
$12.00
$14.00
$16.00
$18.00
Land Cost/SF


Houston: Cumulative Population Income v. Land Cost
$3,500,000,000
$3,000,000,000
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$-
Cumulative Population Income (2 mi Radius)
$-
$5.00
$10.00
$15.00
$20.00
$25.00
Land Cost/SF

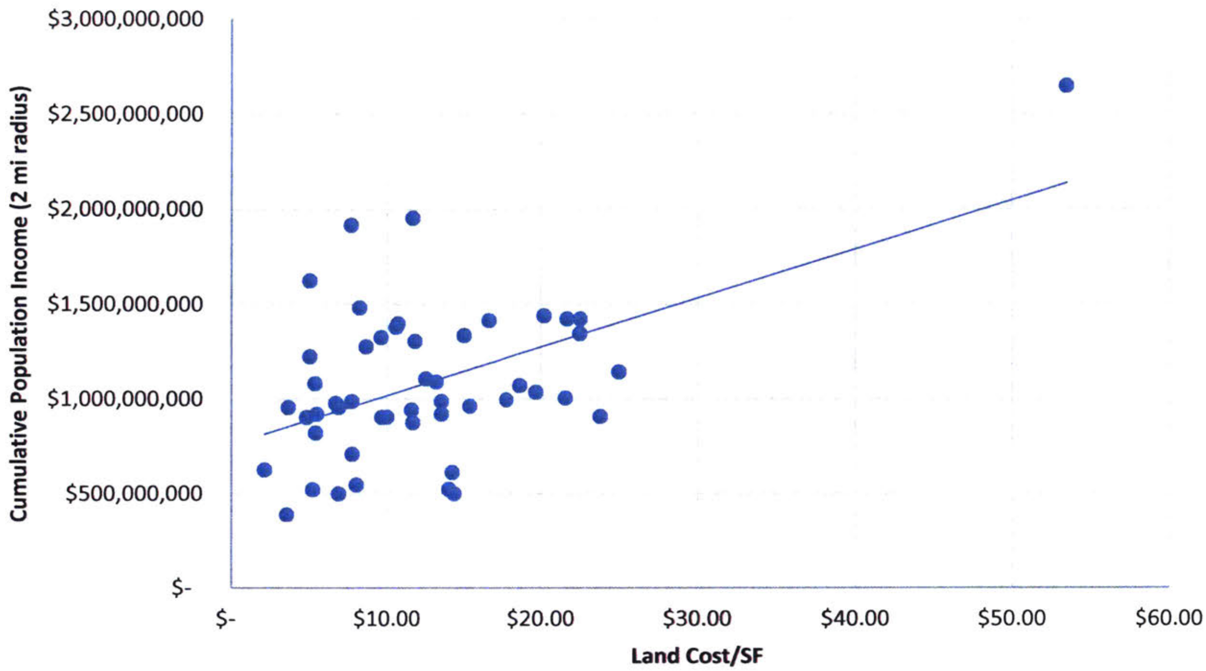
Inland Empire: Cumulative Population Income v. Land Cost



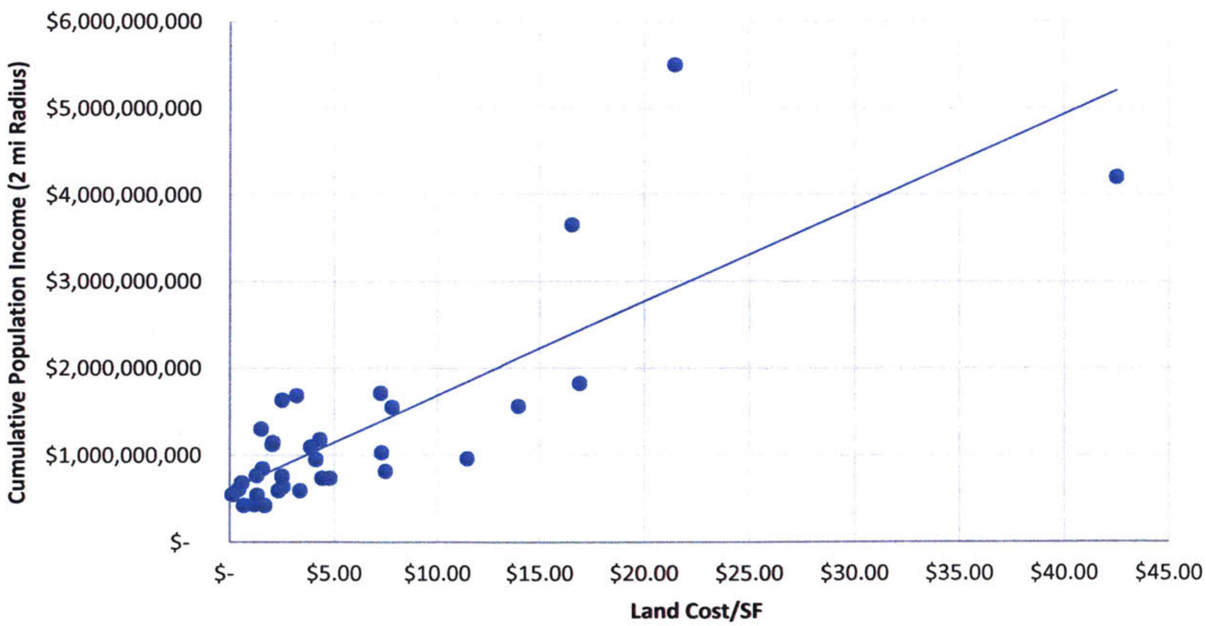
Los Angeles: Cumulative Population Income v. Land Cost



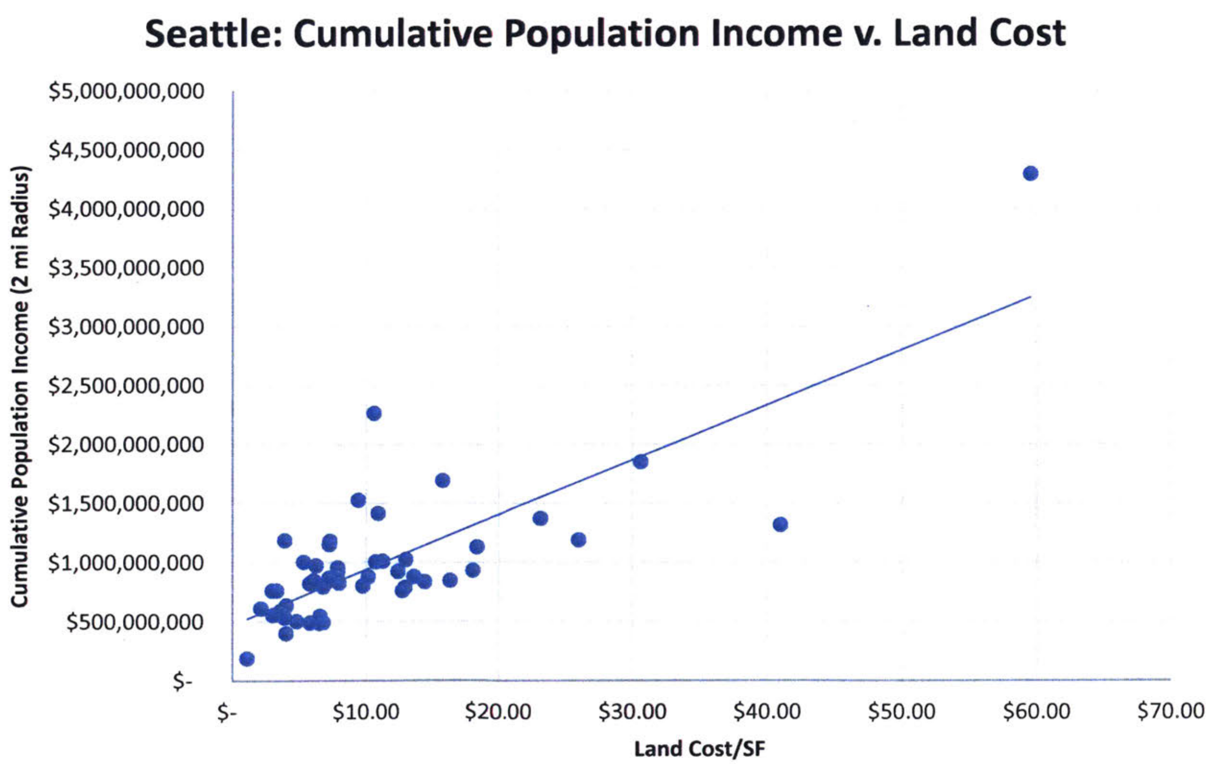
Miami: Cumulative Population Income v. Land Cost



New Jersey: Cumulative Population Income v. Land Cost




San Francisco: Cumulative Population Income v. Land Cost
$3,500,000,000
$3,000,000,000
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$-
Cumulative Population Income (2 mi Radius)
$-
$20.00
$40.00
$60.00
$80.00
$100.00
$120.00
$140.00
$160.00
Land Cost/SF


Seattle: Cumulative Population Income v. Land Cost
$5,000,000,000
$4,500,000,000
$4,000,000,000
$3,500,000,000
$3,000,000,000
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$-
Cumulative Population Income (2 mi Radius)
$-
$10.00
$20.00
$30.00
$40.00
$50.00
$60.00
$70.00
Land Cost/SF