The Effects of Silicon Valley Companies on the Bay Area Housing Crisis

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by

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Abstract

The lack of affordable homes in the San Francisco Bay Area has increased significantly in the past decade causing residents to commute longer to their jobs. In *The Effects of Silicon Valley Tech Companies on the Bay Area Housing Crisis*, the question asked was, *How are major Silicon Valley companies affecting home price and affordability in the San Francisco Bay Area housing market?* In order to answer this question, the study determined how a home's proximity to the center of the Silicon Valley affected its price. Two different linear regressions were run where median home price by census tract was explained by the census tract's distance to the Silicon Valley. For the purpose of the study, the distance from Google's Headquarters in Mountain View, CA., was used as the center point of the Silicon Valley. This calculated distance was used as the independent variable for both linear regressions, and median home price with a mortgage and median home price without a mortgage were used as the two different dependent variables of the study. The results for both regressions showed statistical significance, indicating that, to a certain degree, median home price can be explained by its distance to the Silicon Valley. Additionally, spatial findings showed that census tracts surrounding the study's center point, have median home prices between 1.5 and 2 million dollars. This is almost triple that of census tracts in neighboring counties, which explains a strong desire to live closer to these companies, especially among those who are employed by them.

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1 Introduction

1.1 Background Summary

1.1.1 The San Francisco Bay Area Housing Crisis

The San Francisco Bay Area housing crisis is one marked by a lack of affordable homes and apartments for middle and lower class families. These families are unable to afford the median cost of a home in the city, at $500,000 (Dougherty, 2017). This is more than twice the national median home cost. In the Silicon Valley, some are living out of recreational vehicles in parking lots because of their challenges finding an affordable place to live. This is not uncommon though. In San Francisco, there are stories of other living solutions. There are stories of residents living in trucks, tents, and even a wooden box (Abbey-Lambertz, 2017). One example of someone affected by this crisis is that of a nurse who commutes two hours to her job in San Francisco each day from her home in Manteca, CA. Her home is 80 miles away from her workplace, despite her making a salary of $180,000 a year (Dougherty, 2017). Her frustration of not being able to live close to her job despite making a decent amount of money is at the heart of this "crisis".

However, there are some that believe San Francisco's outrageous prices began as early as 60 years ago, following a phenomenon called the 6.6 percent trend (Abbey-Lambertz, 2017). This concept tells us that prices began steadily rising when the city ran out of vacant land to build houses on. There are documents from as far back as the

year 1968 denoting gentrification in neighborhoods like the Mission. This points to an issue that is much older than many originally had thought.

Some critics say that this crisis is partially due to the state of California ending a 60 year-old program that infused 1 billion dollars each year into redevelopment agencies that set aside a portion for affordable housing (Gutierrez, 2017). In fact, 5 billion dollars in affordable housing bonds, were passed by voters in both 2002 and 2006. These changes are only a part of what is creating a decrease in the availability of new homes. The California Department of Housing and Community Development reports that on average California saw 80,000 new homes built each year during the past decade, which is short of the 180,000 new homes that have been needed each year to keep up with demand. This shortage of new homes is causing the rent prices to skyrocket. According to the National Low Income Housing Coalition, California counties continue to lead the nation in having the most expensive rental housing, the Bay Area being home to six of the top 10 least affordable counties in the USA: Marin, San Francisco, San Mateo, Santa Clara, Alameda, and Contra Costa counties (Gutierrez, 2017).

By now, one might ask: *So what role have the Silicon Valley companies played then in the housing crisis, and are they actually at the root of the issue?* A recent <u>Wall Street Journal</u> report on housing prices looked at neighborhoods in both San Francisco and San Jose, a town just south of San Francisco that had high proportions of Apple

employees living in them (Lam, 2015). The goal of the report was to see whether their presence was driving up nearby housing prices. The report utilized US Census data and housing statistics from Zillow, similar to the methods that will be used for the linear regression explained later on. It is concluded that the prices of homes in neighborhoods where Apple's headquarter employees live, tended to rise at a faster rate. Similarly, it was found that the difference in price between an Apple employee's home and the average San Franciscan's home was close to $400,000. While it isn't Apple alone that is causing such a disparity, they are representative of a more widespread problem present across other tech companies and their employees.

The San Francisco Bay Area's income inequality is a major factor contributing to the housing crisis with a large portion of this inequality coming from the incomes of tech employees who make up 8% of the workers in San Francisco (Lam, 2015). Since the tech industry alone accounts for over 30% of San Francisco's job growth since 2010, we can only expect this number to rise. The city of San Francisco and other Bay Area cities therefore need to think about how they are creating affordable housing, especially for the people in other industries.

1.1.2 Current Affordable Housing Policies

Today, the city of San Francisco in particular has a few different programs in place to accommodate the growing need of affordable units across the city. Their Inclusionary Housing program is a part of Planning Code Section 415 and includes

information on how a household can qualify for one of their available 3,000 affordable

units ("Inclusionary Housing Program", 2017). These requirements include specific

income requirements. The program was enacted in 2002 and requires all new

residential projects in the city to either pay an Affordable Housing Fee or meet the

program requirement of providing a percentage of the new units at "below market rate"

also known as BMR on the project site or at another location in the city.

San Francisco also has a nonprofit affordable rental-housing program, public

housing, and a housing choice voucher program ("Affordable Housing Resources",

2017). The affordable rental housing programs help the city create new construction

consisting of affordable rental housing for those whose household income falls

between 0% and 60% of the area's median income. Public housing in the city provides

subsidized units for low-income families and is funded through the federal housing

program. The Housing Choice voucher program assists not only low-income families,

but also the elderly and disabled by providing federal funds for housing that each

individual finds on their own. Residents can also utilize resources from the city such as a

loan assistance programs for first time homebuyers, a rental assistance information line,

homeless services, and eviction prevention services to further enhance their efforts to

stay within the county's limits. These are just a few of the current policies in place

aimed at keeping housing affordable, but the question still lies of: *Is it enough?*

1.2 Research Questions

1.2.1 Questions

In the following thesis, the question answered is: *How are major Silicon Valley companies affecting home price and affordability in the San Francisco Bay Area housing market?* In order to best answer this overarching research question, two smaller questions were also addressed. Specifically, two linear regressions were conducted to answer the question: *Can a home's price be affected by its distance to the Silicon Valley?* Since the results of the linear regression were statistically significant, indicating that median home price does in fact increase as one gets closer to the center of the Silicon Valley, an additional question was asked. This question was, *Are city planners making effective programs and policies that are increasing the number of affordable units and addressing income inequality?*

1.2.2 Purpose Statement

The purpose of this study is to better understand the effects of Silicon Valley companies on the Bay Area housing crisis. The rationale behind this study is that certain Silicon Valley companies have had an effect on the prices of homes in the Bay Area due to the high salaries their employees are earning.

1.2.3 Value to Planners

This study will be valuable to future planners in the San Francisco Bay Area and beyond due to the unique circumstances that have come about from the Silicon Valley.

Other cities around the world will be able to learn what a fast growing and powerful industry such as the tech industry can have on its surrounding neighborhoods and pre-existing residents. They can learn how to predict an oncoming crisis and hopefully take preventative steps earlier to minimize home displacement and inflated home prices.

2 Literature Review

2.1 Home Price Surge Causes

Prior research done on the San Francisco Bay Area's Silicon Valley is highly available, yet little has been studied on the direct cause of the housing crisis as a result of high tech companies such as Facebook, Twitter, Yahoo, Google, and Apple (Perlberg, 2014). However, there have been studies done that look at possible reasons for the area's popularity.

As Saxenian (1983) notes in her study, the inflation of home price in the Silicon Valley dates all the way back to the 1970s (p. 248). Even though the inflation of home price was occurring nationwide, the imbalance of space in the Silicon Valley, encouraged its growth into one of the most costly in the world. The supply of housing simply could not keep up with the job growth in the region due to the rise of the semiconductor industry, more commonly known as the emerging electronics industry. Saxenian (1983) informs us that even by the year 1980 there were over 670,000 jobs, but only 480,000 housing units in Santa Clara County and that the average price of a home there had already gotten to be double that of the national average (Saxenian, 1983, p.249). It was found that the reasoning for this shortage of homes were restrictive land use policies, and exclusionary planning practices imposed by local governments that were aimed at preserving the land, parks, and quality of life the residents living there already had.

A study that came to similar conclusions had asked the question why residential rent in the San Francisco Bay Area is one of the highest in the United States. The study, conducted by Stephen E. Barton, Deputy Director of the Berkeley Rent Stabilization Board, finds that higher rents in the San Francisco Bay Area cannot be associated with higher quality housing and that low-income tenants have less remaining income, that is income available after paying their rent, than they did in the 1960s (Barton, 2011, p.845). Barton notes that there are two different problems at stake when it comes to affordability: 1.) The problem of not being able to afford an apartment due to lack of funds to support construction, operation, and maintenance, and 2.) simply not being able to afford the land rent while having enough funds to cover the costs of the previously mentioned issues. Barton finds that land rent is the major problem in the San Francisco Bay Area and attributes it to the lack of land availability that is filled with high-quality infrastructure, freeways, companies, world-class universities, and parks (Barton, 2011. P.848). It is this array of amenities that draws people to live in the Bay Area to begin with. From the eye-dropping California coast to the acceptance of diverse cultures, there is a lot to offer, but in limited supply. However, this sought-after location has barriers to housing and development that even stem from its own geography that includes hills, coastlines, steep slopes, and state parks. Barton believes, like many, that it is these geographical barriers that make new housing harder to come by and existing housing more expensive.

Even though the area is desirable, it is still perplexing to some as to why the cost of living in the San Francisco Bay Area so high. A typical rental property in the center of the Bay Area will run at double the cost per square foot of similar properties elsewhere in the United States. However, Barton, notes that higher operating expenses only actually account for 4 to 9% of the 40% gap that is separating the Bay Area's prices from that of the rest of the United States (Barton, 2011, p.854). There are other reasons for this high cost though, according to Barton's study. One of these is the cost of construction. Since the year 1962, construction costs have been higher in the Bay Area than they have in the rest of the country by 9.5%.

Similarly the restructuring of the Bay Area's geography and home prices have also been studied by Dr. Alex Schafran, a scholarly leader on the contemporary restructuring of urban regions. In his study, *Origins of an Urban Crisis: The Restructuring of the San Francisco Bay Area and the Geography of Foreclosure*, Schafran looks at demographics, policy, and capital in order to see the ways in which foreclosure and plummeting property values have occurred since the emergence of the tech industry in the 1970s (Schafran, 2013).

Schafran believes that the problem may have started with war industry, foreign and domestic immigration, and exclusionary housing policies that created segregation in the Bay Area in the early 1970s (Schafran, 2013). He believes that this led to the initial clustering of African Americans to certain Bay Area communities including

Oakland, Richmond, East Palo Alto, Pittsburg, and certain neighborhoods within the city of San Francisco. In an article done by Bloomberg Business Week, "Silicon Valley's Housing Haven Is Under Siege", it is learned that East Palo Alto is one of the last areas in which low-income housing is available in the Silicon Valley where companies like Tesla Motors, Facebook, and Google have created nearly two dozen billionaires and many more millionaires. As the rich continue to gentrify old neighborhoods, the places for lower and middle-income people in California are becoming more and more scarce. In fact, East Palo Alto, with a population of roughly 29,000 people, is the only city between San Francisco and San Jose that has a rent control law in place.

Schafran explains in his findings that the tech industry first started to take off in the year 1999, the height of the dot-com boom (Schafran, 2013). It was during this time that the Bay Area received twice as much venture capital as the next largest metropolitan area. Furthermore, their number sitting at 5.5% was about ten times the nationwide average. Monetarily, Schafran found that this $1.65 billion was not spread evenly throughout the Bay Area, but was concentrated in both Santa Clara and San Francisco counties.

Since most of the tech industry companies lie geographically within Santa Clara, San Mateo, and San Francisco counties, investments increased this same year having an impact on home price and rents in the Silicon Valley and San Francisco (Schafran, 2013, p. 671). In his study, Schafran informs us that: "the profits and salaries earned

from the growing tech miracle quickly multiplied in the local real-estate economy as a new generation of dot-com millionaires and young twenty-somethings bought and rented Silicon Valley and San Francisco real estate to new heights" (Schafran, 2013, p. 671). Because of this, an upsurge of high-end residential buildings went up in the city of San Francisco, making the demand for market-rate and affordable homes increasingly harder to find.

2.2 Tech Boom Impacts on Income Inequality

The tech boom has long been known for its impacts on housing inequality for residents of the Silicon Valley. As Cervero (1996) notes, "Bay Area cities with the greatest job surpluses in 1990, namely the Silicon Valley cities of Santa Clara, Palo Alto, and Sunnyvale, and Walnut Creek in the East Bay, also had the lowest shares of workers living locally" (p. 498). Cities with a lot of jobs had little to no space for their employees to live back then, which makes it no surprise that there would be a similar problem today. Cervero (1996) further notes that it is the moderate-income and nonprofessional workers that are most affected by the poor jobs to housing balance. It may be surprising to some that when looking at job density alone, however, the Silicon Valley is less dense than other employment centers such as Oakland and Berkeley. As Cervero and Wu (1995) point out in their polycentrism study, the lower job density of the Silicon Valley could be due to the way in which the land in the area has been built out (p. 869). The Silicon Valley has been built out to accommodate many low-rise,

campus-style office and industrial parks spread out over a much larger area of 70

square miles. However, high housing prices in and around employment centers in the

Silicon Valley were still found to displace workers to residences in other sub regions.

The exemption from this was, however, professional workers of higher incomes. A

professional worker can be defined as someone who has had to study or pass a

certification to get a higher paying job. These workers were found to live in the higher

priced housing nearby. Cervero and Wu (1995) further make the point that this

segmentation of housing choices among the different types of workers could also be

contributed to by land-use policies implemented by the local governments that are

decreasing affordability. Such policies include those that protect existing open space

and land that is zoned for uses other than residential (Cervero & Wu, 1995, p. 882).

This has even been supported more recently when, Galbraith & Hale (2006)

released a study titled, *American Inequality: From IT Bust to Big Government Boom*,

where they discuss the ten counties in the United States with the largest increases in

income inequality. Not surprisingly, Santa Clara County, was at the top of the list.

To follow this up, John M. Quigley a leading scholar of housing market

discrimination and economics professor at the University of California Berkeley, looked

at the reasons why Santa Clara County's housing market was able to survive the Dot

Com bust that the rest of the United States experienced. Quigley informs us that while

theoretically, prices of homes in the Silicon Valley should have gone down with the

decline in local employment, they actually went up. He gives us three key possible

explanations for this outcome, the first of which was that while yes, employment did fall,

income level did not. Following the Dot Com bust, between the years of 1999 and

2003, income increased by seven percent. The residents selling homes during those

years were able to stick to higher asking prices given that the homebuyers in the

market were likely still able to pay. He says the second reason is that generally

speaking most homeowners prefer to wait and would rather take a longer time to sell

their home than lower their asking price and sell it more quickly. Finally the third reason

Quigley notes for the housing markets price survival is that given the proximity of Santa

Clara County to the city of San Francisco (only 48 miles away), a loss of jobs in the

immediate area didn't necessarily mean people had to move away. They could stay

and put up with a longer commute. He found that this theory was consistent with the

US Census, which estimated that around 99,000 people lived in Santa Clara County

and commuted out to somewhere else for work.

Additionally, in his analysis of the Silicon Valley, Quigley looked at housing

prices for the Silicon Valley in comparison to those throughout the rest of the state of

California (Quigley, 2006). He reports that the home prices in Santa Clara County

increased steadily from 1999 to 2001, making them roughly 14% higher than those in

the rest of the state. Quigley says that based on these statistics "we should not expect

the booming markets to burst suddenly" (Quigley, 2006, p. 4). This comment was

further confirmed by the study, *Long-Term Perspectives on the Current Boom in Home Prices*, where Robert J. Shiller (2006), a professor of economics at Yale University, finds that historically, not all real estate booms have ended in recession and gives examples of a few unique cases. Thus, similarly, Quigley concludes that in the case of the Silicon Valley, home prices will slowly reach an equilibrium matching neighboring counties (Quigley, 2006). However, he also informs us that other cities without the proximity and easy commute that the Silicon Valley has to nearby San Francisco, may be in danger of their housing boom turning into a bust.

2.3 Effectiveness of Planners' Responses

Planning objectives aimed at the creation of affordable units in response to the housing crisis have been studied as early as the 1980s. As Shen (1995), points out, local policies have caused the creation of such units to be harder to come by and have caused the redistribution of people into cities further out in the region (Shen, 1995, p. 61). One of these policies that has prevented the effectiveness of planners' responses to the creation of affordable housing is the policy of growth control (Shen, 1995, p. 64). Growth control policies have been present in the San Francisco Bay Area cities from as early as the year 1972, when one first appeared in the Petaluma, a city north of San Francisco. These policies put a limit on a city's growth by restricting the amount of residential construction that can occur. Shen (1995), used geographical information systems to take a closer look at the outcomes of these policies and gathered that:

"(1) the existing decentralized system of growth management has created

a spatial pattern of urban development that has undesirable economic and

distributional effects; and (2) a carefully developed coordinated regional system

of growth management is preferable because many critical growth problems can

be addressed appropriately only at the regional or metropolitan level" (Shen,

1995, p. 61).

Similarly, Haddad & Rongerude (2016) used a combination of statistical analyses

and spatial patterns to look at the success of the City of San Francisco's the Housing

Choice Voucher Program or, HCV for short (Haddad & Rongerude, 2016). This

program is a way for those with low income to access better neighborhoods. However,

the program requires that a large supply of housing units exist where the landlords are

willing to participate. The problem with this, is that the very neighborhoods where the

HCV program would be a desired option, are also the ones where landlords don't want

to participate. In their study, Haddad & Rongerude (2016) look at where the

households who hold these vouchers actually locate and whether or not the original

goal of this policy to get these people into higher quality neighborhoods was achieved.

Through the use of geographical information systems, they were able to identify that

areas with higher percentages of HCV holders also had higher percentages of African

Americans, people living in poverty, educated people, and lower housing prices. These

characteristics indicated that the planner's initial goal with the implementation of the

HCV program was ineffective in addressing the lack of affordable homes in higher quality neighborhoods. Based on these results, it seems that it's not only cities that need incentives to provide affordable housing, but also landlords.

However, there have been studies that have looked at the effectiveness of planners' responses that have yielded a more positive outlook. In, *Achieving Regional Housing Planning Objectives: Directing Affordable Housing to Jobs-Rich Neighborhoods in the San Francisco Bay Area*, Matthew Palm and Deb Niemeier, both researchers in federal housing policies at the University of California Davis, found that when the regional government, such as that of the city of San Francisco, is able to make their own mandatory affordable housing requirements, those cities have a better outcome at increasing the production of such units (Niemeier & Palm, 2017). In this study, it was noted that California has a regional housing mandate called: the Regional Housing Needs Allocation or RHNA for short. Through this initiative the RHNA works with local governments to estimate the amount of affordable units that each region should be producing to meet the growing households and employment of that area. Through their research, they found that California RHNA goals for the Bay Area counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma have had an impact on the number of affordable housing units built in each respective county. Furthermore, they found that the RHNA goals increased compliance with individual Bay Area city planning objectives between 1990

and 2005. This demonstrated a positive correlation between compliance and the production of homes. The distribution of affordable housing production versus market-rate production was also looked at in the study in combination with respect to the jobs to housing balance between the years of 1999 and 2007. It was found that due to the RHNA targets, the jurisdictions that had jobs to housing imbalances of higher degrees were actually the ones who did end up producing larger shares of affordable units, thereby verifying the effectiveness of the RHNA collaboration. In other words, the new affordable housing units being built in the San Francisco Bay Area were indeed ending up in the cities that had greater needs for them.

To contrast this finding, in another study titled, *31 Flavors of Inclusionary Zoning*, Jenny Schuetz, a professor at the University of Southern California School of Planning, Policy, and Development, looked at San Francisco's Inclusionary Zoning programs and their effectiveness in providing affordable units (Schuetz, Meltzer, & Been, 2009). In the study, data revealed that Inclusionary Zoning Programs have produced a significant amount of affordable units in the city of San Francisco. Furthermore, it was noteworthy that these units were produced by the city of San Francisco's own inclusionary programs during a time when federal funds and programs had recently been cut. One problem that was found during the study was that San Francisco's availability of buyout options for builders in lieu of building affordable units were actually lower than the

construction costs would have been. This finding highlighted a clear problem with the

ways in which policymakers were incentivizing developers to build new affordable units.

3 The Study

3.1 Methodology

3.1.1 Research Design

The design of this study was aimed at answering the question, *How are major Silicon Valley companies affecting home price and affordability in the San Francisco Bay Area housing market?*, through a statistical analysis. The statistical analysis answers this question through looking at median home price at the census tract level in relationship to its distance from the Silicon Valley.

3.1.2 Statistical Procedures

Two linear regressions were to answer a more direct question of: *Does median home price increase with proximity to the Silicon Valley?* The first regression used median home price by census tract for homes with a mortgage as the dependent variable and distance to the center of the Silicon Valley as the independent variable. The second regression used median home price by census tract for homes without a mortgage as the dependent variable and distance to the center of the Silicon Valley as the independent variable. The relationship between the variables in both regressions was analyzed for statistical significance based on their relative p-values. This determined whether or not a census tract's median home price can be explained by its distance to the Silicon Valley.

3.2 Data Collection Procedures

Primary data that is aggregated, anonymized, and publicly available for download was gathered from the United States Census Bureau 2016, American Community Survey. The variables taken from this dataset will be median home price by census tract for both homes with a mortgage and homes without a mortgage. The data was cleaned and trimmed down to one excel sheet with a select 17 counties extending around the greater San Francisco Bay Area. The counties included in the data extracted for the study are as follows:

- Alameda
- Contra Costa
- Marin
- Merced
- Monterey
- Napa
- Sacramento
- San Benito
- Santa Clara County

- Santa Cruz
- San Francisco
- San Joaquin
- San Mateo
- Solano
- Sonoma
- Stanislaus
- Yolo

The whole study area relative to the state of California is represented in Figure 1, a map on the following page.

Figure 1: Map of Study Area… see the following page.

Study Area

As one can see from the Study Area map, Figure 1, on the previous page, counties

from the San Francisco Bay Area were used as well as counties extending much further

outside of the greater Bay Area in order to give the best picture of how home price can

change with distance to this well-known real estate market.

For the purposes of the study Google Headquarters will served as the "center

point" for the Silicon Valley. The reasons for this selection are as follows. Google's

location in Mountain View make it positioned well geographically within the Silicon

Valley, and more centered than say a company who's headquartered in San Jose.

Additionally, Google ranked as the #1 company to work for by the Fortune "Best

Companies to Work For" list six years in a row ("Fortune 100 Best Companies to Work

For", 2017). One of the reasons for this high ranking is high employee compensation

(Gillett, 2016). Furthermore, Google has consistently been able to attract and keep

people with competitive salaries. The median salary of experienced Google employees

sits about $140,000, while those with less than one year of experience earn around

$93,000. These high pay rates indicate that employees working for this company would

be able to afford a much pricier home than the average person.

3.2 Findings

3.2.1 Linear Regression Results

Figure 2 Regression of Median Home Price for homes with a mortgage by census tract explained by Distance of census tract to Silicon Valley

Model Summary				
Model	**R**	**R Square**	**Adj. R Square**	**Std. Error of the Estimate**
1	.523a	.274	.273	295213.3
ANOVA						
Model	**Sum of Squares**	**df**	**Mean Square**		**F**	**Sig.**
Regression	7.709E+13	1	7.709E+13		884.613	.000
Residual	2.045E+14	2347	8.715E+10			
Total	2.816E+14	2348				

Coefficients							
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**95% CI Lower Bound**	**95% CI Upper Bound**
(Constant)	828795.77	11504.7		72.04	.000	806235.34	851356.2
Distance	-3.214	.108	-.523	-29.742	.000	-3.426	-3.002

In the above table, Figure 2, the regression output for median home price of homes with a mortgage by census tract is explained by distance (in feet) of that census tract to the center of the Silicon Valley. As one can see, the p-value for this regression is 0.0, which is less than 0.05, indicating that the results are statistically significant and we can reject the null hypothesis. Furthermore, because the adjusted r squared is 0.273, we can say that 27.3% of the variation of a home's price can be explained by its distance to the Silicon Valley. This finding was confirmed when graphed on scatterplot

as seen below in Figure 3. Figure 3 shows a downward sloping line with distance on

the x axis as the independent variable, and median home price of homes with a

mortgage as the dependent variable on the y axis. The downward fitted line shows that

as distance to the Silicon Valley increases, median home price decreases. There are,

however a few outliers present, which could be evident of census tracts in counties like

Marin County or San Francisco County that are farther away in distance to the center of

the Silicon Valley, yet still have expensive homes.

Figure 3 Scatterplot of Median Home Price with a Mortgage explained by Distance

Median Price of Homes with a Mortgage
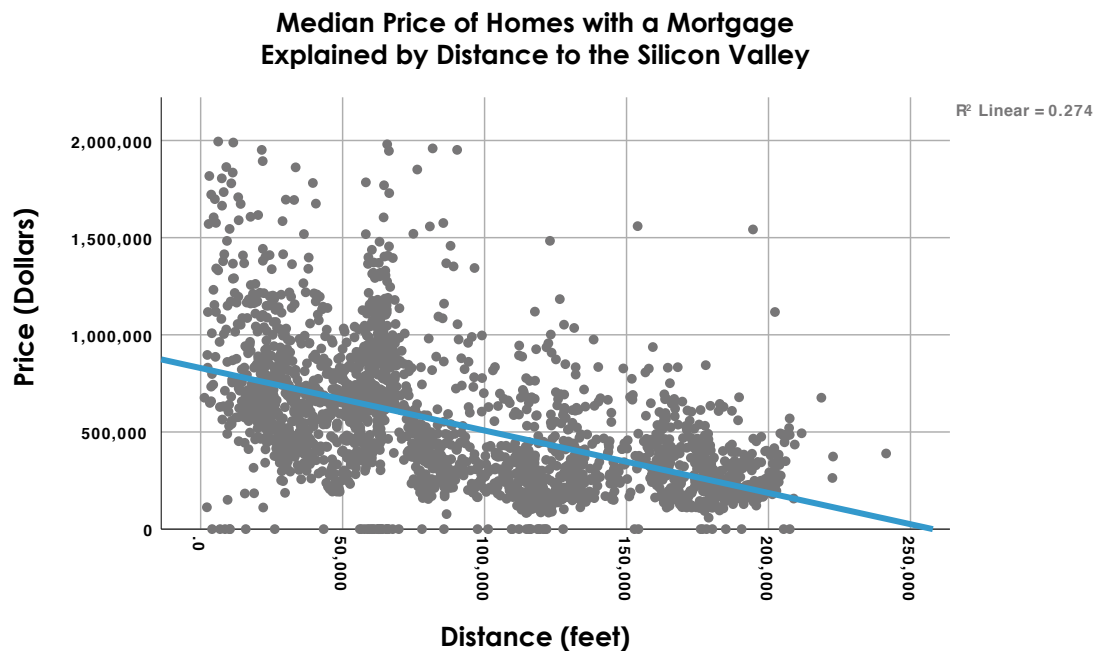Explained by Distance to the Silicon Valley

Figure 4 Regression of Median Home Price for homes without a mortgage by census tract explained by Distance of census tract to Silicon Valley

Model Summary				
Model	**R**	**R Square**	**Adj. R Square**	**Std. Error of the Estimate**
	.480a	.230	.230	307386.35

ANOVA					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	6.621E+13	1	6.621E+13	700.776	.000
Residual	2.213E+14	2342	9.449E+10		
Total	2.875E+14	2343			

Coefficients							
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**95% CI Lower Bound**	**95% CI Upper Bound**
(Constant)	753527.73	12003.11		62.78	.000	729989.91	777065.56
Distance	-2.982	.113	-.480	-26.472	.000	-3.203	-2.761

In the above table, Figure 4, the regression output for median home price of homes without a mortgage by census tract is explained by distance (in feet) of that census tract to the center of the Silicon Valley is displayed. As one can see, the p-value is 0.0, which is less than 0.05, indicating that the results are statistically significant and we can reject the null hypothesis. Additionally, because the adjusted r squared is 0.23, we can say that 23% of the variation in a home's price can be explained by its distance to the Silicon Valley. This finding was confirmed when graphed on a scatterplot as seen below in Figure 3. Figure 3 shows a downward sloping line with distance on the x-axis as the independent variable and median price of homes with a mortgage as the

dependent variable situated on the y-axis. The downward fitted line tells us that as distance to the Silicon Valley increases, the median home price decreases. Similar to that of the scatterplot representing the previous regression of median home price of homes with a mortgage explained by distance, there are existing outliers on the plot. These outliers could represent census tracts present in counties like Marin and San Francisco that are home to some very expensive homes, but also far away distance wise from the Silicon Valley center.

Figure 5 Scatterplot of Median Home Price without a Mortgage explained by Distance

Median Price of Homes without a Mortgage
Explained by Distance to the Silicon Valley

R^2 Linear = 0.230

In sum, the two linear regressions run in the study followed the basic model of,

$$y = mx + b$$

where, mx is the explanatory variable or in this case the distance to the Silicon Valley, and y is the dependent variable, or median home price. The two regressions were run with the intention of answering the question of, *Can a home's price be explained by its distance to the Silicon Valley?* in such a way that the relationship between the two variables was determined by fitting a linear equation to the data. Both regressions suggest a linear relationship between median home price and distance to the Silicon Valley in feet. For homes **without** a mortgage, the regression equation is:

$$\hat{y} = 753527.73 - 2.98x$$

For homes **with** a mortgage, the regression equation is:

$$\hat{y} = 828795.77 - 3.21x$$

These two equations could potentially predict the price of a home in the Bay area. For example, a home 10 miles (52,800 feet) from the center of the Silicon Valley would, according to the equation cost about $828,763,67.

3.2.2 Spatial Findings

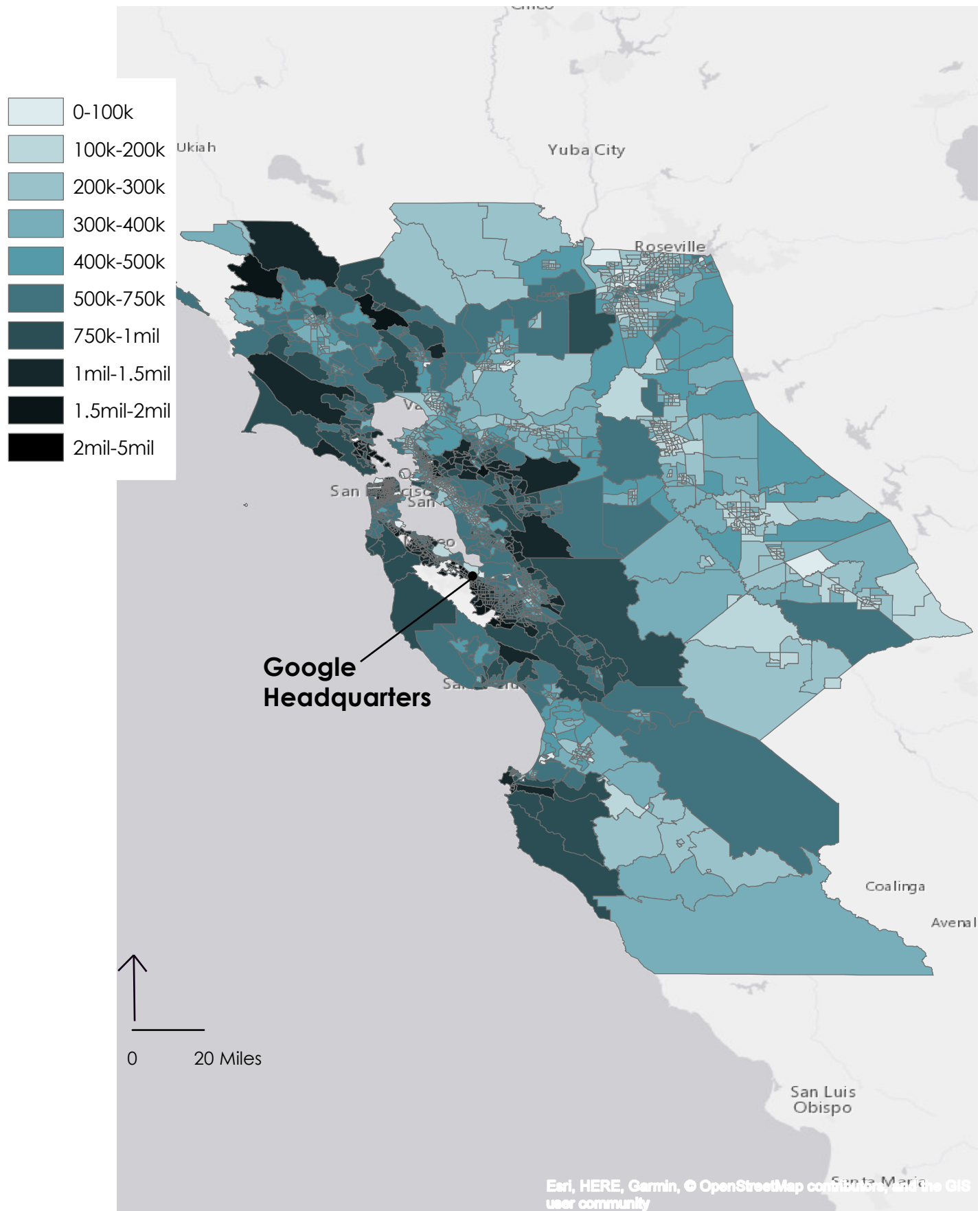**Figure 6** Map of Median Home Price with Mortgage by Census Tract
Figure 7 Map of Median Home Price with Mortgage by Census Tract (zoomed in)
Figure 8 Map of Median Home Price without Mortgage by Census Tract
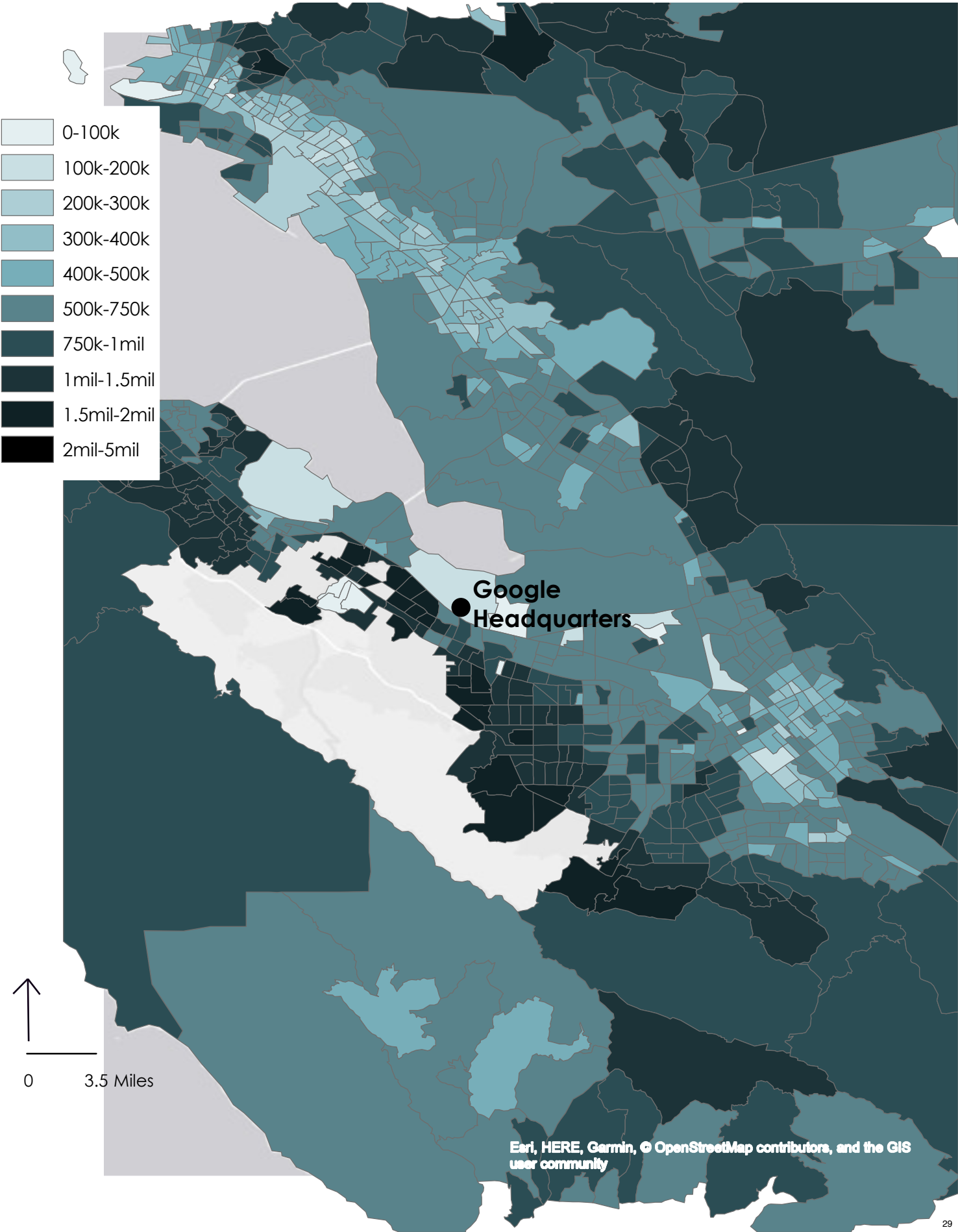**Figure 9** Map of Median Home Price without Mortgage by Census Tract (zoomed in)

For the maps to be discussed for the spatial findings please see figures 6, 7, 8, and 9 on the following four pages.

Median Price of Homes with a Mortgage by Census Tract

Legend:
- 0-100k
- 100k-200k
- 200k-300k
- 300k-400k
- 400k-500k
- 500k-750k
- 750k-1mil
- 1mil-1.5mil
- 1.5mil-2mil
- 2mil-5mil

Google Headquarters

0   20 Miles

Median Price of Homes with a Mortgage by Census Tract

Legend:
- 0-100k
- 100k-200k
- 200k-300k
- 300k-400k
- 400k-500k
- 500k-750k
- 750k-1mil
- 1mil-1.5mil
- 1.5mil-2mil
- 2mil-5mil

Google Headquarters

0   3.5 Miles

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Median Price of Homes without a Mortgage by Census Tract

	0-100k
	100k-200k
	200k-300k
	300k-400k
	400k-500k
	500k-750k
	750k-1mil
	1mil-1.5mil
	1.5mil-2mil
	2mil-5mil

Google Headquarters

0   20 Miles

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Median Price of Homes without a Mortgage by Census Tract

	0-100k
	100k-200k
	200k-300k
	300k-400k
	400k-500k
	500k-750k
	750k-1mil
	1mil-1.5mil
	1.5mil-2mil
	2mil-5mil

Google Headquarters

Woodside

Me

Alto

Los
Altos

0   2.5 Miles

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user community

Figures 6, 7, 8, and 9, on the previous 4 pages, show the median home price by census tract for both homes with a mortgage and homes without a mortgage as a similar color gradient shaded from light to dark turquoise. The lighter colors show census tracts that have homes with a lower median home price and the darker colors indicate census tracts where the median home price is higher. The lowest range represents a median home price of 0-100,000 dollars and the darkest color represents a median home price of 2,000,000-5,000,000 dollars.

Figures 6 and 7, represent the median price of homes with a mortgage by census tract with both an overall view of the greater San Francisco Bay Area and also a close up, more zoomed in view of the census tracts surrounding the center point of the Silicon Valley. From these maps, one can see that while the center point for Silicon Valley (Google Headquarters) lies in a census tract denoting median home prices of $100,000 to $200,000, the census tracts bordering it are on the higher end of the gradient, displaying a median home price of $1.5 million to $2 million. The reason for this could be that Google Headquarters is itself not a residence and rather a large office park.

Figures 8 and 9, represent the median price of homes without a mortgage by census tract with both an overall view of the greater San Francisco Bay Area and also a close up, more zoomed in view of the census tracts surrounding the center point of the Silicon Valley. From the maps, one can see that the homes without a mortgage are also

much more expensive closer to the Silicon Valley and greater Bay Area in general.

There are a lot of home sin the $500,000 to $750,000 price range. The census tracts

that are located farther away show gradient colors indicating homes of a lesser value.

This is suggestive that our hypothesis that as you get closer to the Silicon Valley, home

prices increase, is in fact accurate.

What is most interesting is that when comparing the spatial findings of the two

regressions, it becomes evident that the homes with a mortgage have higher overall

prices per census tract than those owned without one. There could many reasons for

this. The main reason that I can think of, is a person who has lived in the Silicon Valley

for a long time and owns their house outright or in other words has already paid off

their mortgage. This home may have bought years ago before the Silicon Valley first

started to really boom. Since prices were obviously much lower then, than they are

today, these people might have bought at a lower price and already paid off whatever

loan they may have needed to purchase it.

3.2.3 Comparison of Linear Regression with Spatial Findings

When looking at the linear regression results and plots, the spatial findings make

sense and seem to match up almost perfectly. One of the things considered in the

linear regression results was the fact that certain census tracts contained homes with a

high median home price that were actually far away from the Silicon Valley center.

These census tracts showed up as outlier points on the relative scatterplots. In the

spatial findings, these census tracts were evident as having the same dark colors of the gradient as those that were surrounding the Google Headquarters in the Silicon Valley.

3.2.4 Limitations of the study

Limitations of the study vary widely, but are predominantly linked to the lack of availability of data for a variable that defines the presence of tech industry specific jobs in the Silicon Valley. Because the Silicon Valley is large and there are many different types and ranges of jobs there, we cannot say for instance that every job in that region is related to tech. This makes it difficult to say then exactly how many of the people who own the expensive homes in the region are holders of these jobs. The United States Census Bureau does not give us a specific number for tech jobs, making it more difficult to thoroughly explain their relation to the affordability in the area. Ideally, there would have been a publicly available number for those living in the Silicon Valley who also work for the Silicon Valley Tech companies.

Additionally, using the distance from the Silicon Valley to the census tract does give us an idea of just how much the presence of tech companies may be the culprit of the high housing costs. It is hard to say that there is a direct linear relationship because as one can see, the regression did not account for outliers in the way of other existing expensive counties in the San Francisco Bay Area. For instance, it is well known that certain towns in Marin County and San Francisco County have census tracts containing homes of high prices. These census tracts, were included in the study because they are

a part of the San Francisco Bay Area. However, they also work against the linear regressions in the form of outliers based on their distance to the Silicon Valley. For example a home in the Pacific Heights neighborhood in San Francisco can be upwards of $10 million, but is 37.5 miles from the Silicon Valley center point used in this study of Google Headquarters. Similarly, a home in Ross California, a wealthy Marin County town, can be pricey in the $5 to $10 million range as well, but is even further from our center point at approximately 52 miles. Therefore, due to the inherent nature of outliers and the known existence of other expensive neighborhoods in the San Francisco Bay Area, it is hard to say that it is just tech companies creating the jobs that are paying employees more. What about the rich executives who live further away in Marin and San Francisco counties?

4. Discussion and Implications

4.1 Discussion

4.1.1 Answer to Research Question

The answer to the original research question, *How are major Silicon Valley companies affecting home price and affordability in the San Francisco Bay Area housing market?,* is largely apparent in the linear regression findings. For both homes with and those without a mortgage, a home's price can be explained by its distance to the Silicon Valley, indicating that a more expensive home closer to the tech companies is more desirable, thereby yielding a higher land price. Furthermore, there appears to be an uneven distribution of median home price in the greater San Francisco Bay Area, when looking at census tracts spatially. About 75% of the census tracts tend to sit at median home prices at or above $500,000, with only a few census tracts at lower median home price levels. What's more significant is the presence of census tracts with a median home price of $1.5 million to $2 million clustering around the study's center point of the Silicon Valley, Google Headquarters. This could also indicate that living closer to the tech companies is desirable.

4.1.3 Directional Spatial Pattern

In addition to the linear regression results that indicated that as distance to the center of the Silicon Valley decreased, median home price increased, spatial patterns also suggested that higher priced homes were in census tracts surrounding the center

point. There was an overarching directional spatial pattern apparent in all of the created maps displaying darker colors or higher median home prices in census tracts both directly north and south of the Silicon Valley center. However, excluding a few outliers, the spatial pattern indicating that as one continued either north or south in either direction, the color shades slowly began to lighten, indicating lower median home prices. Additionally, census tracts due east of the Silicon Valley center point showed lighter shades of the color gradient, indicating that they were also lower in median home price.

4.1.2 So What?

Since both the calculated linear regression findings and spatial findings show similarities, in that census tracts closer to the center point have higher median home prices, one can safely assume that whatever is happening at the center point of the Silicon Valley is desired. Since the center point used for the study was Google Headquarters, it can be assumed that people desire to live close to Google Headquarters and are willing to pay above market rate to reside there. While the reasons for wanting to live close to this point are undocumented, one can only assume that the reason people may want to live in this exact location is because of job proximity. In other words, people want to live close to their job, so that they may experience a reduced commute time and more pleasurable lifestyle. This desire is in effect causing home price in surrounding areas to go up and contributing to the crisis

that is not just in the Silicon Valley alone, but expanding across the Bay Area. With the amount of jobs that tech companies like Google provide, there are simply not enough homes in surrounding areas to house them all in addition to the people that already live and work there. Therefore it is both the working class people and lower income people that appear to be getting the short end of the stick. They are being pushed farther and farther away as tech company employees with high salaries are paying more and more to live in these areas.

4.1.4 Need for Regional Policies

Since both the linear regression findings and the spatial findings show that census tracts closer to the Silicon Valley center have a much higher median home price, one can assume that the effect these companies are having on the Bay Area housing crisis at large is significant. This is a case where many would say policymakers need to step in to develop new policies that protect working and lower class residents living and working in the Silicon Valley. Based on prior research, it was found that the California statewide policies clearly are not doing much to enforce the growth of affordable housing. Therefore it is up to those policymakers in individual regions to step in and make the necessary changes to garner growth in the affordable housing sector. Some of the policies that could be added include: (1) a minimum ratio requirements of affordable to market rate housing by city and (2) regional rent control laws that prevent current affordable housing from experiencing price increases as a

result of the surrounding market. Another area in which policy growth could occur is within the transportation sector. That is, in order to better connect people to affordable housing near their jobs, policy-makers and urban planners would need to work together to assure that the affordable housing that gets created has adequate public transportation to connect it to both the surrounding areas as well as to neighboring cities.

4.2 Implications for Planning

4.2.1 Policy Recommendations

Since there is evidence of a linear relationship between the distance to the Silicon Valley and median home price, the next question to be answered is, *Are city planner/s making effective programs and policies that are increasing the number of affordable units and addressing income inequality?* It is these programs that would be able to alleviate the long commutes of lower and middle class citizens who are being forced to live farther away from their jobs. Since the majority of the Silicon Valley lies within Santa Clara County, it was important to first see what types of programs they already have in place to address this issue. After thorough review, it becomes evident that while Santa Clara County does offer affordable housing to its lower income residents, there is not a multitude of programs or building efforts currently in place ("Office of Supportive Housing", 2018). There have however been many studies about the issue that evaluate different policies that have worked in other cities.

In his initial paper, *Jobs-Housing Balancing And Regional Mobility*, Cervero

(1989) gave a few great ideas for how the cities and counties can address the lack of

affordable housing in the Silicon Valley, many of which are still relevant today (Cervero,

1989, p.145). One of the major ways that Cervero (1989) gives for addressing the lack

of affordable housing is through tax relief designed to stimulate construction of

housing in urban centers. His example of this type of program was most recently used

in the metropolitan areas of Oregon. In Oregon, they wanted to ensure the use of the

areas where they built the housing as both residential and nature areas, where citizens

would have the opportunity to live as well as work. The types of tax initiatives they

implemented through this program included extraterritorial tax sharing and tax

abatements. These types of tax incentives encouraged development of affordable

housing. Policies for the Silicon Valley, most notably, Santa Clara County, could be

modeled after such programs since they proved affective. Furthermore, such programs

may actually be effective and less likely to be corrupted by cheaters as Glaeser et. al

(2005) points out: "developers' ability to use cash to influence local decision makers

has decreased over time" (p. 332). While historically, developers were able to become

savvy in their manipulation of such systems, zoning environments have become more

restricted and less politicians have been known to take cash payments and bribes.

The only way that remains however, to get effective planning policies in place, is

to require local governments to take measures to accommodate affordable housing

preemptively (Cowan, 2006, p. 296). In her study, *Anti-snob Land Use Laws, Suburban Exclusion, and Housing Opportunity*, Cowan (2006), confirms that state like Florida and the previously mentioned Oregon are leading the way in including affordable housing measures as part of their state's comprehensive plan and obligation to citizens. The only problem, she notes is that there is no mechanism that follows up with these initiatives to guarantee that the affordable housing actually gets built. This is where there is room for policy growth. Instead of merely incorporating affordable housing requirements into either county or state plans, why not also create a full committee that can follow up with what is decided to ensure its completion.

Another policy that has previously been implemented in some areas as a means to generate new public development is that of an impact fee. An impact fee is a fee that is imposed by a local government within the United States on both new and proposed development projects. It pays for a all of or a portion of the costs of providing public services to the new development. Burge and Ihlanfeldt (2006) found that impact fees can increase the new housing construction in suburban areas. The way in which they do this is by reducing exclusionary regulations and increasing the amount of the development projects that receive local government approval (Burge & Ihlanfeldt, 2006, p. 284). This is actually contradictory of what previously was known as something that could actually reduce new home construction. Burge and Ihlandfeldt have evidence in their study that impact fees actually decrease the financial losses

imposed on existing residents by new developments (p. 305). Reducing these financial

losses, they found, actually leads to more affordable homes being developed in the

area. Even though the economics of this impact fees can be tricky, as Brueckner (1997)

points out, they are in fact a necessary part of financing urban growth (p. 384).

Therefore, since there is no evidence that impact fees reduce the amount of new home

construction and actual empirical evidence that certain fees actually increase the

completion of new home projects, it would be worthwhile to look into these fees

further. If they can in fact be helpful, it is something that the Silicon Valley could easily

pass through their legislation.

4.2.2 Recommendations for Further Study

In addition to the policies looked at in the previous section, it would also be

beneficial to study the ways in which neighboring counties with similar problems, such

as San Francisco County, have addressed the lack of affordable housing. With a

thorough analysis of their programs, officials of Santa Clara County, may be able to see

what worked and what didn't and develop their own plan to try and adopt some new

programs. One such program that has been successful in San Francisco, is the

Inclusionary Housing program, guided by the San Francisco Planning Code Section 415.

This program proposes that when a housing developer proposes a housing project

with 10 or more units they must also do one of the following: (1) reserve a percentage

of units in the new building to be sold or rented at below market rate, (2) reserve a

percentage of units in another building they build to be rented or sold at below market

rate, or (3) pay a fee ("Inclusionary Housing Program", 2017). Looking at the success of

this program and whether or not it did help bring homes prices to more affordable

levels for residents would be useful when developing a strategy to address the

affordability issues in the Silicon Valley. Additionally, it would be beneficial to look at

the qualifications for qualifying for a "below market rate" housing unit, since in the

case of the Silicon Valley and other high income areas of the San Francisco Bay Area,

the market rate is much higher than the national average. With this in mind it would

only make logical sense that the qualifications to rent or buy below market rate would

also have a higher cut off, so that the people who need it can qualify. The city of San

Francisco has specified this income requirement as a household income between 55%

and 120% of Area Median Income ("Affordable Housing Resources", 2017). While this

number, is calculated based on the number of people in a given household, a further

study would be able to evaluate if this threshold is sufficient and translate it to a new

program in Santa Clara County.

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