

# **Benefits of BART for Office and Apartment Properties**

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STRATEGIC ECONOMICS INC

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## EXECUTIVE SUMMARY

This report evaluates BART's influence on office and apartment rents in Alameda, Contra Costa, and San Mateo Counties.<sup>1</sup> The report includes a literature review, as well as statistical analyses of how office and apartment building characteristics and rents vary as a function of distance from BART. Key findings are summarized below.

### The Transit Premium for Offices and Apartments

Many studies have shown that rail transit investments have a positive effect on property values and new development. However, most of the literature has focused on single-family home sales. Relatively few researchers have specifically studied the relationship of office or apartment values or rents to transit proximity. A study of the BART system in the mid-1990s called *BART at 20* did not find clear evidence of a premium associated with proximity to BART stations in the East Bay (Alameda and Contra Costa Counties) either for commercial sales values or for office or apartment rents.<sup>2</sup> However, more recent studies of other regions have generally concluded that office and other commercial properties do experience a transit premium. There is also some evidence for a transit premium for apartment properties, although results are more mixed.

The emerging evidence from other regions suggests that it is worth revisiting the relationship between proximity to BART and office and apartment rents. Moreover, a number of trends suggest that the benefits of locations near BART may be greater today than in the past. These include:

- **Expanded service to regional employment centers and other important destinations:** New service to East Dublin/Pleasanton (in 1997), San Francisco International Airport (2003), West Dublin/Pleasanton (2011), and Oakland International Airport (2014) has increased the amount of employment as well as the number of households located within close proximity to a BART station. In general, transit systems that provide strong access to employment centers and other regional destinations appear to have the greatest positive impact on property values.
- **Increased ridership:** Average daily ridership on the BART system increased from 215,544 (or 25.9 trips per capita per year) in 1995 to 325,136 (or 32.5 trips per capita per year) in 2012.<sup>3</sup> In recent years, ridership has continued to increase even in the absence of significant service expansions, reaching an average of more than 400,000 trips a day in 2014.<sup>4</sup> The significant rise in ridership suggests that BART is becoming increasingly important in the daily lives of commuters and other travelers.
- **Supportive local land use policy and public investments:** Over the past two decades, BART and local governments have invested in improvements to reinforce the pedestrian, bicycle, transit, and auto connections to many stations. In addition, many local governments now have station area plans and zoning in place to allow for higher densities around BART stations.
- **Significant new development:** Local real estate markets have had time to adjust to the system, particularly in the East Bay where most stations have been in service since the 1970s. BART station areas in places such as Downtown Oakland, Downtown Berkeley, Walnut Creek, Pleasant Hill, Colma, and South San Francisco have attracted new apartment development. Some stations, including Pleasant Hill, Dublin/Pleasanton, and Downtown Oakland, have also attracted some

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<sup>1</sup> San Francisco was excluded because of the significant challenges involved in isolating BART's impact in a city where BART is only one of many rail transit options. BART's influence on the Downtown San Francisco office market will be examined separately, in a forthcoming study.

<sup>2</sup> Cervero and Landis, "BART at 20"; Landis and Loutzenheiser, *Bart @ 20: BART Access and Office Building Performance*.

<sup>3</sup> Metropolitan Transportation Commission, "Transit Ridership."

<sup>4</sup> Bay Area Rapid Transit District (BART), "BART 2014 Factsheet."

new office investments. Many of these projects have been built with design features intended to capitalize on the location near BART, and hence maximize the transit premium.

These trends suggest that offices and apartment near BART should rent for a significant premium. In turn, higher rents near BART should result in higher values for property owners, and higher property tax revenues for local governments.

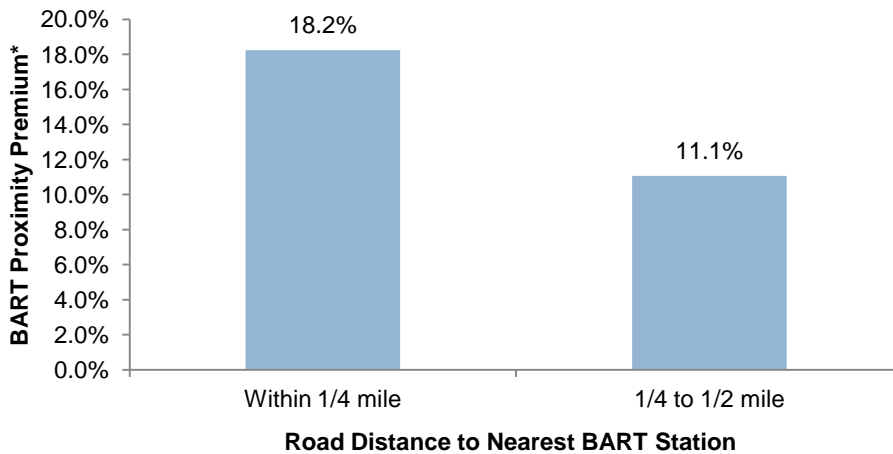
## Office Properties and BART

The study evaluates how office rents and building characteristics vary with distance from BART. The analysis was based on data on asking rents<sup>5</sup> from the second quarter of 2014.

### BART's Impact on Rents

**All else equal, office rents in the East Bay are 18 percent higher within a quarter mile of a BART station and 11 percent higher within a quarter to a half mile, compared to rents of properties located more than a half mile from the station.** Strategic Economics used a statistical model to control for building characteristics, freeway access, location within the region, and local employment density. Figure 1 shows the results. These effects are much stronger and more statistically significant than the findings from *BART at 20*, indicating that changes in the transit system and real estate market have resulted in real benefits for office tenants and property owners near BART in the East Bay.

Figure 1. Office Rent Premiums Associated with Proximity to BART Compared to Areas More than a Half Mile from a Station: East Bay



\*Percentage difference in annual average rental rate compared to being located more than 1/2 mile from a BART station, after controlling for other factors with regression analysis.

Source: Strategic Economics, 2015.

**BART does not have the same influence on office rents in San Mateo County.** Based on a simple comparison of average rents at different distances from BART, asking rents are 12 percent lower within a half mile of BART stations in San Mateo County than within one-half to one mile of the stations. Moreover, including northern San Mateo County with Alameda and Contra Costa Counties in the statistical model reduces the overall estimated premium associated with proximity to BART stations. These results in part reflect the land uses around the San Mateo County stations, which are predominantly residential; there are no major employment centers located in close proximity to the San Mateo County BART stations. In addition, the San Mateo County stations (with the exception of Daly City) are

<sup>5</sup> I.e., quoted rental rates, before taking into account negotiated concessions or other factors.

relatively new, dating from the late 1990s and early 2000s. As land uses continue to evolve around the stations over the coming decades, office tenants in San Mateo County may come to place a greater value on locations near BART.

**In aggregate, BART contributes an estimated \$80 million per year in added lease revenues for East Bay office property owners located within a half mile of a station.** According to CoStar's database, approximately 30 million square feet of office space are located within a half mile of the BART stations in the East Bay. In 2014, these properties generated an estimated \$80 million in additional rent associated with proximity to BART.<sup>6</sup>

### Office Space near BART

**Nearly 30 percent of the existing office inventory in Alameda County and 15 percent of the office space in Contra Costa County is located within a half mile of a BART station.** Office space in the East Bay remains relatively concentrated around the BART stations, despite decades of employment decentralization in the Bay Area. A particularly high share of Class A space – including 67 percent of the Class A inventory in Alameda County and 32 percent in Contra Costa County – is located within a half mile of BART.<sup>7</sup>

**Only a small amount of office space is located near BART in San Mateo County.** Fewer than one million square feet, or less than two percent, of San Mateo County's office inventory is located within a half mile of the BART stations. Most of the large, high-value office nodes in San Mateo County are located in cities to the south that are not served by the BART system, such as San Mateo, Redwood City, and Menlo Park.

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<sup>6</sup> This estimate is based on multiplying the average rent premium for East Bay properties located within a quarter mile and a quarter to a half mile of BART (\$4.02 and \$2.44 per square foot per year, respectively) times the total inventory in each distance category, and subtracting a factor for average vacancy rates in each office submarket. See Appendix A for a more detailed description of this methodology.

<sup>7</sup> Office space is generally classified into three categories (A, B, and C) that reflect building quality; Class A buildings have the highest quality finishes and amenities.

## Apartment Properties and BART

The analysis explored how the characteristics of apartment complexes vary with distance from BART, and used several different methods to assess the impact of BART on apartment rents. Highlights from the analysis are discussed below.<sup>8</sup> The analysis is based on asking rents from the second quarter of 2014, for market-rate apartment complexes that include 50 or more units.

### BART's Impact on Rents

**In the East Bay, proximity to BART is associated with 20 percent higher rents.** A simple comparison of rents by distance from BART showed that apartments within a half mile of a BART station rent for approximately 20 percent more compared to apartments located one-half to one mile from a station. The relatively high rents within a half mile of BART likely reflect the value that renters place on the accessibility benefits provided by the transit system. However, the high rents may also reflect other differences between BART station areas and other parts of the East Bay, including the fact that apartment units near BART tend to be newer and higher quality.

**In San Mateo County, apartments near the BART stations rent for a discount.** Rents in San Mateo County generally increase at greater distances from BART, reflecting the higher priced markets closer to the heart of Silicon Valley.

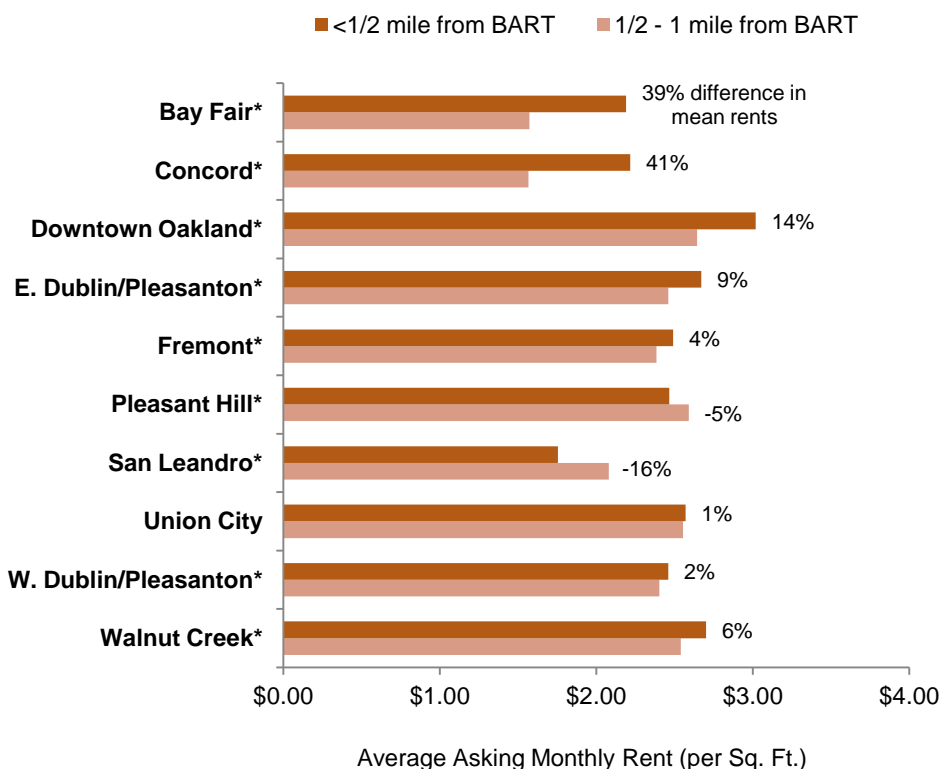
**There is also a statistically significant premium for proximity to BART in most of the individual East Bay station areas.** This analysis compared average rents within one-half mile of selected BART stations to average rents within one-half to one mile of a station. Overall, rents per square foot are significantly higher within one-half mile of most stations, compared to rents for properties located one-half to one mile from a station (Figure 2). The premiums for locations within one-half mile of BART range from one to two percent at the Union City and West Dublin/Pleasanton stations, to about 40 percent near the Concord and Bay Fair station.

The only exceptions are in the Pleasant Hill and San Leandro station areas, where rents are lower within a half mile of the stations. The relatively low rents within a half mile of the San Leandro and Pleasant Hill stations appear to reflect conditions at a few specific properties. For example, in Pleasant Hill, there is a concentration of new or recently renovated buildings within one-half to one mile of the station, while the properties within a half mile of the station include a mix of new construction (such as the Avalon Walnut Creek project located directly adjacent to the station) as well as some older properties with lower rents.

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<sup>8</sup> Note that the results in this section do not control for apartment quality or other factors. Because of the strong correlation between proximity to BART and other factors that also influence rents (including unit size, age, quality, and development density), it was not possible to statistically control for these factors.

Figure 2. Comparison of Average Rents for Selected Station Areas



Results do not control for quality of apartment buildings or other factors that may influence rents.

\*Difference between mean rents is statistically significant at the 95% confidence interval.

Downtown Oakland includes 12th Street, 19th Street, and Lake Merritt station areas.

All station areas with at least two properties located in each distance band (less than a half mile and a half to one mile) were included in the analysis

Source: realAnswers, 2Q 2014; Strategic Economics, 2015.

### Characteristics of Apartments near BART

**In the three counties, 33 percent of all units built since 1999 are located within a half mile of a BART station, compared to just 7 percent of units built before 1999.** The concentration of new development around the BART stations suggests that developers see BART access as an important amenity. The significant new development around the stations may also reflect successful efforts by cities to concentrate multi-family development in places that are well-served by transit.

**Apartments located within a half mile of BART are higher quality than units located further away from a station.** Nearly 40 percent of units located in the half-mile BART station areas are Class A – a category that encompasses newer buildings with significant amenities and high-end finishings – compared to 16 percent within one-half to one mile of a station and just five percent of units located more than a mile from a station. The concentration of Class A buildings near the stations in part reflects the many new buildings located near BART; most Class A properties are either new or recently renovated.

**Apartment projects within a half mile of BART have higher development densities.** Nearly 90 percent of units located within a half mile of BART are in properties with three or more stories, compared to just 67 percent within one-half to one mile of a station. Fifteen percent of units within a half mile of a station are in properties with six or more stories. In part, this may reflect the success of public policies that seek to concentrate higher-density development around transit stations.



## I. INTRODUCTION

This study assesses the relationship between proximity to BART and office and apartment rents. The report builds on Strategic Economics' August 2014 report, *Property Value and Fiscal Benefits of BART*, which evaluated the value that BART confers to single-family and condominium homes and estimated BART's overall impact on communities' local tax base. Like the 2014 study, this report focuses on Alameda, Contra Costa, and San Mateo Counties. San Francisco was excluded because of the significant challenges involved in isolating BART's impact in a city where BART is only one of many rail transit options. However, BART's influence on the Downtown San Francisco office market will be examined separately, in a forthcoming report.

Following this introduction, this report includes:

- A literature review focused on the property value and rent impacts of transit on offices and apartments, including a discussion of the findings from *BART at 20* (Chapter II).
- An evaluation of BART's influence on office rents (Chapter III).
- An assessment of the relationship between apartment rents and proximity to BART (Chapter IV).

Appendices A and B provide details on the statistical models that were developed to estimate BART's contribution to office and apartment rents, respectively. Appendix C provides a bibliography of research cited in the report.

## II. LITERATURE REVIEW

A number of studies have shown that rail transit investments have a positive effect on property values and new development. However, most studies of the relationship between transit and property values are focused on single-family homes. Relatively few analyses have explored how transit influences office, apartment, or other commercial properties. This chapter provides an overview of some of the key findings from the broader literature on property values and transit, and then discusses the studies that have focused specifically on office and apartment properties, including a detailed discussion of *BART at 20*.

### OVERVIEW: PROPERTY VALUES AND TRANSIT

Strategic Economics' August 2014 report, *Property Value and Fiscal Benefits of BART*, included a detailed literature review on the property value and fiscal impacts associated with transit investments. Key findings from the literature review are summarized below.

#### The Transit Land Value Premium

The expectation that rents and sale values will be higher near transit stations is based on the premise that households and firms are willing to pay a premium to locate in transit-served areas, where they can take advantage of the improved accessibility and other benefits that transit systems offer. Households that live near a transit station benefit from reduced transportation costs and faster, more convenient access to employment and other important destinations. Employers located near transit benefit from improved access to their workforce and customers, resulting in increased productivity and sales. To the extent that employers help pay for their workers' commutes – for example, by providing parking or paying higher wages to compensate for a long or expensive commute – firms located near transit may also realize direct savings.<sup>9</sup> Where traffic congestion makes driving a particularly unpleasant alternative for workers (as in much of the Bay Area), employers located near transit may also benefit from improved employee recruitment and retention. The price premium that households and firms pay for these advantages is transmitted (or “capitalized”) into higher land values near transit stations, and is known as a “land value” premium because the benefit of transit is primarily a function of the location of the land (as opposed to the value of buildings or other structures).<sup>10</sup>

#### Other Sources of Value in Transit-Oriented Locations

In addition to attracting households and firms who are willing to pay a premium to locate near a transit station, transit can also help create value by enabling new, higher density development. Supportive public policy can help reinforce the value of transit-served locations for new, intensity development by allowing higher densities, reducing parking requirements, and providing supportive public infrastructure such as improved parks and public spaces, pedestrian paths, and bike lanes.<sup>11</sup> In turn, higher-density development can attract clusters of pedestrian-oriented retail and other amenities that make neighborhoods more attractive places to live. Higher-density development may also facilitate “agglomeration economies” – or the benefits that result when firms cluster together, including the ability for businesses to more easily share suppliers and distributors, access skilled workers, and transfer knowledge.<sup>12</sup>

#### Findings from the Empirical Literature

Many studies have explored the influence of transit investments on property values or rents, controlling for factors such as property attributes, local and regional differences in market conditions, and other

<sup>9</sup> Landis and Loutzenheiser, *Bart @ 20: BART Access and Office Building Performance*.

<sup>10</sup> Fogarty et al., *Capturing the Value of Transit*, November 2008.

<sup>11</sup> Fogarty et al., *Capturing the Value of Transit*, 2008.

<sup>12</sup> Iacono and Levinson, “Case Studies of Transportation Investment to Identify the Impacts on the Local and State Economy”; Belzer, Srivastava, and Austin, *Transit and Regional Economic Development*.

neighborhood characteristics. As discussed below, most studies have focused on the impact of transit on single-family home values, and used transaction (sales) data. Studies have found widely varying property value effects associated with transit investments, ranging from -45 percent to more than 100 percent compared to areas not served by transit. However, most fall in the range of 5 to 20 percent.<sup>13</sup> In general, transit appears to have the greatest positive impact on property values when the transit system significantly improves households' access to employment centers and other regional destinations, and service is fast, frequent, and reliable.<sup>14</sup> Pedestrian-friendly, mixed-use neighborhoods with good connections to transit stations generally experience the most significant property value benefits from transit, particularly when local governments implement zoning and land use regulations to facilitate transit-oriented development (TOD).<sup>15</sup>

Studies that find negative property value impacts suggest that in some cases, the noise, pollution, crime, or other negative externalities of locations near transit may outweigh the accessibility benefits. For example, the negative effects may be more likely to outweigh the positive effects of transit proximity in places where taking transit does not provide significant time savings or improved convenience compared to driving. These negative externalities may affect single-family homes in very close proximity to transit stations more than commercial or multi-family properties, since the latter may be more compatible with the busy environment surrounding transit stations.<sup>16</sup> In some cases, new transit systems may take some time to attract riders and new development, and thus to influence property values. This appears to have occurred with the BART system in the East Bay; early studies observed reduced property values around some station areas, while *BART at 20* found some types of property values to be higher in close proximity to transit.

## **THE TRANSIT PREMIUM FOR OFFICE AND APARTMENT PROPERTIES**

Research on transit ridership and household and firm location patterns suggest that apartment and office properties located near transit should command a significant premium, perhaps larger than the premium for other types of residential and commercial properties. After all, renters and office workers are among the groups most likely to ride transit. Compared to homeowners, renters tend to take transit more often, own fewer cars, and are more likely to live within a half mile of a transit station.<sup>17</sup> Compared to workers employed in other types of jobs, office-based workers are more likely to commute via transit.<sup>18</sup> Firms in office-based industries (e.g., professional, scientific, information, and financial services) are more likely than other businesses to choose locations based on commute options and other quality of life factors for workers,<sup>19</sup> and are particularly likely to locate near transit stations.<sup>20</sup>

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<sup>13</sup> Mohammad et al., "A Meta-Analysis of the Impact of Rail Projects on Land and Property Values."

<sup>14</sup> Debrezion, Pels, and Rietveld, "The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-Analysis"; Landis et al., *Rail Transit Investments, Real Estate Values, and Land Use Change: A Comparative Analysis of Five California Rail Transit Systems*.

<sup>15</sup> Duncan, "Comparing Rail Transit Capitalization Benefits for Single-Family and Condominium Units in San Diego, California"; Duncan, "The Impact of Transit-Oriented Development on Housing Prices in San Diego, CA"; Duncan, "The Synergistic Influence of Light Rail Stations and Zoning on Home Prices"; Atkinson-Palombo, "Comparing the Capitalisation Benefits of Light-Rail Transit and Overlay Zoning for Single-Family Houses and Condos by Neighbourhood Type in Metropolitan Phoenix, Arizona."

<sup>16</sup> Kittrell, Hamidi, and Ewing, "Transit's Value as Reflected in U.S. Single Family Home Premiums: A Meta-Study Summarizing 40 Years of Research."

<sup>17</sup> Pollack, Bluestone, and Billingham, *Maintaining Diversity in America's Transit-Rich Neighborhoods: Tools for Equitable Neighborhood Change*.

<sup>18</sup> Greenberg and Belzer, *TOD 202: Transit & Employment*.

<sup>19</sup> Salvanes and Renski, *The Importance of Quality of Life in the Location Decisions of New Economy Firms*; Chapple and Makarewicz, "Restricting New Infrastructure."

<sup>20</sup> Center for Transit-Oriented Development, *Trends in Transit-Oriented Development, 2000-2010*.

However, the majority of studies about the value premium associated with proximity to transit have been based on sales of single-family homes. This reflects the availability of large, geographically comprehensive datasets on single-family transactions. Single-family homes sell more frequently than multi-family apartment or commercial properties, and are the predominant form of housing in most U.S. regions. In comparison, apartment complexes, office buildings, and other revenue-generating properties change ownership less frequently – particularly in California, where Proposition 13 creates incentives for property owners to avoid real property transactions in order to avoid reassessment.<sup>21</sup> In addition, apartments, offices, and other commercial land uses are often spatially clustered in particular areas within a region, creating challenges for some types of statistical analysis.

Given the limitations on sales data for commercial properties, rents and occupancy rates are sometimes a better measure for studying the value of transit for office and apartment properties. To the extent that rents and occupancy rates are higher near transit, this should in turn result in higher operating revenues for property owners, and be reflected in higher property values. However, studying rents and occupancy rates can also be challenging. First, rent data are typically collected by brokerage firms or commercial data vendors. These sources collect information from property owners, managers, and brokers, who report information on a voluntary basis. In addition, most sources track asking rents for available properties, which may not reflect actual (negotiated) lease rates. For office properties in particular, lease agreements vary widely and can include a range of utilities and services in the rent. Moreover, given the duration of an office lease (typically 5 to 10 years), only a fraction of all properties appear on the market at a given time. As a result, datasets on asking rents reflect only a small proportion of the total rental stock.

Despite these challenges, a limited number of studies have focused specifically on the relationship of office or apartment values or rents to transit proximity. These studies are summarized in Figure II-1, and are further discussed below. All of the studies shown in Figure II-1 use hedonic regression analysis to control for building characteristics such as age, quality, and unit size; some also control for highway access, proximity to employment centers, neighborhood socio-economic attributes, local land use characteristics, or other factors related to location.

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<sup>21</sup> Under Proposition 13, properties are reassessed only when they change ownership or undergo new construction, so owners have an incentive to retain their property in order to keep the assessed value – and, thus, the tax liability – low. Given this incentive, some commercial property owners may choose to lease rather than sell their properties. Moreover, trusts and corporations can hold land for decades (and, in the case of publicly-traded corporations, even change ownership) without facing reassessment. See Lenny Goldberg and David Kersten, *High-Tech, Low Tax: How the Richest Silicon Valley Corporations Pay Incredibly Low Taxes on Their Land*.

Figure II-1. Summary of Studies on Office and/or Apartment Values and Transit Proximity (Page 1 of 2)

Study Author(s) and Date	Location	Type of Rail	Measure	Transit Premium (+) or Discount (-) (Difference in Value between Properties Near Transit Station Compared to Properties Located Further Away)		
				Office (or Commercial*)	Apartments	Other
Debrezion et al. (2007)	National (meta-analysis)	Multiple (meta-analysis)	Multiple (meta-analysis)	+16.4 percent within ¼ mile*		Residential (including apartments): +4.2 percent within ¼ mile
Mohammad et al. (2013)	International (meta-analysis)	Multiple (meta-analysis)	Multiple (meta-analysis)	+24 to 31 percent higher value for commercial properties* compared to residential properties near transit		
Nelson et al. (2015)	Dallas and Denver	Light rail	Office rents	Positive effect on office rents extended about 2.35 miles from a station, but half the premium was lost by the first 0.65 mile from a station, and three-quarters of the premium was lost by 1.1 miles from a station		
Clower et al. (2014)	Dallas	Light rail	Office rents	+13.9 percent within ¼ mile		
WMATA (2011)	Washington D.C.	Commuter rail	Assessed property values	+8.9 percent within ½ mile	+9.4 percent within ½ mile	SFR: +6.8 percent within ½ mile
Ko and Cao (2010)	Minneapolis	Light rail	Property sales	\$6,500 within ¼ mile		
Ryan (2005)	San Diego	Light rail	Office and industrial rents	No significant premium		Industrial: No significant premium
Weinberger (2001)	Santa Clara County	Light rail	Office rents	+7 to 13 cents per square foot within ¼ mile		
Cervero and Duncan (2001)	Santa Clara County	Light rail and commuter rail	Property sales	+23 percent within ¼ mile for light rail* +120 percent within ¼ mile for commuter rail*		

Study Author(s) and Date	Location	Type of Rail	Measure	Transit Premium (+) or Discount (-)		
				<i>(Difference in Value between Properties Near Transit Station Compared to Properties Located Further Away)</i>		
				Office (or Commercial*)	Apartments	Other
Bollinger, Ihlanfeldt, and Bowes (1998)	Atlanta	Heavy rail	Office rents	-7 percent within ¼ mile		
Cervero and Duncan (2002)	San Diego	Light rail and commuter rail	Property sales	-9 to +91 percent within ½ mile, depending on location*	-7 to +17.3 percent within ½ mile, depending on location	Condos: +2.2 to +46 percent within ½ mile SFR: -4 to +17 percent within ½ mile, depending on location
Cervero and Duncan (2002)	Los Angeles	Heavy rail, commuter rail, light rail, bus rapid transit	Property sales	-30 to +13 percent within ½ mile, depending on location*	-6 to +6 percent within ½ mile, depending on location	Condos: -16 to +14 percent within ½ mile SFR: -16 to +14 percent within ½ mile, depending on location
Benjamin and Sirmans (1996)	Washington D.C.	Heavy rail	Apartment rents		+2.5 percent for each 1/10 <sup>th</sup> mile closer to station	
Cervero and Landis (1995)	Alameda and Contra Costa Counties	Heavy rail (BART)	Apartment rents		No significant premium after controlling for other factors	
Cervero and Landis (1995)	Alameda and Contra Costa Counties	Heavy rail (BART)	Property sales	No significant premium after controlling for other factors	No significant premium after controlling for other factors	SFR: +\$2.00 per meter closer to station
Landis and Loutzenheiser (1995)	Alameda, Contra Costa, San Francisco Counties	Heavy rail (BART)	Office rents	No significant premium after controlling for other factors		

\*Includes multiple types of commercial (i.e., revenue-generating) property in addition to office (e.g., retail, hotels, industrial)

All of the results shown are based on hedonic regression analyses, which use statistical methods to control for building characteristics, location within the region, and other factors that may also affect rents or property values.

## BART at 20

A series of studies led by Professors Robert Cervero and John Landis<sup>22</sup> examined the land use, development, and property value impacts of BART in its twentieth year of operation. The studies provided detailed analysis of the impacts of BART on single-family, apartment, and office values. Cervero and Landis found that single-family homes in Alameda and Contra Costa Counties increased in sales value by \$2.00 for every meter closer a home was located to the nearest BART station. However, the results for commercial property sales, office rents, and apartment rents were much more mixed:

- **Commercial property sales:** In an analysis of office, retail, and industrial properties sold between 1988 and 1994, Cervero and Landis found that properties within a quarter mile of a BART station in Alameda County sold for a premium. However, the results were inconclusive because when the researchers used a regression analysis to control for other building and site characteristics, the premium disappeared. Commercial properties near BART stations in Contra Costa County did not sell for a premium.
- **Office rents and occupancy rates:** Landis and Loutzenheiser studied 1993 office rents and building occupancy rates in the San Francisco and East Bay office markets. The analysis began with a simple comparison of rents and occupancy rates at different distances from BART stations. Occupancy rates were generally higher within a half mile of BART, and a few markets showed higher rents within a half mile of BART as well. However, the difference in rents and occupancy rates was only statistically significant in the Fremont and Walnut Creek markets. The authors also used regression analysis to control for building quality, age, and other characteristics, and found that after controlling for these factors, buildings located within 3/8 of a mile of the Walnut Creek BART station rented for a premium of \$0.25 per square foot per month. Otherwise, there was no systematic, statistically significant premium associated with proximity to a station after controlling for building characteristics.
- **Apartment rents:** Cervero and Landis collected data on 1994 rents in three East Bay apartment market areas, including Concord/Pleasant Hill/Walnut Creek, Albany/El Cerrito/Richmond, and Union City/Fremont. Rents were analyzed using two different methods: a matched pair comparison of buildings located within walking distance of a BART station versus buildings located further away, and a hedonic regression analysis controlling for unit and property characteristics as well as distance to BART. The matched pair comparison showed that apartment rents for one- and two-bedroom units located within walking distance of BART were 10 to 15 percent higher than units of the same size located elsewhere in the same market area. The hedonic regression analysis did not produce results that were statistically significant. The authors speculated that it was difficult to obtain a statistically significant result because project density, unit size, and BART proximity were highly correlated, making it difficult to separate out the influence of these three factors on rents.

The previous apartment and office rent studies point to several challenges with this type of analysis, including small sample sizes, the use of asking rather than effective rents, and the fact that the available data are only for one year and may in part reflect market conditions at a single point in time. The authors speculated that given the general oversupply of commercial space in the late 1980s and early 1990s, commercial space near BART may have been plentiful, reducing any premium that property owners were able to charge for transit access or other special amenities. Landis and Loutzenheiser also hypothesized that the lack of a transit premium for office properties could reflect the decentralization of office development and office-based employment, particularly in the East Bay.

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<sup>22</sup> Cervero and Landis, "BART at 20"; Landis and Loutzenheiser, *Bart @ 20: BART Access and Office Building Performance*.

## Other Studies of Office and Commercial Properties

In the years since *BART at 20* was published, a number of other studies have examined how office sales values or rental rates are influenced by proximity to transit across the United States (Figure II-1). Several more analyzed transit's impact on commercial properties defined more broadly, including office as well as other types of revenue-generating uses such as retail, hotel, and even industrial property. While there is significant variation in the results, taken together the research suggests that office and other types of commercial properties typically experience a value premium associated with proximity to rail stations. Major findings from the literature include:

- **In general, the premium associated with proximity to a transit station may be higher for commercial properties than for residential properties.** Two recent meta-analyses<sup>23</sup> of the empirical literature on property values and transit proximity found that commercial properties (which were mostly but not exclusively office) tend to experience a higher premium than residential properties (including apartments). In a 2007 meta-analysis, Debrezion et al. found that commercial properties within a quarter mile of a rail transit station were 16.4 percent more expensive than commercial properties located further away. In comparison, residential properties within a quarter mile of a station experienced a 4.2 percent premium. In a more recent meta-analysis that considered a wider range of studies (including international studies), Mohammad et al. found that commercial properties near transit were worth 24 to 31 percent more than residential properties near transit, after controlling for other factors.<sup>24</sup>
- **However, most research shows that the transit premium for commercial properties is concentrated within short distances of a station.** For example, the Debrezion et al. study found that while commercial properties experienced a higher premium than residential properties within a quarter mile of a station, the premium for commercial properties dissipated sharply after a quarter mile. In contrast, residential property values continued to be influenced by transit even at further distances from the station.<sup>25</sup> Other studies focused specifically on office have found that the premium associated with proximity to transit declines significantly after the first half to one mile from a station.<sup>26</sup> In a recent study of light rail's effect on office rents in Denver and Dallas, Nelson et al. found that while the positive effect on office rents extended as far as 2.35 miles from a station, half the premium was lost by the first 0.65 mile from a station, and three-quarters of the premium was lost by 1.1 miles from a station.<sup>27</sup> The value of transit access may extend over shorter distances for commercial properties than for residential properties because whereas riders are able to drive and park (as well as walk, bike, or take transit) from their residences to many BART stations, walking is the primary mode of transportation on the destination (work) end of many trips.
- **While most studies find a positive relationship between office or commercial values and transit proximity, a few studies have found that office or commercial properties located near transit experience either a neutral or negative property value effect.** For example, Bollinger et al. found that office space within a quarter mile of MARTA stations in Atlanta rented for a discount in the early 1990s; the authors hypothesized that these lower rents could reflect concerns about safety near the stations.<sup>28</sup> Another potential explanation is that the MARTA system did not provide a significant accessibility advantage compared to driving, at least at the time of the study.<sup>29</sup> In a San Diego study,

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<sup>23</sup> A meta-analysis is a statistical method for combining and comparing results across multiple studies.

<sup>24</sup> Mohammad et al., "A Meta-Analysis of the Impact of Rail Projects on Land and Property Values."

<sup>25</sup> Debrezion, Pels, and Rietveld, "The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-Analysis."

<sup>26</sup> Ko and Cao, *Impacts of the Hiawatha Light Rail Line on Commercial and Industrial Property Values in Minneapolis*; Weinberger, "Light Rail Proximity."

<sup>27</sup> Nelson et al., "Office Rent Premiums with Respect to Light Rail Transit Stations in Dallas and Denver."

<sup>28</sup> Bollinger, Ihlanfeldt, and Bowes, "Spatial Variation in Office Rents within the Atlanta Region."

<sup>29</sup> Mohammad et al., "A Meta-Analysis of the Impact of Rail Projects on Land and Property Values."



Cervero and Duncan found that commercial properties near commuter and light rail stations in Downtown San Diego and Mission Valley (a major commercial corridor) experienced large premiums, while commercial properties that were located near transit stations but outside of major employment centers sold for a relatively discounted price.<sup>30</sup>

## Other Studies of Apartment Property Values and Rents

The literature on transit proximity and apartment rents or sales values is even more limited than the literature on office properties. Findings from the literature review include the following:

- **The results of the few available studies on apartment values and transit proximity indicate some positive premiums, but are mixed.** A 1996 study of the influence on Metrorail stations in Washington D.C. on apartment rents found that rents decreased by 2.4 percent for each 1/10<sup>th</sup> of a mile further from a station, after controlling for building and neighborhood characteristics.<sup>31</sup> More recently, a 2011 study of assessed property values in the D.C. region found that multi-family rental properties within a half mile of a Metrorail station were worth 8.9 percent more than properties located further away, after controlling for building features.<sup>32</sup> However, in a series of studies in Los Angeles and San Diego in the early 2000s, Cervero and Duncan found wide variations in effects, ranging from slightly negative to strongly positive, depending on the transit line.<sup>33</sup> A few other studies (not shown in Figure II-1) have examined rents and transit in European countries, with similarly mixed results.<sup>34</sup>
- **One reason for the mixed results is that isolating the value of proximity to transit from other factors that influence value - such as building type or unit quality - can be challenging.** As discussed above, Cervero and Landis attempted to use hedonic regression analysis in *BART at 20* to estimate BART's influence on apartment rents, but were unable to obtain statistically significant results. The authors found that because BART proximity was so correlated with unit size and density, the regression analysis could not isolate BART's influence from the effect of these other factors. Cervero and Landis' small sample size may also have contributed to the challenge of producing statistically significant results.<sup>35</sup>

## CONCLUSION

In *BART at 20*, Cervero and Landis did not find clear evidence of premium associated with proximity to BART stations for commercial sales values or office or apartment rents in the East Bay. However, more recent studies of other regions have generally concluded that office and other commercial properties do experience a transit premium. Indeed, the premium associated with proximity to a transit station may be higher for commercial properties than for residential, although the benefits for commercial properties may only extend within a relatively short distance (e.g., one-quarter to one-half mile) from a station. There is also some evidence for a transit premium for apartment properties, although results are more mixed – in part reflecting the challenge of isolating transit's influence from other factors that affect apartment rents and property values.

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<sup>30</sup> Cervero and Duncan, "Land Value Impacts of Rail Transit Services in San Diego County."

<sup>31</sup> John Benjamin and Stacy Sirmans, "Mass Transportation, Apartment Rent and Property Values."

<sup>32</sup> Washington Metropolitan Area Transit Authority, *Making the Case for Transit: WMATA Regional Benefits of Transit*.

<sup>33</sup> Cervero and Duncan, "Land Value Impacts of Rail Transit Services in San Diego County"; Cervero and Duncan, *Land Value Impacts of Rail Transit Services in Los Angeles County*.

<sup>34</sup> Efthymiou and Antoniou, "How Do Transport Infrastructure and Policies Affect House Prices and Rents? Evidence from Athens, Greece"; Brunauer et al., "Additive Hedonic Regression Models with Spatial Scaling Factors"; Kryvobokov and Wilhelmsson, "Analysing Location Attributes with a Hedonic Model for Apartment Prices in Donetsk, Ukraine."

<sup>35</sup> John Landis, Subhrajit Guhathakurta, and Ming Zhang, *BART at 20: Property Value and Rent Impacts*.

The emerging evidence from other regions suggests that it is worth revisiting the relationship between proximity to BART and office and apartment rents. Moreover, in the two decades since *BART at 20*, a number of new trends have emerged that suggest that the benefits of locations near BART may be greater today than in the past. These include:

- **Expanded service to regional employment centers and other important destinations:** New service to East Dublin/Pleasanton (in 1997), San Francisco International Airport (2003), West Dublin/Pleasanton (2011), and Oakland International Airport (2014) has increased the amount of employment as well as the number of households located within close proximity to a BART station. In general, transit systems that provide strong access to employment centers and other regional destinations appear to have the greatest positive impact on property values.
- **Increased ridership:** Average daily ridership on the BART system increased from 215,544 (or 25.9 trips per capita per year) in 1995 to 325,136 (or 32.5 trips per capita per year) in 2012.<sup>36</sup> In recent years, ridership has continued to increase even in the absence of significant service expansions, reaching an average of more than 400,000 trips a day in 2014.<sup>37</sup> The significant rise in ridership suggests that BART is becoming increasingly important in the daily lives of commuters and other travelers.
- **Supportive local land use policy and public investments:** Over the past two decades, BART and local governments have invested in improvements to reinforce the pedestrian, bicycle, transit, and auto connections to many stations. In addition, many local governments now have station area plans and zoning in place to allow for higher densities around BART stations.
- **Significant new development:** Local real estate markets have had time to adjust to the presence of the BART system, particularly in the East Bay where most stations have been in service since the 1970s. BART station areas in places such as Downtown Oakland, Downtown Berkeley, Walnut Creek, Pleasant Hill, Colma, and South San Francisco have attracted new apartment development. Some stations, including Pleasant Hill, Dublin/Pleasanton, and Downtown Oakland, have also attracted some new office investments. Many of these projects have been built with design features intended to capitalize on the location near BART, and hence maximize the transit premium.

The following chapters analyze BART's current influence on office and apartment rents in light of the changes that have occurred over the past two decades.

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<sup>36</sup> Metropolitan Transportation Commission, "Transit Ridership."

<sup>37</sup> Bay Area Rapid Transit District (BART), "BART 2014 Factsheet."

### III. OFFICE PROPERTIES AND BART

This chapter assesses the extent to which office rents are influenced by proximity to BART stations in Alameda, Contra Costa, and San Mateo Counties. The chapter includes:

- An overview of the approach to the analysis.
- A discussion of the location of office space in the East Bay and San Mateo County in relation to BART, and a comparison of how office building characteristics (such as age, quality, parking availability, and occupancy rates) vary with distance from BART.
- The results from our analysis of office rent premiums associated with distance from BART.

#### APPROACH

The goal of the analysis was to estimate the value that proximity to BART conveys to office properties. The analysis relied on data on rents, which (along with occupancy rates and operating expenses) determine a building's cash flow and may be capitalized into property values.<sup>38</sup>

Strategic Economics began by evaluating how much of the office inventory is located near BART in each of the three counties, and how the characteristics of each county's office space vary with distance from the stations. We then analyzed how office rents vary with distance from BART, including both a simple comparison of rents at different distances from BART, and a hedonic regression analysis that estimated the value that proximity to BART confers to office rents after controlling for other factors. Appendix A provides a detailed description of the regression analysis methodology.

#### Data Source

This study is based on data from CoStar, a commercial real estate data vendor that tracks rents, vacancies, lease terms, and building characteristics of commercial properties throughout the country. The data includes both traditional office and flex properties. As defined by CoStar, flex properties may include a combination of office, research and development, and/or industrial uses; however, at least half of the rentable building area must be used as office. It should be noted that CoStar – like most other sources of office data – tracks asking rents, so the data may not reflect negotiated concessions or other factors. For the purposes of this analysis, rents have been adjusted to full service equivalent, meaning that the rents include all standard services including taxes, insurance, maintenance, utilities, and janitorial services.<sup>39</sup>

In the East Bay and San Mateo County, CoStar tracks a total of 181 million square feet in 6,551 office buildings. Of these, the database only provides data on rental rates for 81 million square feet in 1,666 properties, or 45 percent of total square feet and 25 percent of office buildings listed.<sup>40</sup> This is a lower coverage rate than researchers have documented in other regions like Denver and Dallas.<sup>41</sup> However, the average rents calculated from the CoStar data for specific office submarkets were similar to office rents reported by major brokerage firms, indicating that the data are generally reliable.

Figure III-1 shows all the office properties in the CoStar database (including those for which rental data are not available). Strategic Economics calculated the road distance (i.e., the shortest route using the street

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<sup>38</sup>Expected future cash flows are an important determinant of commercial property value because, at least in theory, commercial property owners (excluding owner-occupants) are primarily interested in generating a return from their investment in the form of future revenues.

<sup>39</sup>See description of methodology for adjusting rents to full service equivalent in Appendix A.

<sup>40</sup>A smaller subset of properties (for which data on all variables were available) were included in the regression analysis; see discussion in Appendix A.

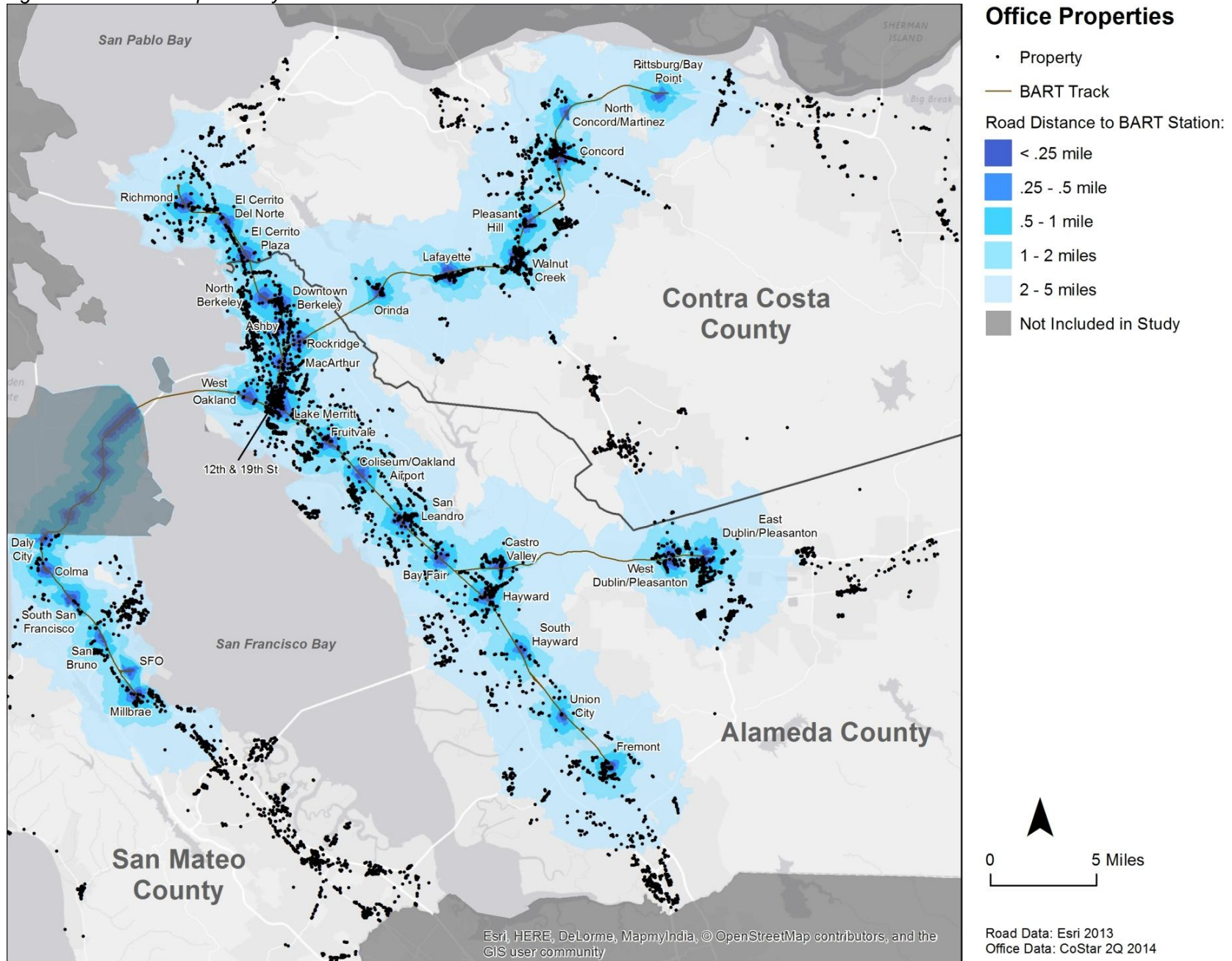
<sup>41</sup>Nelson et al., "Office Rent Premiums with Respect to Light Rail Transit Stations in Dallas and Denver."

network) from each property in the CoStar database to the nearest BART station. For the purposes of the analysis described below, the CoStar data were aggregated into five categories based on the distance of each building from the nearest BART station: within one-half mile, one-half to one mile, one to two miles, two to five miles, and five or more miles from a station.<sup>42</sup>

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<sup>42</sup> Note that for the regression analysis, the data were aggregated into three categories (within a quarter mile, a quarter to a half mile, and more than a half mile from a station). This is discussed further below.

Figure III-1. Office Properties by Distance from Nearest BART Station



## **BART AND OFFICE BUILDING LOCATION AND CHARACTERISTICS**

This section examines the amount of office inventory that is located near BART in each of the three counties, and how the characteristics of each county's office space – including building quality, year built, and the amount of parking provided – vary with distance from the stations.<sup>43</sup>

**In Alameda County, 27 percent of the existing office inventory is located within a half mile of a BART station.** Figure III-2 shows the total office inventory tracked by CoStar, by county and distance from the nearest BART station. In Alameda County, there are nearly 13 million square feet of office located within a quarter mile of a BART station, and another 11 million located within a quarter to a half mile. As shown in Figure III-1, most of this space is located around the Downtown Berkeley, Downtown Oakland, or Dublin/Pleasanton BART stations, but there are also smaller concentrations around the Ashby, Fremont, San Leandro, Hayward, and Castro Valley stations.

**About 15 percent of office space in Contra Costa County is located within a half mile of BART.** The majority of the 6.7 million square feet of space within a half mile of BART in Contra Costa County is located around the Concord, Pleasant Hill, and Walnut Creek stations. In contrast to Alameda County, many of the BART stations in Contra Costa County are surrounded by surface parking, with office and other development located slightly further from the stations. Reflecting this land use pattern, only about 1.7 million square feet of office is located within a quarter mile of the stations, and another 4.8 million square feet within a quarter to a half mile of a station.

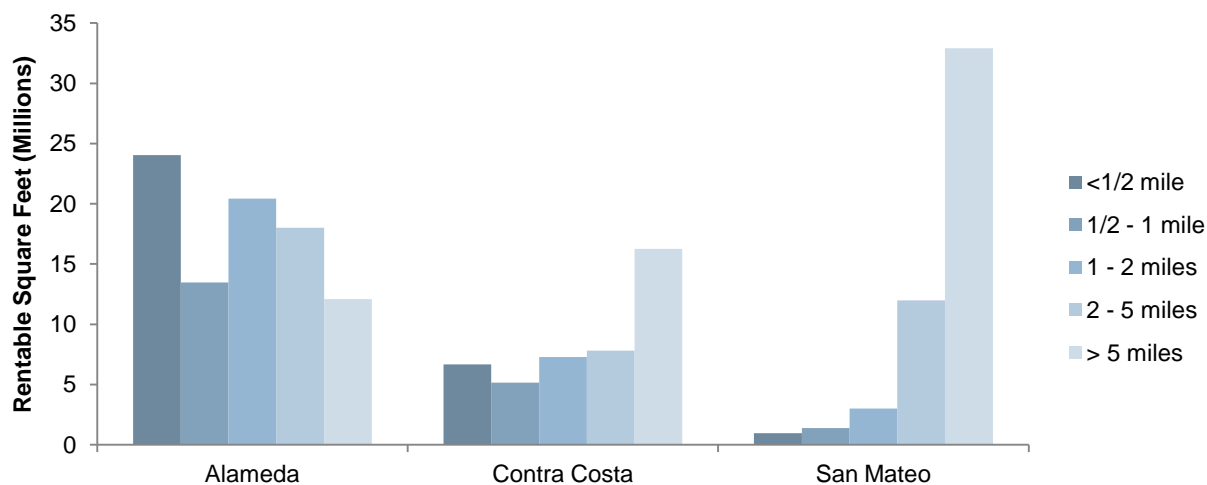
**Only 2 percent of San Mateo County's office space is located within walking distance of BART.** Fewer than one million square feet, or less than two percent, of San Mateo County's office inventory is located within a half mile of the BART stations, most of it near the Millbrae and Daly City stations. Oyster Point in South San Francisco, the largest office concentration in northern San Mateo County, is located approximately three to four miles from a BART station. Most of the large, high-value office nodes in San Mateo County are located in cities to the south that are not served by the BART system, such as San Mateo, Redwood City, and Menlo Park.

**Many major employers and office parks that are not located within walking distance from BART provide shuttles for their employees, suggesting that property owners and employers across the region experience a benefit from the system.** Examples of employers and office parks that provide BART shuttles include Kaiser Permanente and Alta Bates in Oakland, Genentech in South San Francisco's Oyster Point, and the Bishop Ranch office park in San Ramon. The Emery-Go-Round shuttle, which is primarily funded by commercial property owners, connects businesses throughout Emeryville to the MacArthur BART station.

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<sup>43</sup> Unless otherwise noted, the analysis in this section (on office building location and characteristics) is based on all the data in the CoStar database, as shown above in Figure III-1. The analysis in the following section (on rents) is based only on the properties for which CoStar provides data on rents.

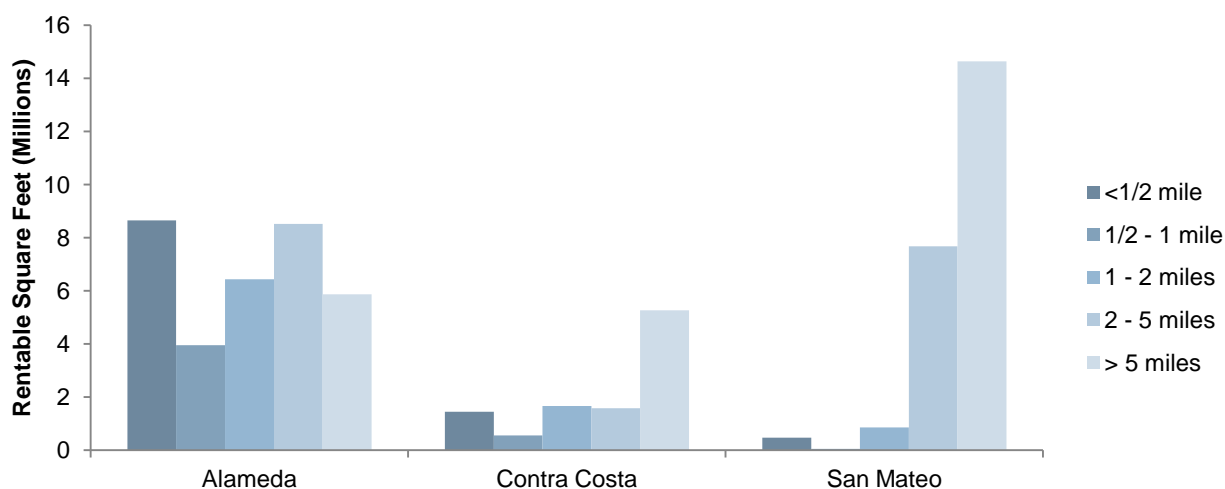
Figure III-2. Total Office Inventory (Millions of Rentable Sq. Ft.) by County and Distance from BART



Source: CoStar, 2Q 2014; Strategic Economics, 2015.

**Recent construction of office space has mostly occurred more than a mile from BART, reflecting the general decentralization of office-based employment in the region.** Figure III-3 shows the location of office space built since 1994. In Alameda County, about 25 percent of office space built in the last two decades was located within a half mile of a BART station. In all three counties, however, most of the new inventory is located at least a mile from a station. This is consistent with the general decentralization of employment and office space that has occurred over the past several decades in the Bay Area, California, and the nation as a whole, as jobs have followed households to the suburbs. For example, in the six largest metropolitan areas in California (including the Bay Area), employment densities within three miles of the central business districts fell 25 percent between 1992 and 2006, while employment densities ten or more miles from the central business districts rose slightly.<sup>44</sup>

Figure III-3. Office Space Built Since 1994 by County and Distance from BART

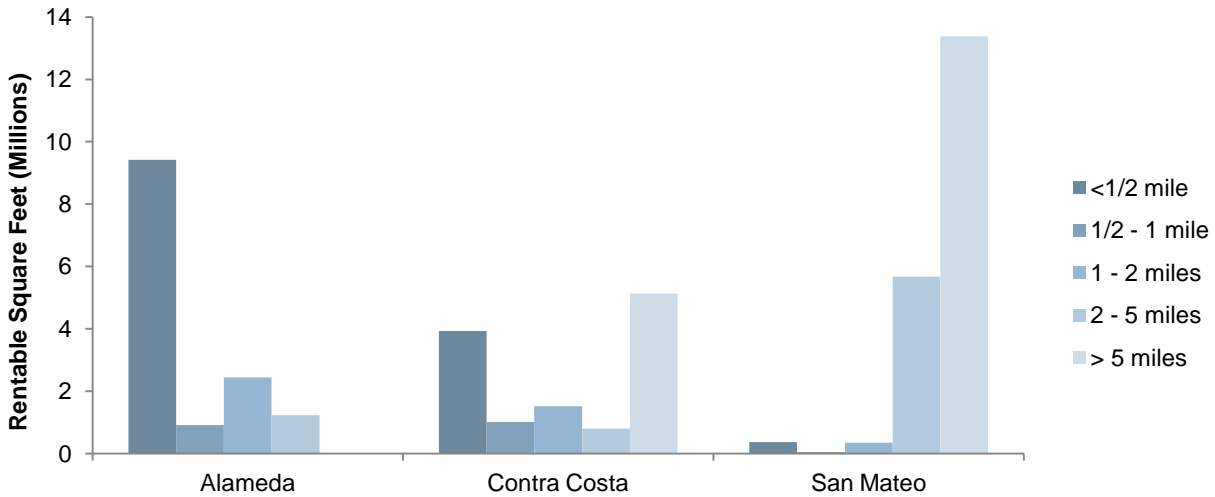


Source: CoStar, 2014; Strategic Economics, 2015.

<sup>44</sup> Kolko, *Making the Most of Transit: Density, Employment Growth, and Ridership around New Stations*.

**In the East Bay, Class A office space is highly concentrated near the BART stations.** Figure III-4 shows the location of Class A<sup>45</sup> office space in the three counties. Sixty-seven percent of the Class A space in Alameda County and 32 percent of the Class A space in Contra Costa County is located within a half mile of a BART station. Almost all of the Class A office space in San Mateo County is located much further from the stations, in the southern part of the county. The fact that Class A office space is disproportionately concentrated near the BART stations despite the decentralization of recent office development suggests that property owners are choosing to reinvest in their transit-adjacent properties.

Figure III-4. Class A Office Space by County and Distance from BART



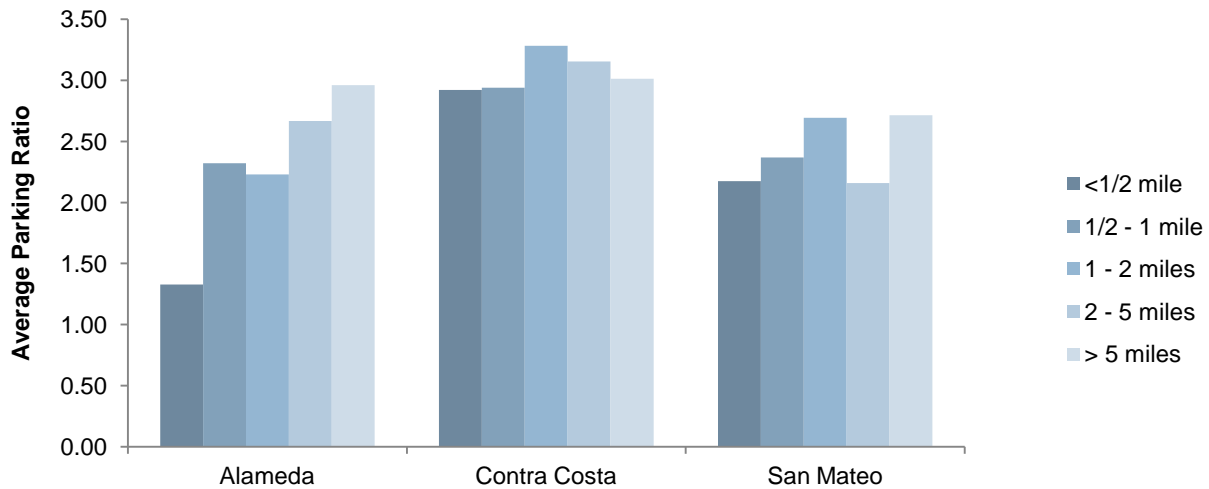
Source: CoStar, 2Q 2014; Strategic Economics, 2015.

**Office buildings located within a half mile of BART provide relatively less parking.** Figure III-5 shows average parking ratios by county and distance from BART. In Alameda and San Mateo Counties, parking ratios (number of parking spaces provided per 1,000 square feet of rentable building space) tend to be lower within close proximity to BART. In Contra Costa County, average parking ratios within a half mile of BART are relatively high. This reflects the presence of several large buildings with extensive parking garages located immediately adjacent to the Walnut Creek, Concord, North Concord/Martinez, and Dublin/Pleasanton stations. The generally low parking ratios near the stations suggest that many office workers are taking transit rather than driving to work.

<sup>45</sup> CoStar defines as Class A office building as “an extremely desirable investment-grade property with the highest quality construction and workmanship, materials and systems, significant architectural features, the highest quality/expensive finish and trim, abundant amenities, first rate maintenance and management; usually occupied by prestigious tenants with above average rental rates and in an excellent location with exceptional accessibility. . . . It may have been built within the last 5-10 years, but if it is older, it has been renovated to maintain its status and provide it many amenities.”



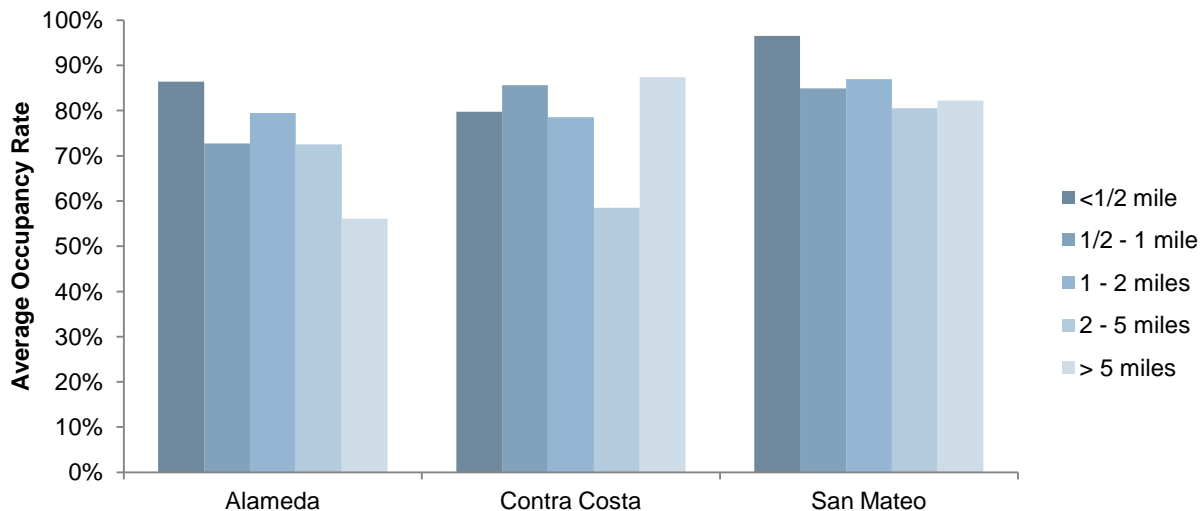
Figure III-5. Average Parking Ratio (Spaces per 1,000 Sq. Ft. of Rentable Building Area) by County and Distance from BART



Source: CoStar, 2014; Strategic Economics, 2015.

**Locations within a half mile of BART in Alameda and San Mateo Counties have high average occupancy rates.**<sup>46</sup> However, this is not true in Contra Costa County (Figure III-6). The high occupancy rates more than five miles from a station in Contra Costa County reflect the competitiveness of Bishop Ranch and other office parks on the I-680 corridor.

Figure III-6. Average Occupancy Rates by County and Distance from BART



Source: CoStar, 2014; Strategic Economics, 2015.

<sup>46</sup> Occupancy rate data shown in Figure III-6 are based only on the subset of properties for which CoStar provides rent data. (While CoStar provides occupancy data on some properties for which rent data are not available, these did not appear to be consistent or reliable.)

## BART AND OFFICE RENTS

To the extent that office tenants value proximity to BART, we would expect rents to be higher near the stations. In order to test this hypothesis, Strategic Economics first compared rents at different distance from the BART stations in each county, and then conducted a hedonic regression analysis to estimate the value that BART confers to office properties after controlling for other factors. These two analyses are described below.

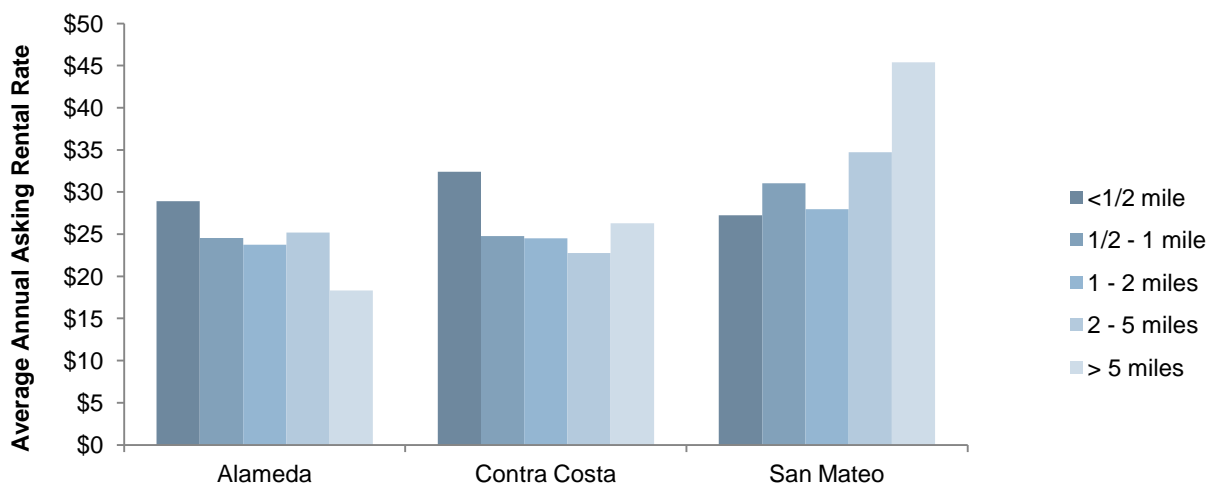
### Comparison of Rents by Distance from BART

Figure III-7 shows how average annual asking rental rates vary as a function of distance from BART, without controlling for any of the other factors that may also influence rents. A map of the asking rents for the individual properties for which rent data are available in the CoStar database is provided in Figure III-8.

In Alameda and Contra Costa Counties, properties within a half mile of a BART station have significantly higher average rents than properties located one-half to one mile from a station. However, this premium does not appear to extend beyond one-half mile (Figure III-7). In Alameda County, the lowest average rents are found more than five miles away from BART, reflecting low-density, low-value properties in parts of Livermore and Fremont that are more than five miles from a BART station. By contrast, in Contra Costa County a number of high rent areas are located more than five miles from a BART station, including Bishop Ranch and other office parks on the I-680 corridor.

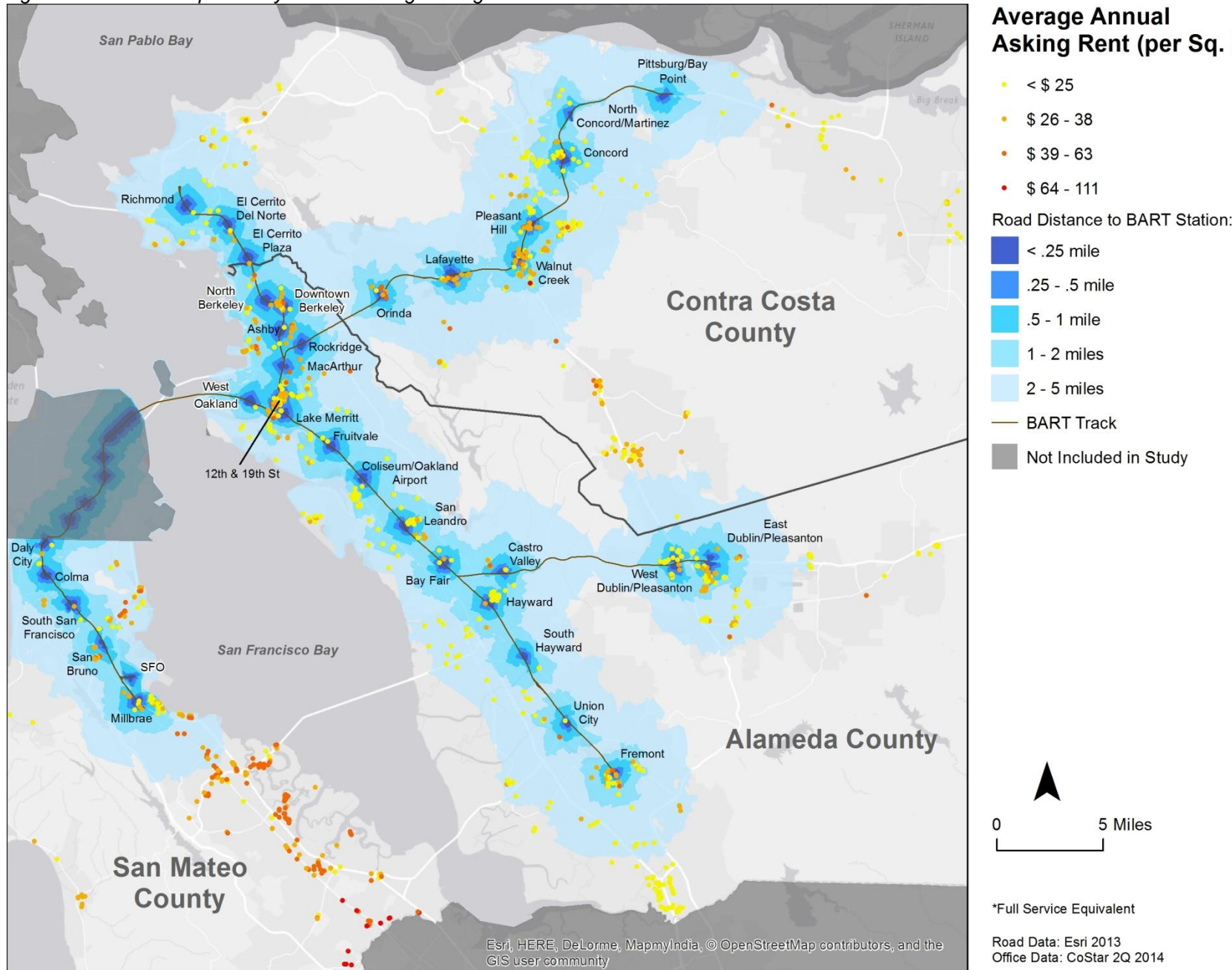
In general, rents in San Mateo County tend to be higher than rents in the East Bay. However, San Mateo County office properties located near BART rent for a discount relative to properties located further away. At least in part, this reflects the limited office inventory located in close proximity to the stations. In general, high-value office space is usually located in major employment centers, and there are no significant employment clusters near BART in San Mateo County. In San Mateo County, high-value office space is concentrated in the southern part of the county, closer to the heart of Silicon Valley.

Figure III-7. Average Annual Asking Rents by County and Distance from BART\*



\*Not controlling for quality of space or other factors.  
Source: CoStar, 2014; Strategic Economics, 2015.

Figure III-8. Office Properties by Annual Asking Average Rent and Distance from Nearest BART Station



## Hedonic Regression Analysis

The relatively high rents within a half mile of the BART stations in Alameda and Contra Costa Counties presumably reflect the value that employers place on access to BART. However, these high observed rents may also reflect other factors, such as the concentration of new, Class A space near the stations or the benefits of being located near retail, restaurants, and other amenities that are also clustered around the stations. Similarly, in San Mateo County, the lower rents observed near BART could in part reflect the quality of the space around the stations, and the fact that there are no major employment concentrations around the stations.

In order to control for these and other factors, Strategic Economics conducted a hedonic regression analysis. Hedonic regression analysis is a statistical method that breaks the value of a property into its constituent parts, allowing the researcher to isolate the value associated with each specific attribute. As part of the analysis, Strategic Economics tested a wide variety of variables considered likely to influence office rents, based both on professional experience and a review of previous studies on the relationship of commercial property values and transit proximity. Several of these variables were ultimately excluded from the model because they were found either not to be statistically significant, or to be strongly correlated with proximity to BART or other key variables. Appendix A provides a more detailed discussion of the methodology, including all of the variables that were tested in the model.

The final version of the analysis modeled the average asking rental rate of an office property as a function of three categories of variables. These are described below and listed in Figure III-9.

- **Building and lease attributes**, including building class, lease type (direct or sublease), property type (office or flex), most recent year of construction or major renovation, number of stories, and occupancy rate.
- **Transportation accessibility**, including the distance from the property to the nearest BART station modeled in three categories, based on whether the property was located within 1) a quarter mile of a BART station, 2) a quarter to a half mile, or 3) more than a half mile from a station.<sup>47</sup> Properties located more than one-half mile from a station were grouped together based on the finding, discussed above, that the premium associated with proximity to BART does not extend beyond the half mile.<sup>48</sup> The model also included a variable for distance to the nearest freeway on-ramp.<sup>49</sup>
- **Other location controls**, including variables for the office market submarket as well as employment density. Figure III-10 provides a map of the office submarkets, which were used in the analysis in order to control for location within the region. The submarkets were defined based on the market areas that local real estate brokerage firms use to report data, as well as observed spatial patterns in the CoStar data. Two employment density variables were included in the model. One variable captured density of employment in office-based industries (including finance, real estate, professional and scientific services, information, management, and health and education services), and was used to control for the agglomeration effects that may occur when firms cluster together, such as easier access to clients and workers. The second variable captured density of employment in retail, dining, lodging, and services, and was intended to capture the benefits that firms experience from being located near stores, restaurants, and other services.

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<sup>47</sup> Distance categories were found to produce more robust results than using a single continuous variable for distance from BART.

<sup>48</sup> Note that these distance categories are different than the categories used in Strategic Economics' previous report on BART and single-family and condominium property values (*Property Value and Fiscal Benefits of BART*, August 2014).

<sup>49</sup> The model did not include proximity to other types of transit, such as shuttle, bus, or Caltrain stations.

Figure III-9. Independent Variables Included in the Hedonic Regression Model

**Building and Lease Attributes**

- Property class:
  - Class A
  - Class B
  - Class C
- Lease type:
  - Direct: Offered directly from the tenant
  - Sublet: Existing tenant is attempting to sublease space
- Building type
  - Office: Buildings intended to "to house employees of companies that produce a product or service...such as administration, accounting, marketing, information processing and dissemination, consulting, human resources management, financial and insurance services, educational and medical services, and other professional services."
  - Flex: Buildings "designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space...."
- Number of stories in building
- Percent of space in the building that has been leased or pre-leased
- Year of latest construction, whether year built or year of most recent renovation

**Transportation Accessibility**

- Distance to freeway, calculated based on the road distance to the nearest freeway on-ramp
- Distance to BART, calculated based on road distance from the property to the nearest BART station entrance, in three categories:
  - Within 1/4 road mile of nearest BART station
  - Within 1/4 to 1/2 road mile of nearest BART station
  - More than a 1/2 road mile from nearest BART station

**Location Controls**

- Dummy variables for submarket in which the property is located (see Figure III-10)
- Office-based employment density within a half mile of the property. Includes employment in finance, real estate, professional and scientific services, information, management, and health and education services.<sup>(a)</sup>
- Retail-based employment density within a half mile of the property. Includes employment in retail, food, and services.<sup>(b)</sup>

(a) NAICS codes 51-62

(b) NAICS codes 44-45, 71-72, 81

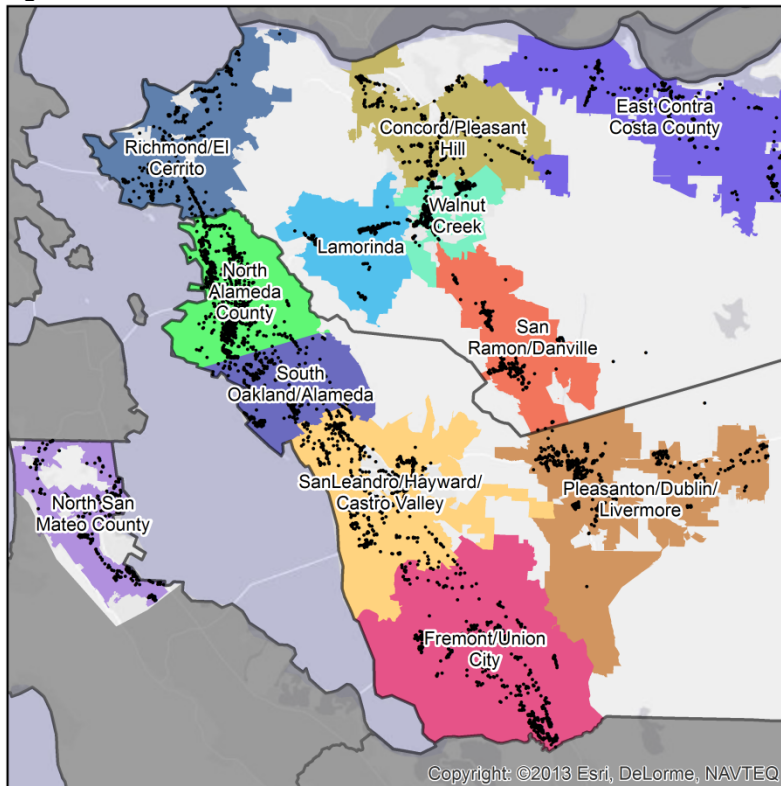
See Appendix A for a detailed discussion of the variables, including data sources for each variable.

Using the variables described above, Strategic Economics created two separate models to estimate the rent premium associated with proximity to BART in two geographies:

- **East Bay (Alameda and Contra Costa Counties) and north San Mateo County:** North San Mateo County was defined to include Daly City, South San Francisco, San Bruno, Millbrae, and Burlingame. Cities south of Burlingame in San Mateo County were excluded from the analysis because they are not directly served by BART.
- **East Bay:** San Mateo County was excluded from this model since relatively few office properties are located near BART in San Mateo County, and because the preliminary comparison of rents by distance from BART (shown in Figure III-7, above) found that properties located near BART in San Mateo County rent for a discount compared to properties located elsewhere in the county.

Early iterations of the model attempted to estimate separate values for proximity to BART for each county and/or submarket. However, the number of records was insufficient to produce statistically significant estimates by county or submarket.

Figure III-10. Office Submarkets



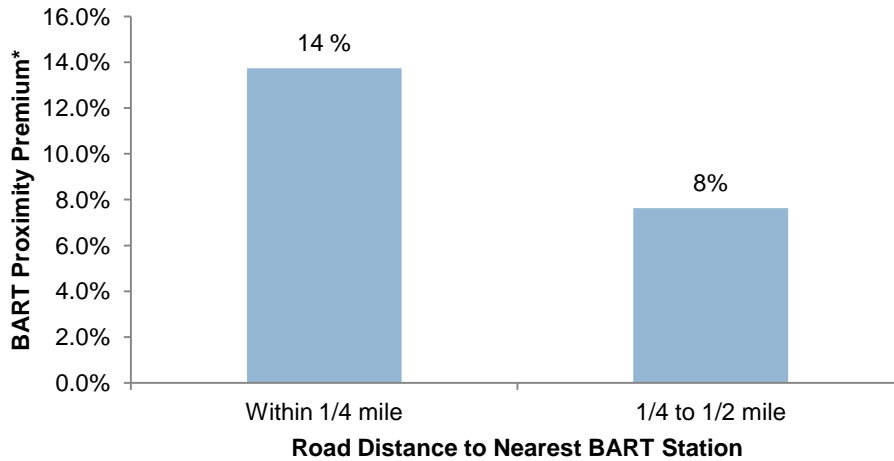
## Key Findings

Key findings from the hedonic regression analysis are summarized below. The complete results for all the variables included in the analysis are provided in Appendix A.

### Model that Includes East Bay and North San Mateo County

**In the East Bay and north San Mateo County combined, properties located within a quarter mile of a BART station command an additional \$3.16 per square foot per year, or nearly 14 percent, more than offices located more than one-half mile from BART.** Figures III-11 and III-12 show the estimated average premium that properties within a quarter and a quarter to a half mile of BART command, compared to properties located more than a half mile from a station. Properties within a quarter to a half mile of a station in the East Bay and north San Mateo County command a premium of \$1.76 per square foot per year, or about 8 percent, all else equal.

*Figure III-11. Office Rent Premiums Associated with Proximity to BART Compared to Areas More than a Half Mile from a Station: East Bay and North San Mateo County*



\*Percentage difference in annual average rental rate, compared to being located more than 1/2 mile from a BART station, after controlling for other factors with regression analysis.

Source: Strategic Economics, 2015.

Figure III-12. Predicted Office Rents and Proximity to BART  
(2014 Rents; Dollars Per Square Foot Per Year)

	East Bay & North San Mateo County	East Bay
<u>Predicted Average Annual Rent<sup>(a)</sup></u>		
Within 1/4 Mile of BART	\$26.19	\$26.07
1/4-1/2 Mile of BART	\$24.78	\$24.49
>1/2 Mile from BART	\$23.03	\$22.05
<u>BART Proximity Premium</u>		
<u>Average Dollar Value Premium<sup>(b)</sup></u>		
Within 1/4 mile	\$3.16	\$4.02
1/4 to 1/2 mile	\$1.76	\$2.44
<u>Percentage Premium<sup>(b)</sup></u>		
Within 1/4 mile	13.7%	18.2%
1/4 to 1/2 mile	7.6%	11.1%

(a) Full service equivalent. Calculated by assuming mean values for all variables except distance from BART; see Appendix A for additional discussion.

(b) Compared to properties located more than ½ mile from BART, after controlling for other factors with regression analysis.

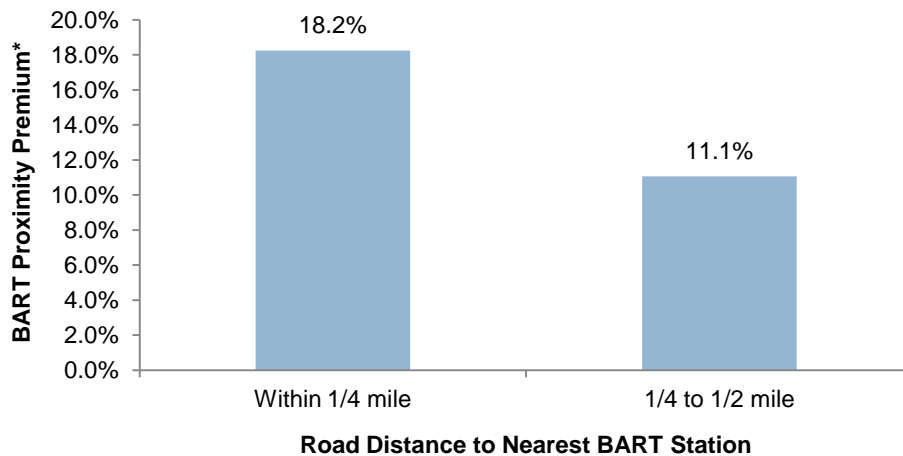
Source: Strategic Economics, 2015.

### East Bay Only Model

**After controlling for other factors, East Bay office properties located within a quarter mile of a BART station rent for \$4.02 per square foot per year more than properties located more than a half mile away, a premium of 18 percent.** Properties located within a quarter to a half mile of a station command a premium of \$2.44 per square foot per year, or 11 percent, higher than the average value for properties located more than a half mile away (Figure III-13). Excluding north San Mateo County from the analysis results in a higher estimate of the rent premium associated with BART. This is consistent with the finding, above, that properties near BART in the East Bay have higher asking rents compared to properties farther away, while properties in north San Mateo County rent for less than properties located elsewhere in the county.



Figure III-13. Office Rent Premiums Associated with Proximity to BART Compared to Areas More than a Half Mile from a Station: East Bay



\*Percentage difference in annual average rental rate, compared to being located more than 1/2 mile from a BART station, after controlling for other factors with regression analysis.  
Source: Strategic Economics, 2015.

**In aggregate, BART contributes an estimated \$80 million per year in added lease revenues for East Bay office property owners located within a half mile of a station.** According to CoStar’s database, approximately 30 million square feet of office space are located within a half mile of the BART stations in the East Bay. In 2014, these properties generated an estimated \$80 million in additional rent associated with proximity to BART.<sup>50</sup>

## CONCLUSION

In the East Bay, BART serves many of the largest, highest value office nodes. Despite decades of employment decentralization, office space in the East Bay remains relatively concentrated around the BART stations. A particularly high share of Class A space – including 67 percent of the Class A inventory in Alameda County and 32 percent in Contra Costa County – is located within a half mile of BART.

There is also strong evidence that BART has a significant, positive influence on rents in the East Bay. After controlling for building characteristics, freeway access, location within the region, and local employment density, office rents in the East Bay are 18 percent higher within a quarter mile of a BART station and 11 percent higher within a quarter to a half mile, compared to rents of properties located more than a half mile from the station. These results are much stronger than those from *BART at 20*, which found no systematic, statistically significant premium associated with proximity to BART after controlling for other factors. This indicates that changes in the transit system and real estate market over the past twenty years have resulted in real benefits for office tenants and property owners near BART in the East Bay.

On the other hand, proximity to BART is not associated with a premium in San Mateo County. Based on a simple comparison of average rents at different distances from BART, asking rents are 12 percent lower within a half mile of BART stations in San Mateo County than within one-half to one mile of the stations.

<sup>50</sup> This estimate is based on multiplying the average rent premium for East Bay properties located within a quarter mile and a quarter to a half mile of BART (\$4.02 and \$2.44 per square foot per year, respectively) times the total inventory in each distance category, and subtracting a factor for average vacancy rates in each office submarket. See Appendix A for a more detailed description of this methodology.

Moreover, including northern San Mateo County with Alameda and Contra Costa Counties in the regression analysis reduces the overall estimated premium associated with proximity to BART stations. These results in part reflect the land uses around the San Mateo County stations, which are predominantly residential; only two percent of San Mateo County's office properties are located within a half mile of BART. Finally, the San Mateo County stations (with the exception of Daly City) are much newer than the East Bay stations, dating from the late 1990s and 2000s. As land uses continue to evolve around the stations over the coming decades, office tenants in San Mateo County may come to place a greater value on locations near BART.

## IV. APARTMENTS AND BART

This chapter evaluates how apartment rents vary as a function of distance from BART stations in Alameda, Contra Costa, and San Mateo Counties. The chapter is organized into the following sections:

- A summary of the approach to the analysis.
- An evaluation of the characteristics of large apartment complexes within a half mile of BART, compared to apartments located further away.
- The results of our analysis of how proximity to BART influences apartment rents.

### APPROACH

As discussed in Chapter II, few previous studies have attempted to quantify the impact of transit proximity on apartment rents, and the results of those studies are mixed. One reason for the mixed results is that separating the effect of proximity to transit from other factors such as development density or unit quality can be challenging, particularly given that most datasets that include apartment rents include a relatively small subset of a region's overall apartment stock.

The dataset for this study (discussed in further detail below) includes market-rate apartment projects with 50 or more units. Given the challenges that previous researchers have encountered, Strategic Economics began by exploring how the characteristics of the apartment complexes in the dataset vary with distance from BART, and then tried several different methods for assessing the impact of BART on apartment rents. These included a simple comparison of rents and occupancy rates by distance from BART, a hedonic regression analysis, and a matched pair analysis comparing rents by station area and unit type. These three types of analysis are similar to those used in *BART at 20*. The results from these analyses are described below; Appendix B provides additional detail on the regression analysis.

### Data Source

The analysis is based on data purchased from realAnswers (formerly RealFacts), a data vendor focused on the multi-family apartment market. Researchers from realAnswers survey property managers and leasing agents on a quarterly basis to collect data on asking rents and occupancy rates. The data used for this analysis includes asking rents and occupancy rates for the second quarter of 2014. In addition to rents and occupancy rates, the realAnswers database also provides information on building characteristics and amenities.

The realAnswers database only includes apartment complexes with 50 or more units. According to the 2005-2009 American Community Survey, apartment buildings with 50 or more units account for about 15 percent of apartment units in the three counties overall, and 20 percent of the apartment units within a half mile of BART.<sup>51</sup> Restricting the analysis to larger properties limits the sample size in the analysis, but also ensures that the properties are somewhat comparable (for example, complexes with 50 or more units typically have on-site property managers, laundry facilities in the building, and other basic amenities).

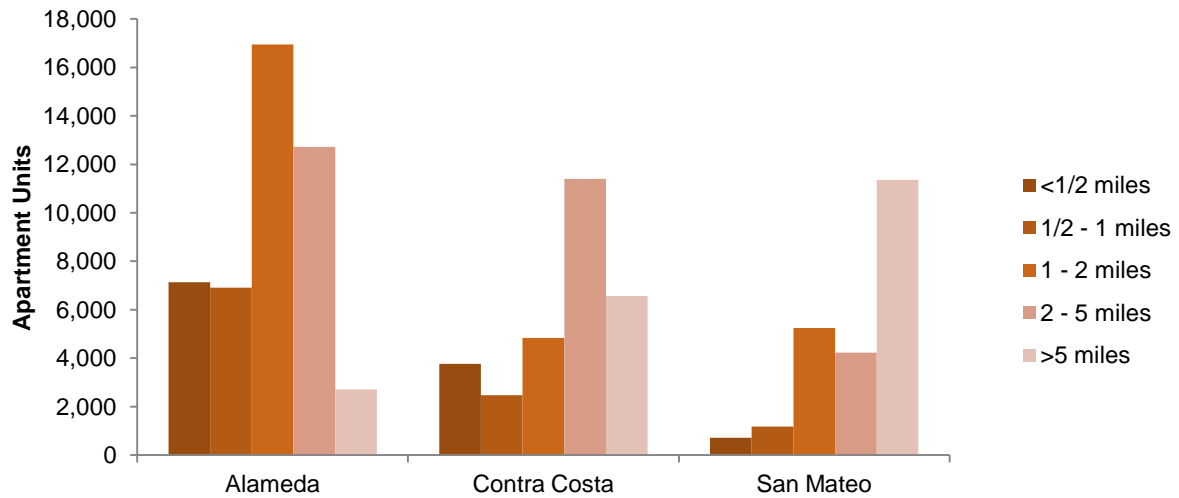
Figure IV-1 shows the apartment units in the realAnswers database by county and distance from the nearest BART station. Figure IV-2 provides a map of the apartment complexes in the database. Approximately 11,600 units in the database, or 12 percent of total units in the three counties, are located within a half mile of the BART stations (Figure IV-1). This relatively low proportion may reflect limited

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<sup>51</sup> 2005-09 is the most recent period for which American Community Survey data aggregated into half-mile transit sheds are available (through the National TOD Database). Note that while realAnswers tracks apartment complexes (which may include multiple buildings), the American Community Survey tracks individual apartment buildings.

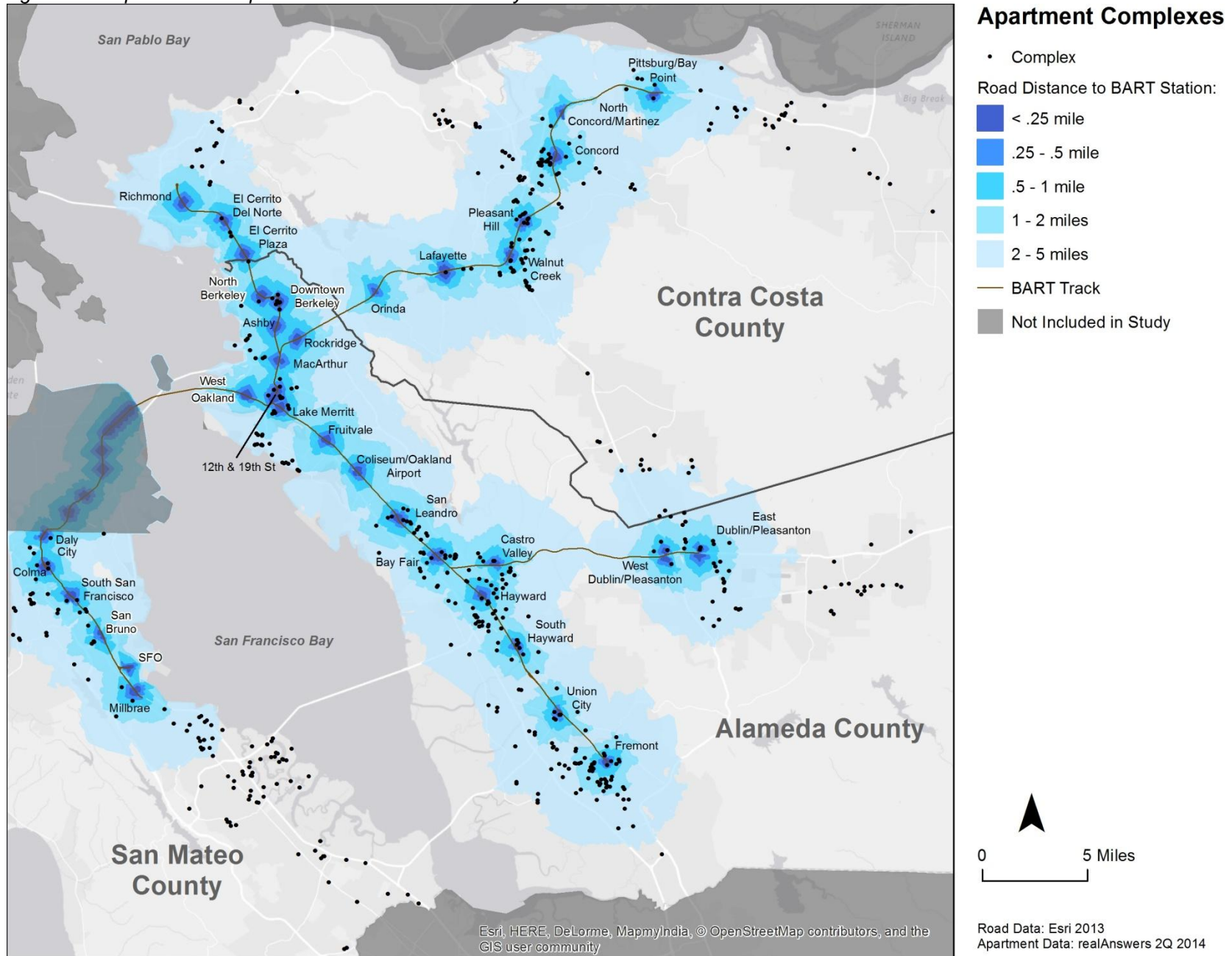
parcel availability for large-scale apartment development. Particularly in older neighborhoods where much of the development predates BART (for example, in parts of Berkeley, Oakland, Richmond, and Daly City), there may be few parcels within one mile of a BART station that are large enough to accommodate apartment complexes with 50 or more units.

Figure IV-1. Total Apartment Units in the realAnswers Database, by County and Distance from Nearest BART Station



Includes apartment units in complexes with 50 or more units.  
 Source: realAnswers, 2Q 2014; Strategic Economics, 2015.

Figure IV-2. Apartment Complexes with 50 or More Units by Distance from BART



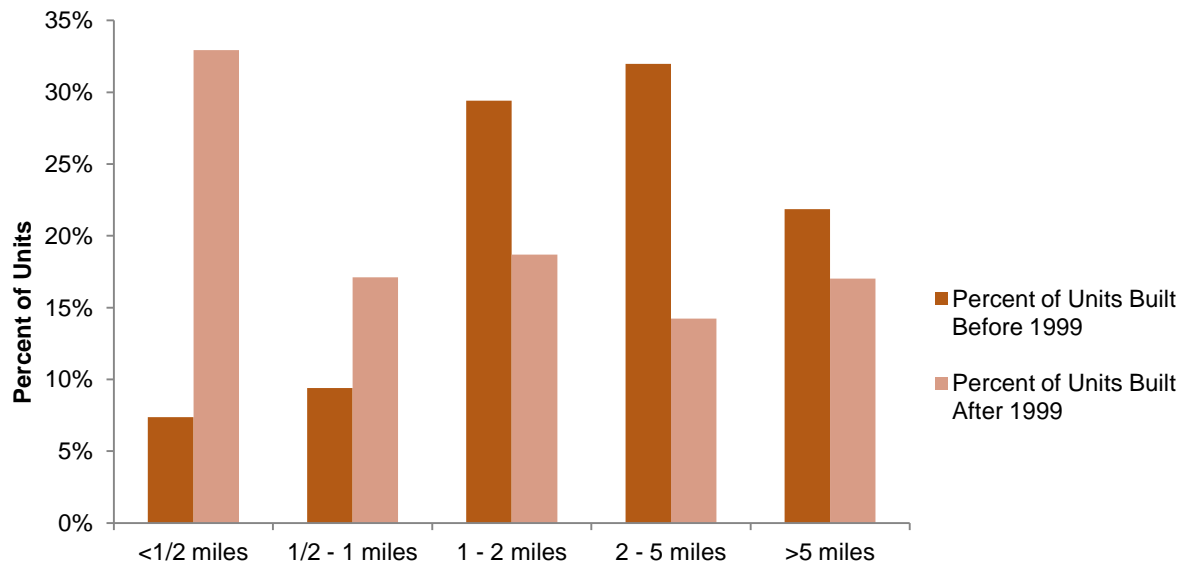
## CHARACTERISTICS OF APARTMENTS NEAR BART

This section explores how the characteristics of the apartments in the realAnswers database – including property age and quality, building type (number of stories), unit size, and occupancy rates – vary as a function of distance from BART.

### Property Age

**In the three counties overall, 33 percent of all units built since 1999 are located within a half mile of a BART station, compared to just 7 percent of units built before 1999.** Figure IV-3 compares the location of units built before 1999 to the location of units built after 1999 for the three counties overall. The concentration of new development around the BART stations suggests that developers see BART access as an important amenity. The significant new development around the stations may also reflect the influence of land use planning, zoning regulations, and other efforts by cities to concentrate multi-family development in places that are well-served by transit.

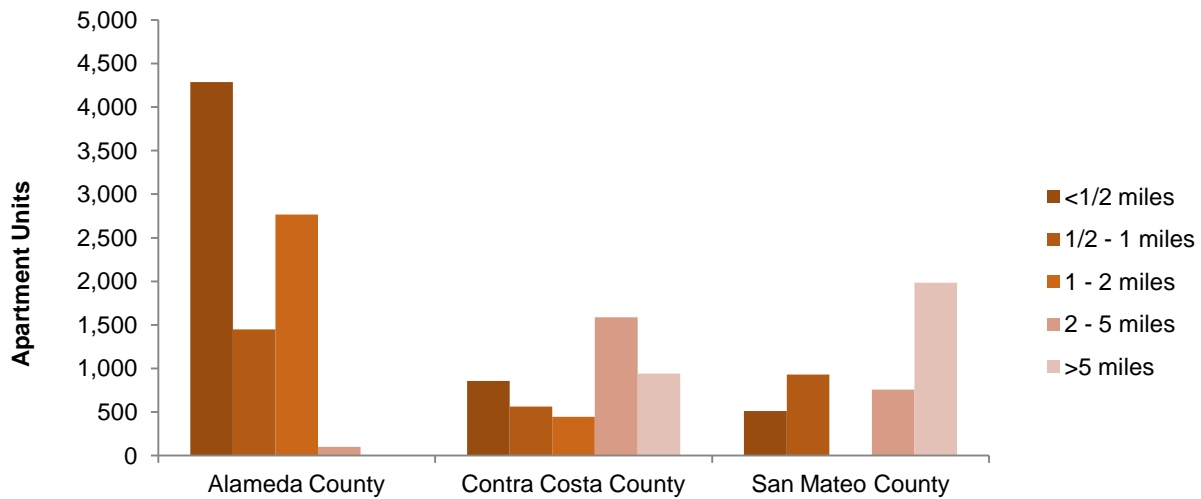
Figure IV-3. Units by Year Built and Distance from BART (Three Counties)



Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

**Of the three counties studied, Alameda County has seen the most new apartment development near BART.** Figure IV-4 shows the number of units built after 1999 by county and distance from BART. Since 1999, nearly 4,300 new apartment units have been built within a half mile of a BART station in Alameda County, accounting for 50 percent of all units built in the county during that time period.

Figure IV-4. Number of Units Built Since 1999 by County and Distance from Nearest BART Station

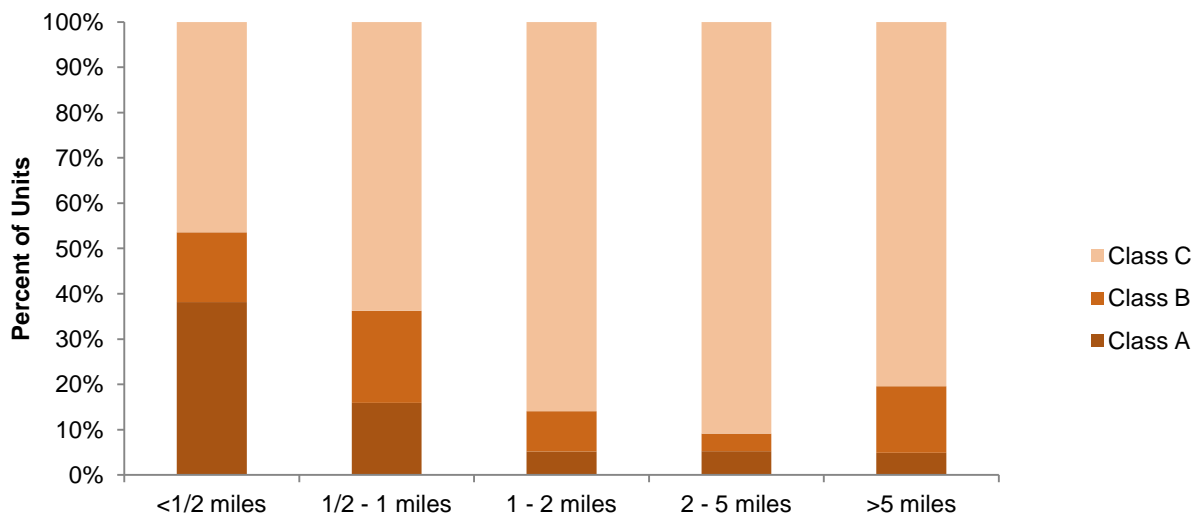


Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

### Property Quality

**In all three counties, apartments located within a half mile of BART tend to be higher quality than units located further away from a station.** Figure IV-5 shows apartment class by distance from BART, for units in all three counties. Nearly 40 percent of units located in the half-mile BART station areas are Class A – a category that encompasses newer buildings with significant amenities and high-end finishings – compared to 16 percent within one-half to one mile of a station and just five percent of units located more than a mile from a station.

Figure IV-5. Share of Units by Class by Distance from Nearest BART Station (Three Counties)

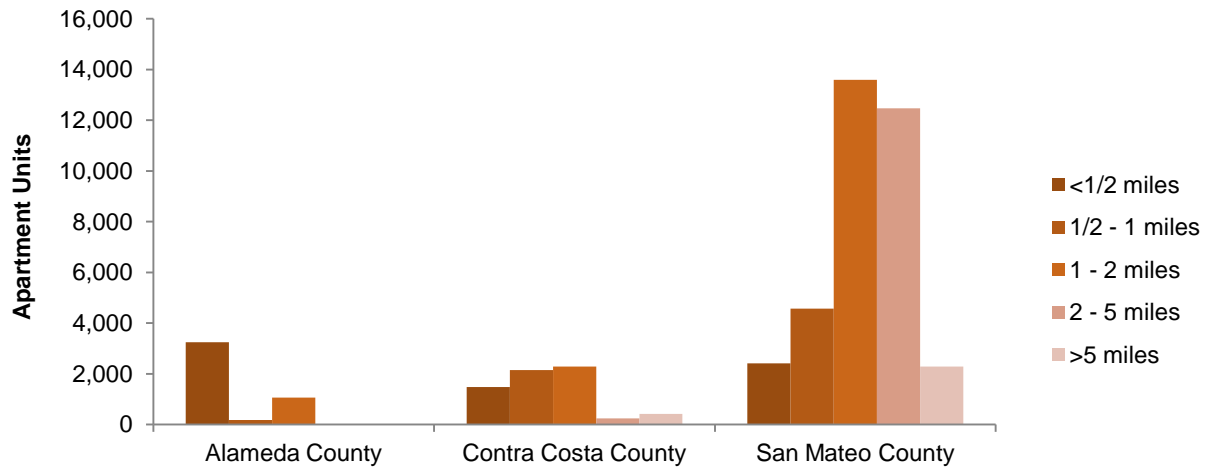


Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

**While San Mateo County has the most Class A units overall, Alameda County has a particularly high concentration of Class A units near BART.** Figure IV-6 shows where Class A apartment units are

located, by county and distance from BART. Nearly three-quarters of all the Class A units in Alameda County are located within one-half mile of a BART station, reflecting the significant new construction that has occurred near the stations as discussed above. In Contra Costa County, about 22 percent of all the Class A units are located within a half mile of BART. San Mateo County has more Class A units overall compared to the other two counties, but only 7 percent are located within a half mile of a BART station. Most of the Class A stock in San Mateo County is located further south, in areas that are not directly served by BART.

Figure IV-6. Number of Class A Units by County and Distance from Nearest BART Station



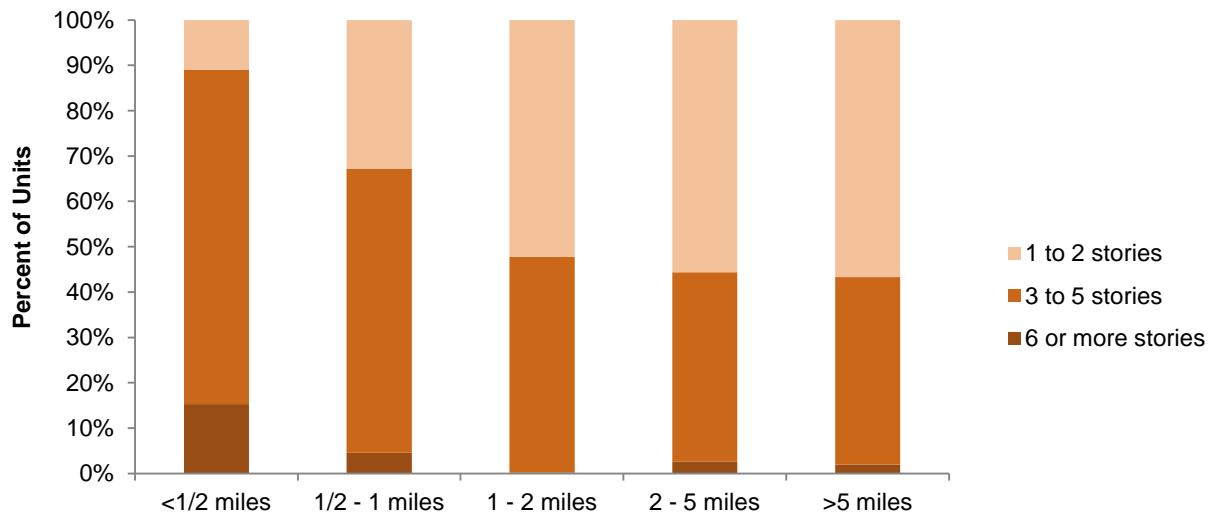
Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

### Building Type

**Apartment projects within a half mile of BART tend to have higher densities.** Figure IV-7 shows the distribution of units by building type in the three counties. Nearly 90 percent of units located within a half mile of BART are in properties with three or more stories, compared to just 67 percent within one-half to one mile of a station. Fifteen percent of units within a half mile of a station are in properties with six or more stories. The concentration of higher density buildings near BART likely reflects the fact that many communities allow greater development densities near transit stations, as well as the strong market demand for these locations.



Figure IV-7. Share of Units by Building Type and Road Distance from Nearest BART Station (Three Counties)

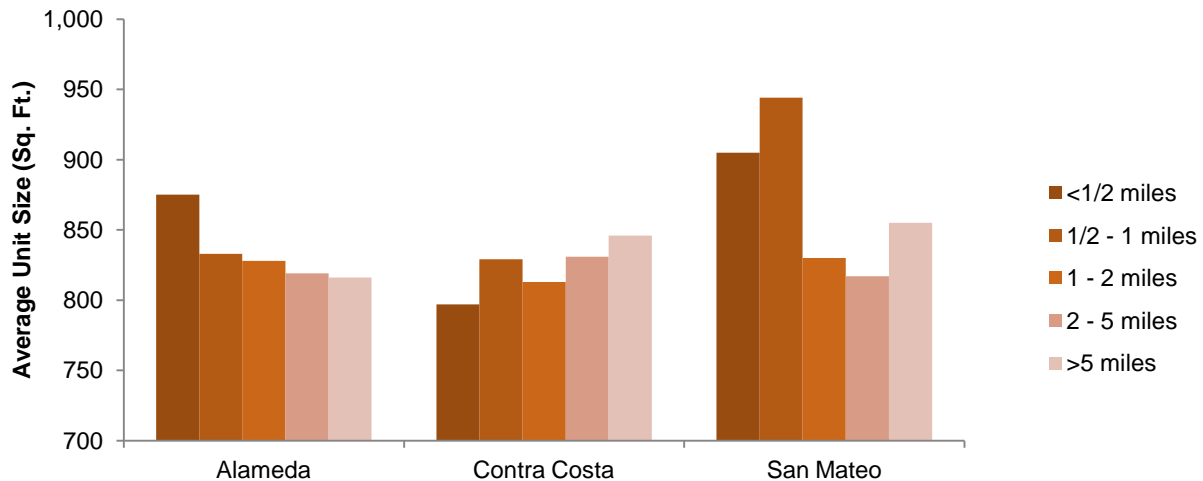


Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

### Unit Size

**In Alameda and San Mateo Counties, apartment units located closer to BART tend to be larger than units in other parts of the region.** Figure IV-8 shows average apartment unit sizes by county and distance from the nearest BART Station. In Alameda and San Mateo Counties, average unit sizes tend to be larger near BART, perhaps because a high percentage of the development near BART is new. Developers are increasingly building apartment units to condominium specifications (including larger units with high-end amenities) in order to allow for future condo conversions if market conditions change. In Contra Costa County, units tend to be smaller in closer proximity to the BART stations.

Figure IV-8. Average Apartment Unit Size by County and Distance from Nearest BART Station

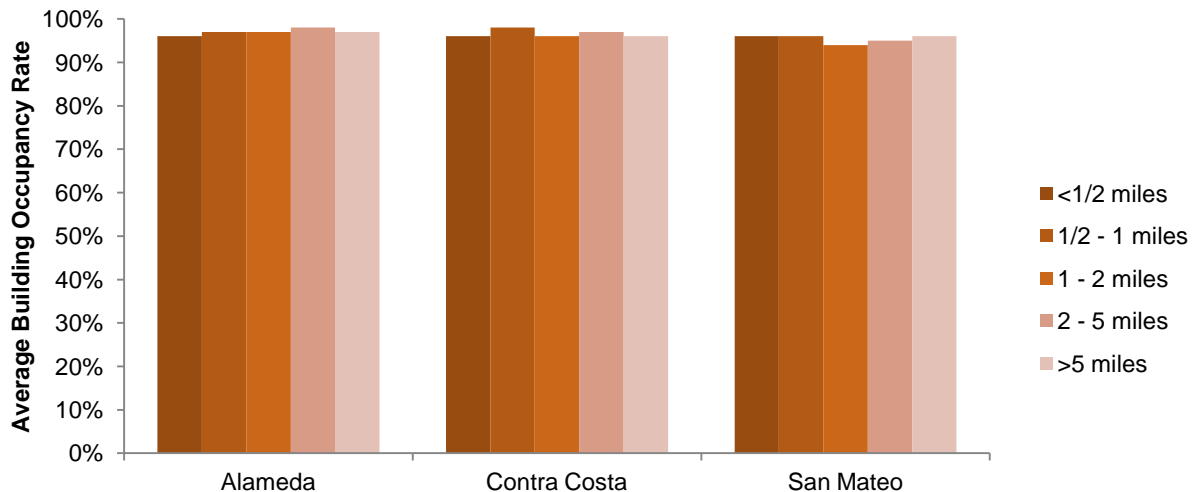


Includes apartment units in complexes with 50 or more units.  
Source: realAnswers, 2Q 2014; Strategic Economics, 2015.

## Occupancy Rates

**Occupancy rates do not vary significantly with distance from BART.** As shown in Figure IV-9, occupancy rates are well above 90 percent throughout the region and above 95 percent in most areas. Because the current rental market in the Bay Area is so tight, even properties that are relatively less desirable – because of their location, amenities, or other features – are able to attract tenants. As a result, occupancy rate does not appear to be a good indicator of household preferences for transit-adjacent apartments in the current market.

Figure IV-9. Average Building Occupancy Rates by County and Road Distance from Nearest BART Station



Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

## BART'S INFLUENCE ON APARTMENT RENTS

This section explores how apartment rents vary with distance from BART, beginning with a simple comparison of rents by distance from the nearest station and moving into more sophisticated statistical methods that attempt to isolate BART's influence on rents.

Strategic Economics first attempted to use a hedonic regression analysis to estimate the value of proximity to BART, similar to the one presented in the office section. The regression analysis is provided in Appendix B. However, this analysis did not result in a statistically significant estimate of BART's value because of the strong correlation between proximity to BART and other factors that also influence rents. As an alternative method, Strategic Economics conducted a matched pair analysis<sup>52</sup> comparing rents by station area and unit type. The results from these various analyses are discussed below.

### Comparison of Rents by Distance from BART

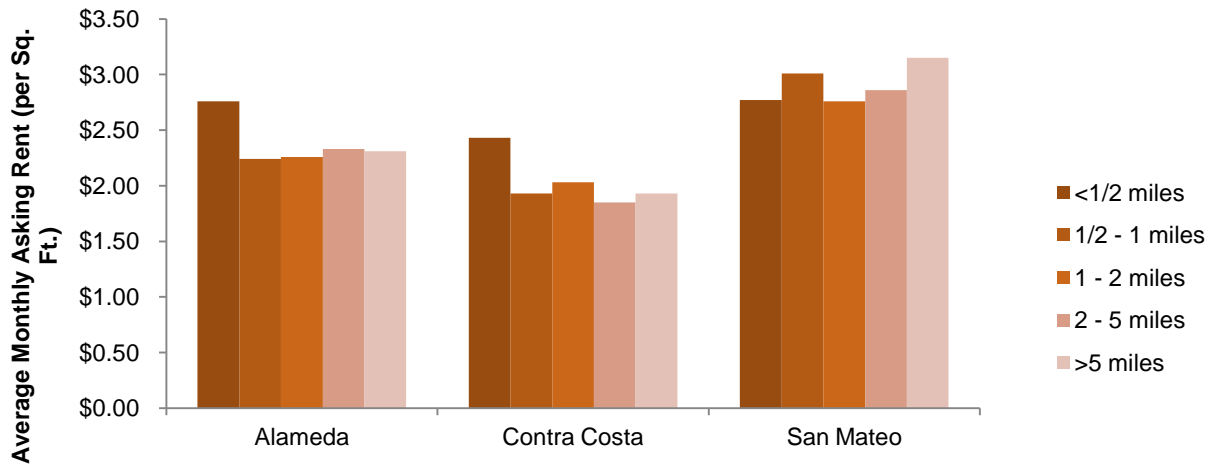
Figure III-10 compares average asking rents at different distance from BART, by county. Figure IV-11 shows average rents for individual apartment complexes.

<sup>52</sup> In a matched pairs analysis, properties are compared to other properties that have similar attributes in order to control for the effects of those attributes. As discussed below, this analysis compared the average rents of properties located in similar neighborhoods but at slightly different distances from BART in order to control for local neighborhood characteristics. The analysis also compared rents by unit type (one and two bedroom units).

In Alameda and Contra Costa Counties, asking rents for apartment units located within a half mile of a BART station are more than 20 percent higher than rents for apartments located one-half to one mile from a station. After a half mile, average rents do not vary significantly as a function of distance from BART in either county (Figure IV-10). As Figure IV-11 shows, rents are particularly high near the Downtown Berkeley and Downtown Oakland BART stations in Alameda County, and near the Dublin/Pleasanton, Walnut Creek, and Pleasant Hill stations in Contra Costa County.

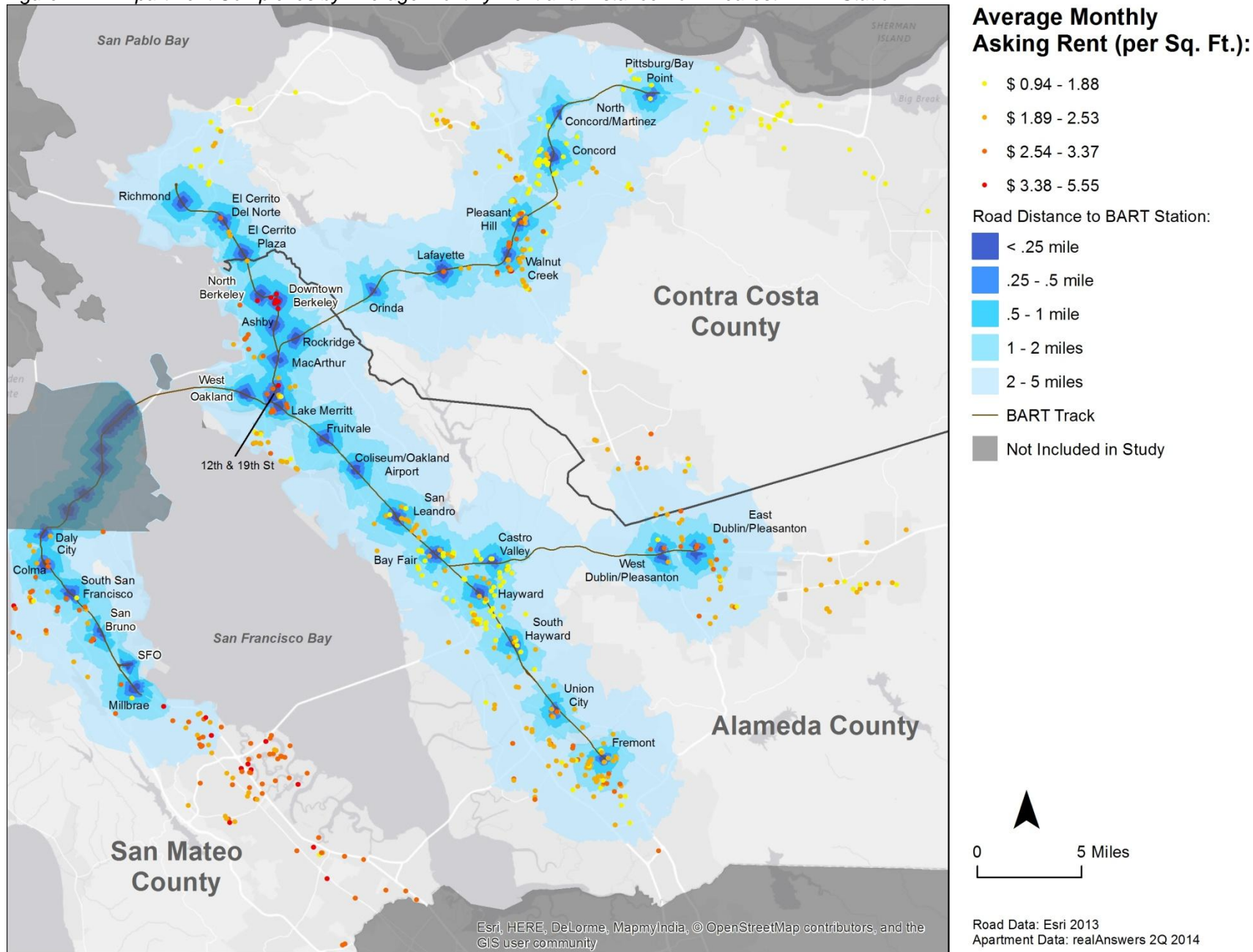
As with offices, apartment rents in San Mateo County are generally higher than in Alameda County. However, apartments within a half mile of BART stations rent for a discount. Rents in San Mateo County generally increase at greater distances from BART, reflecting the higher priced markets closer to the heart of Silicon Valley.

Figure IV-10. Average Monthly Rents by County and Road Distance from Nearest BART Station\*



\*Not controlling for quality of space or other factors.  
Includes apartment units in complexes with 50 or more units.  
Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

Figure IV-11. Apartment Complexes by Average Monthly Rent and Distance from Nearest BART Station



## Hedonic Regression Analysis

The regression analysis modeled asking rents as a function of building and unit characteristics, access to BART, and other factors related to location. Although many different variations were tested, the analysis did not produce a statistically significant estimate of the value of locations near BART. The challenge in obtaining statistically significant results appeared to be related, first, to a relatively small sample size and, secondly, to interactions between proximity to BART and other factors that also influence rents, including unit size, age, quality, and building intensity. Proximity to BART is also highly correlated with factors related to location; for example, many areas near BART have excellent access to amenities and employment opportunities. These types of interaction among key variables in a hedonic regression analysis make it difficult to separate out the influence of different factors on the dependent variable (in this case, on rents). Appendix B provides more details regarding this analysis.

The challenges in creating a statistical model of apartment rents are consistent with Cervero and Landis' experience in *BART at 20*. As discussed in Chapter II, Cervero and Landis were also unable to obtain a statistically significant result for proximity to BART because of a small sample size, and because project density, unit size, and BART proximity were highly correlated in their dataset as well.

## Station Area Matched Pair Comparison

This analysis compared average rents within one-half mile of selected BART stations, to average rents within one-half to one mile of a station. Station areas with at least two properties located in each distance band (less than a half mile and one-half to one mile) were included in the analysis.<sup>53</sup> Similar to *BART at 20*, the matched pair analysis compared rents by unit type (one and two bedroom units), as well as on average for all units in the station areas. By comparing properties located in similar neighborhoods but at slightly different distances from BART, this analysis was intended to control for local neighborhood characteristics. Key findings are described below.

**In most of the station areas tested, proximity to BART is associated with a statistically significant rent premium.** Figures IV-12, IV-13, and IV-14 compare average rents within one-half mile of a station to average rents within one-half to one mile of a station, for all units, one-bedroom units, and two-bedroom units, respectively. The charts show the following trends:

- Overall, rents per square foot are significantly higher within one-half mile of most stations, compared to rents for properties located one-half to one mile from a station (Figure IV-12). The premiums for locations within one-half mile of BART range from one to two percent at the Union City and West Dublin/Pleasanton stations, to about 40 percent near the Concord and Bay Fair station. The only exceptions are in the Pleasant Hill and San Leandro station areas, where rents are lower within a half mile of the stations.
- For one-bedroom units, rents are also higher within one-half mile of all the stations except Pleasant Hill and San Leandro. This pattern holds both for total monthly rents and rents per square foot (Figure IV-13).
- For two bedroom units, total monthly rents are higher within one-half mile of all the stations except San Leandro. On a per-square-foot basis, however, two-bedroom rents are lower within one-half mile of several stations, including the Downtown Oakland stations, San Leandro, Union City, and West Dublin Pleasanton (Figure IV-14). This discrepancy between total monthly and per-square-foot rents appears to be related to unit size. As discussed above, apartment unit within a half mile of the Alameda County BART stations tend to be larger than units located more than a

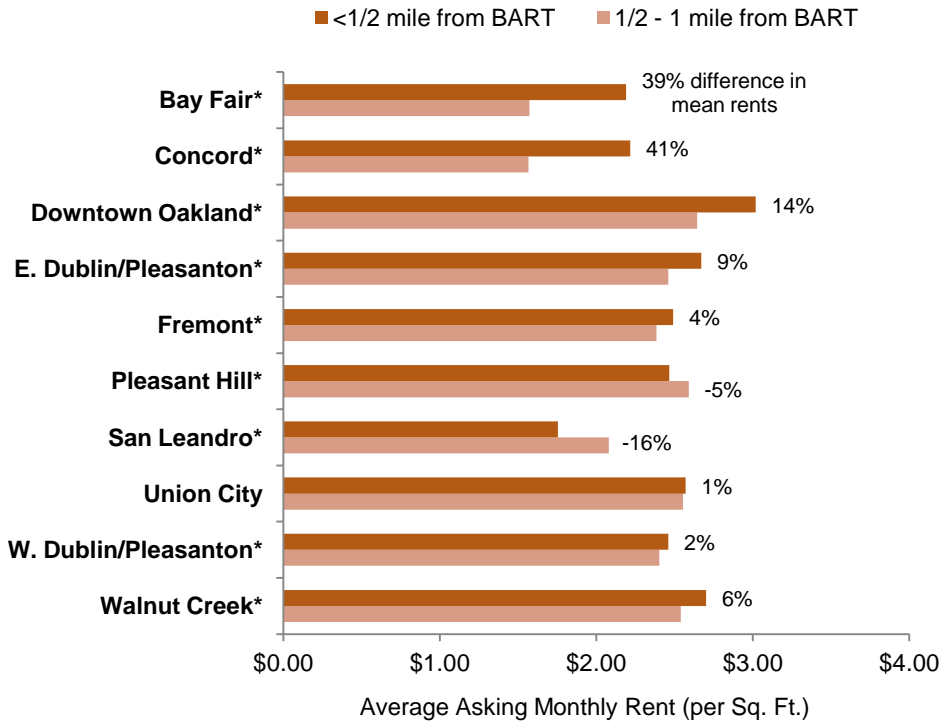
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<sup>53</sup> No single station area in San Mateo County met these criteria; as a result, the San Mateo County stations were not included in the matched pair analysis.

half mile from the stations. As a general rule, larger apartment units typically have higher total rents, but lower per-square foot rents.

Note that the matched pair analysis in *BART at 20* found a more consistent premium (of about 10 to 15 percent) for properties located near BART stations compared to properties located further away. However, Cervero and Landis conducted their matched pair analysis for three submarkets (Concord/Pleasant Hill/Walnut Creek, Albany/El Cerrito/Richmond, and Union City/Fremont), each of which included several different station areas. Our analysis focused on individual station areas because a submarket-level approach would have masked significant differences among some station areas (for example, between Concord and Walnut Creek, which are located adjacent to downtowns, and Pleasant Hill which is not).

Figure IV-12. Comparison of Average Rent per Square Foot for Selected Station Areas (All Units)



Results do not control for quality of apartment buildings or other factors that may influence rents.

\*Difference between mean rents is statistically significant at the 95% confidence interval.

Downtown Oakland includes 12th Street, 19th Street, and Lake Merritt station areas.

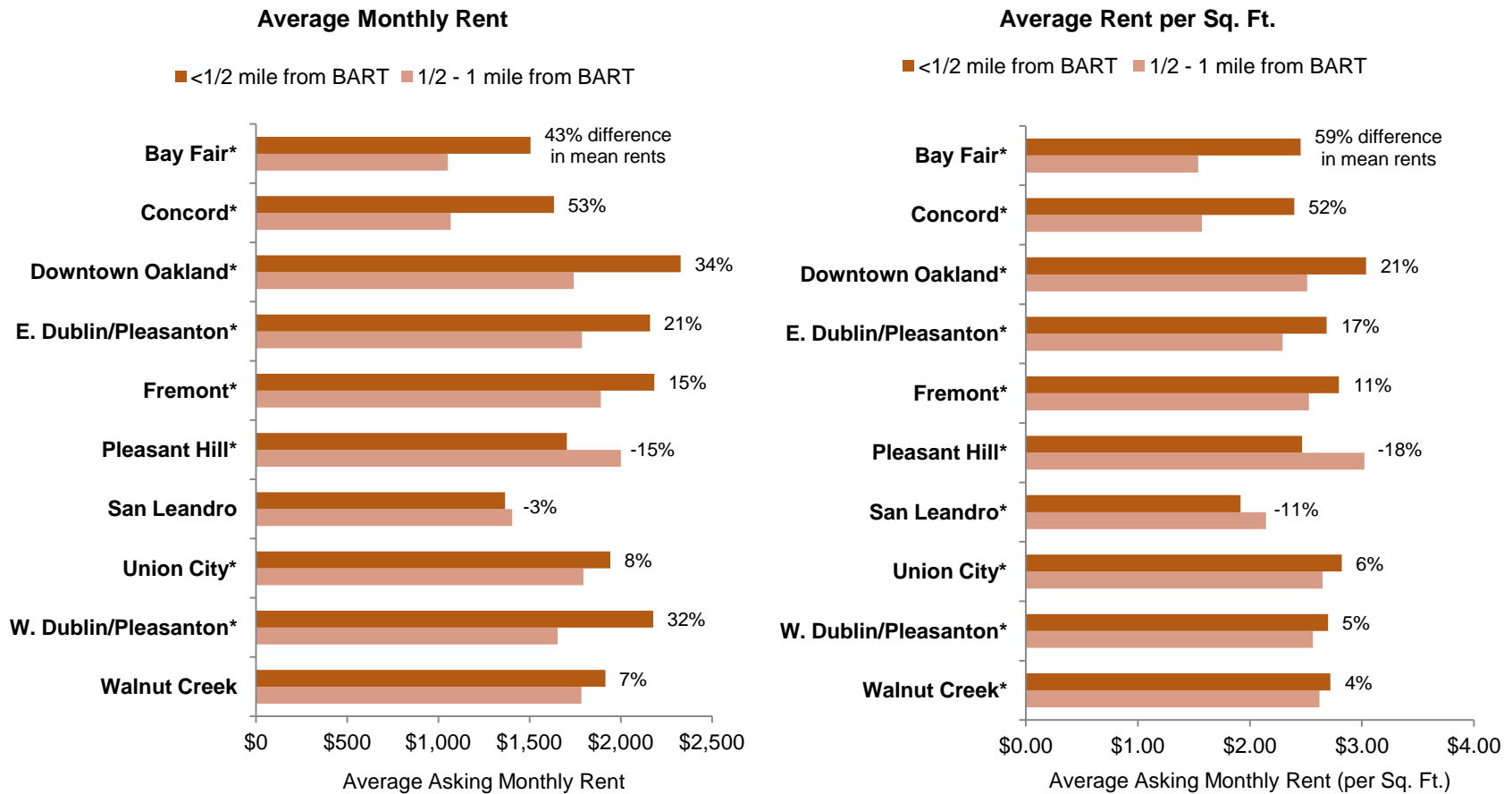
All station areas with at least two properties located in each distance band (less than a half mile and a half to one mile) were included in the analysis

Source: realAnswers, 2Q 2014; Strategic Economics, 2015.

**The relatively low rents within a half mile of the San Leandro and Pleasant Hill stations appear to reflect conditions at a few specific properties.** In San Leandro, two apartment buildings in the dataset are located within a half mile of the BART station, and six apartments are located within a half to one mile of the station. All eight buildings are Class C properties built more than 25 years ago. Several of the properties located a half to one mile away from the station appear to have been updated relatively recently (for example, with new kitchens or bathrooms), resulting in slightly higher rents. In Pleasant Hill, there is a concentration of new or recently renovated buildings within one-half to one mile of the station, while the properties within a half mile of the station include a mix of new construction (such as the Avalon

Walnut Creek project located directly adjacent to the station) as well as some older properties with lower rents.

Figure IV-13. Comparison of Average One Bedroom Unit Rents for Selected Station Areas



Results do not control for quality of apartment buildings or other factors that may influence rents.

\*Difference between mean rents is statistically significant at the 95% confidence interval.

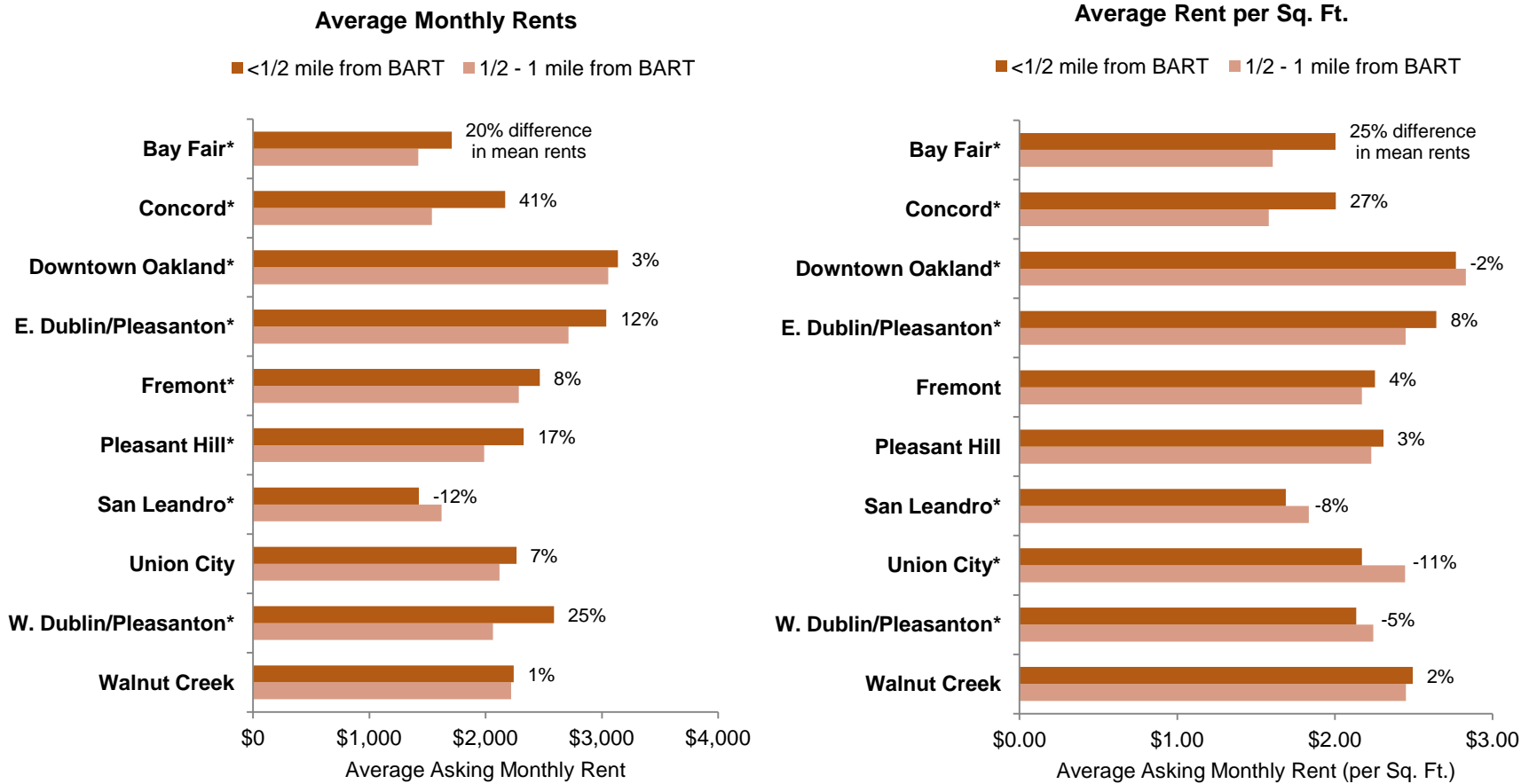
Downtown Oakland includes 12th Street, 19th Street, and Lake Merritt station areas.

All station areas with at least two properties located in each distance band (less than a half mile and a half to one mile) were included in the analysis

Source: realAnswers, 2Q 2014; Strategic Economics, 2015.



Figure IV-14. Comparison of Average Two Bedroom Unit Rents for Selected Station Areas



Results do not control for quality of apartment buildings or other factors that may influence rents.

\*Difference between mean rents is statistically significant at the 95% confidence interval.

Downtown Oakland includes 12th Street, 19th Street, and Lake Merritt station areas.

All station areas with at least two properties located in each distance band (less than a half mile and a half to one mile) were included in the analysis

Source: realAnswers, 2Q 2014; Strategic Economics, 2015.

## **CONCLUSION**

In all three counties, large apartment buildings located within a half mile of a BART station tend to be newer, higher quality, and have higher densities than units located further away. The concentration of new development around the BART stations indicates that developers see BART access as an important amenity. The new, higher density development around the stations may also reflect efforts by cities to concentrate multi-family development in places that are well-served by transit.

In the East Bay, average rents are more than 20 percent higher within a half mile of a BART station, compared to rents for apartments located one-half to one mile away. As in *BART at 20*, the hedonic regression analysis was not successful in isolating BART's influence on rents from other factors such as unit size, age, quality, and access to employment and amenities. However, a matched pair analysis of units by station area and unit type showed that the premium holds in most of the East Bay station areas for which sufficient data are available.

In San Mateo County, however, apartments near the BART stations rent for a discount. This finding is similar to the results for office development in San Mateo County, discussed in Chapter III of this report. Previous analyses have also found that single-family residential and condominiums near BART in San Mateo County sold for a discount.<sup>54</sup> The limited evidence for a premium associated with proximity to BART in San Mateo County may reflect the relatively recent introduction of BART service in the area, as well as the auto-oriented character of many San Mateo County station areas. Over time, supportive local land use policy, station connectivity improvements, and new transit-oriented development may make proximity to BART more valuable to San Mateo County households as well as employers.

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<sup>54</sup> See Strategic Economics, "Benefits of BART to Single-Family and Condominium Property Values by County," forthcoming.

## **APPENDIX A: OFFICE REGRESSION ANALYSIS**

This appendix provides a detailed discussion of the data and methodology of the hedonic regression analysis presented in Chapter III, as well as the complete results.

### **OFFICE RENTAL DATA**

The analysis used a database of office and flex properties tracked by CoStar. Both office and flex<sup>55</sup> properties were included in the analysis because there is considerable overlap between the two categories; as defined by CoStar, at least half of the rentable building area must be used as office in order for a building to qualify as flex space. This analysis used data downloaded from the CoStar database in August 2014, reflecting rents in the second quarter of 2014. For the purposes of this analysis, Strategic Economics adjusted average rents for individual buildings in the CoStar database to full service equivalent, using data on operations and maintenance costs for office buildings in the San Francisco Bay Area reported by the Building Owners and Managers Association (BOMA).

CoStar tracks approximately 5,580 existing office and flex properties in Alameda, Contra Costa, and North San Mateo Counties, accounting for 147 million square feet of rentable building area (RBA). Of these, the CoStar database only includes information on average asking rent for 1,443 properties and 69 million square feet, or 26 percent of properties and 47 percent of RBA. This is a much lower coverage rate than researchers have documented in other regions; for example, in a similar study conducted in Dallas and Denver, Nelson et al. found that only about three percent of properties in the CoStar database were missing rent or other data needed for the analysis.<sup>56</sup> The relatively limited availability of rent data in Alameda, Contra Costa, and San Mateo Counties may reflect the highly competitive nature of the Bay Area commercial real estate market. Anecdotally, real estate brokers in the region report a reluctance to report transaction data to CoStar, because of concerns that competitors will have access to the information. Note also that CoStar reports asking rental rates rather than effective rates, so the data do not reflect negotiated concessions.

Despite the limitations of the database, CoStar is the most comprehensive source of office lease transaction data available. In addition, the average submarket rents and vacancies calculated from the CoStar data (shown in Figure A-1) are generally similar to office and R&D rents reported by major brokerage firms such as DTZ (formerly Cassidy Turley) and CBRE.

In order to obtain a dataset that would be appropriate for analysis, the CoStar data were filtered to exclude properties missing data on asking rents or other variables included in the model (see discussion of independent variables, below). The data were also filtered to exclude outliers, defined conservatively as properties with per-square-foot rents more than three standardized deviations from the mean rent in each submarket. Figure A-2 shows the total number of properties and rentable building area that 1) are listed in the CoStar database; 2) have valid rent data; and 3) were included in the final regression model after filtering for other missing data fields and outliers.

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<sup>55</sup> CoStar defines flex buildings as "designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. . . ."

<sup>56</sup> Nelson et al., "Office Rent Premiums with Respect to Light Rail Transit Stations in Dallas and Denver."

Figure A-1. Average Office/Flex Rents and Vacancies by Submarket

Office Submarket	Average Annual Asking Rent (per Sq. Ft.) <sup>(a)</sup>	Vacancy Rate <sup>(b)</sup>
<b>Contra Costa County</b>		
Richmond/El Cerrito	\$23.36	42%
Concord/Pleasant Hill/Martinez	\$21.97	25%
Walnut Creek	\$30.41	19%
Lamorinda	\$31.39	18%
San Ramon/Danville	\$27.56	9%
East Contra Costa County	\$21.90	23%
<b>Alameda County</b>		
North Alameda County	\$29.85	15%
South Oakland/Alameda	\$20.81	34%
San Leandro/Hayward/Castro Valley	\$19.78	32%
Fremont/Union City	\$20.30	38%
Pleasanton/Dublin/Livermore	\$24.30	19%
<b>San Mateo County</b>		
North San Mateo County	\$32.14	17%
Other San Mateo County <sup>(c)</sup>	\$45.16	18%

(a) Full service equivalent. Based on all properties for which CoStar reports rent data.

(b) Based on all properties for which CoStar reports leasing data.

(c) Not included in hedonic regression model.

See map of submarkets in Chapter III (Figure III-10).

Sources: CoStar, 2Q 2014; Strategic Economics, 2015.

Figure A-2. Properties and Rentable Building Area in the CoStar Database

	Office Properties			Total Rentable Building Area (Sq. Ft.)		
	<1/4 mile	1/4 -1/2 mile	>1/2 mile	<1/4 mile	1/4 -1/2 mile	>1/2 mile
<b>Alameda County</b>						
Listed in CoStar Database <sup>(a)</sup>	228	318	2,577	12,916,112	11,135,194	63,984,445
Valid Rent Data	92	64	624	8,539,659	4,904,080	27,215,374
Included in Model <sup>(b)</sup>	61	42	388	5,028,765	3,646,988	17,177,411
<b>Contra Costa County</b>						
Listed in CoStar Database <sup>(a)</sup>	45	171	1,879	1,797,104	4,882,527	36,527,260
Valid Rent Data	12	37	501	1,450,462	2,911,815	16,435,854
Included in Model <sup>(b)</sup>	11	27	313	1,259,756	2,320,470	11,557,564
<b>San Mateo County</b>						
Listed in CoStar Database <sup>(a)</sup>	9	22	1,301	84,127	861,114	49,286,869
Valid Rent Data	3	3	330	49,147	464,066	19,428,946
Included in Model <sup>(c)</sup>	3	2	85	49,147	97,782	5,650,198

(a) Excludes properties that are not currently occupied because they are under construction, proposed, under renovation, or demolished.

(b) Filtered to exclude properties missing rent data, data on other variables included in the model, and outliers (defined as properties with per-square-foot rents more than three standardized deviations from the mean rent in each submarket).

(c) Only properties in North San Mateo County were included in the model. Filtered to exclude properties missing rent data, data on other variables included in the model, and outliers (defined as properties with per-square-foot rents more than three standardized deviations from the mean rent in each submarket).

Sources: CoStar, 2Q 2014; Strategic Economics, 2015.

## FORM OF THE STATISTICAL MODELS

Hedonic regression analysis uses a statistical model to decompose the value of a property into its constituent parts. The coefficient of each variable can then be interpreted as the value associated with each specific attribute. The regression analysis modeled the average asking per-square-foot rental rate of an office property as a function of three types of attributes – transportation accessibility, building and lease characteristics, and location within the region – using the general form:

$$P_i = f(T, B, L)$$

Where

$P_i$  = the average, per-square foot asking rent of a given property (property  $i$ ), adjusted to full service equivalent.

T = transportation accessibility variables, including road distance from property  $i$  to the nearest BART station.

B = building and lease attributes for property  $i$ , such as building class, year built, and number of stories.

L = controls for where the building is located, including office submarket and local employment density.

The analysis resulted in two hedonic regression models: one for the East Bay (Alameda and Contra Costa Counties) and a second for the East Bay and North San Mateo County. The models were estimated using a weighted least squares model, weighted by the total rentable building area for each property included in the modeled dataset. This model was found to fit the data well, creating a model that meets the assumptions about linearity, normality of errors, and homogeneity of variance required for regression analysis to provide a valid, statistically significant result.

## INDEPENDENT VARIABLES

Figure A-3 describes the independent variables that were included in the model. Figure A-4 provides summary statistics for each variable, including either the mean value (for continuous variables) or the proportion of total transactions (for categorical variables). The distance from each property to the nearest BART station was modeled in three categories, based on whether the property was located within 1) a quarter mile of a BART station, 2) a quarter to a half mile, or 3) more than a half mile from a station. Distance categories were found to produce more robust results than using a single continuous variable for distance from BART. Properties located more than one-half mile from a station were grouped together based on the finding from the initial exploratory analysis that the premium associated with proximity to BART does not extend beyond the half mile.

A variety of other variables were tested but ultimately excluded from the model because they were found either not to be statistically significant, or to be strongly correlated with proximity to BART or other key variables. These include building parking ratios, rentable building area, and the Euclidean distance from the freeway and BART right-of-ways (ROWs) to each property. The distance from transportation ROWs is often included in models of property value because the noise and pollution from the ROW is considered to be a negative externality. However, while Strategic Economics' earlier analysis of for-sale residential properties did find a small negative price effect associated with proximity to BART and freeway ROWs, the value of proximity to the ROWs appeared to be slightly positive for office properties – potentially reflecting the benefit that office tenants receive from being visible from the highway or BART track, as well as the fact that office users are less affected by noise and pollution than residents (many office buildings have windows that do not open, and more advanced heating, ventilation, and air conditioning systems than homes). Given the apparent lack of a negative externality, and the fact that distance from the BART and freeway ROWs is highly correlated with distance from BART stations and freeway on-ramps, the ROW variables were omitted from the final model.

In order to explore whether the value of proximity to BART varies by location within the region, interaction variables were used to test how the value associated with distance from BART varies by office submarket and/or county. However, the interaction variables were not statistically significant and were ultimately omitted.

Figure A-3. Independent Variables Included in the Office Model

Variable	Description	Data Source
<b>Dependent Variable</b>		
Rent per sq. ft.	Average asking annual rent per square foot for the property in 2014 dollars, full service equivalent	CoStar, 2014; BOMA, 2014
<b>Transportation Accessibility</b>		
Dist. to freeway	Road distance to nearest freeway on-ramp (miles)	ESRI 2013
<1/4 mi BART	Property located within 1/4 road mile of nearest BART station (dummy: 0=no; 1=yes)	BART 2014; ESRI 2013
1/4 - 1/2 mi BART	Property located within 1/4 to 1/2 road mile of nearest BART station (dummy: 0=no; 1=yes)	BART 2014; ESRI 2013
>1/2 mi BART*	Property located more than 1/2 road mile from nearest BART station (dummy: 0=no; 1=yes)	BART 2014; ESRI 2013
<b>Building/Lease Attributes</b>		
Class A	Class A office building (dummy: 0=no; 1=yes)	CoStar, 2014
Class B	Class B office building (dummy: 0=no; 1=yes)	CoStar, 2014
Class C*	Class C office building (dummy: 0=no; 1=yes)	CoStar, 2014
Sublet	Existing tenant is attempting to sublease space	CoStar, 2014
Direct lease*	Space is being offered for lease directly from the owner/landlord	CoStar, 2014
Flex building	A type of building that is "designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. . . ."	CoStar, 2014
Office building*	A type of building that is intended "to house employees of companies that produce a product or service primarily for support services such as administration, accounting, marketing, information processing and dissemination, consulting, human resources management, financial and insurance services, educational and medical services, and other professional services."	CoStar, 2014
Stories	Number of stories in the building	CoStar, 2014
Percent leased	The percentage of space in the building that has been leased or pre-leased	CoStar, 2014
Latest construction	Year of latest construction, whether year built or year of most recent renovation	CoStar, 2014
<b>Location Controls</b>		
Submarket_San Leandro	Property located in San Leandro/Hayward/Castro Valley submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_Pleasanton	Property located in Pleasanton/Dublin/Livermore submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_ECCC	Property located in East Contra Costa County submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_Fremont	Property located in Fremont/Union City submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_NAlameda	Property located in North Alameda County submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_Concord	Property located in Concord/Pleasant Hill/Martinez submarket (0=no; 1=yes)	SE, 2015
Submarket_NSMC	Property located in North San Mateo County submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_SanRamon	Property located in San Ramon/Danville submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_Richmond	Property located in Richmond/El Cerrito submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_Lamorinda	Property located in Lamorinda submarket (dummy: 0=no; 1=yes)	SE, 2015
Submarket_WalnutCreek	Property located in Walnut Creek submarket (dummy: 0=no; 1=yes)	SE, 2015

Submarket_SOak*	Property located in South Oakland/Alameda submarket (dummy: 0=no; 1=yes)	SE, 2015
Office_Emp	Density of office-based employment (NAICS codes 51-62) within a half mile of the property, weighted by distance from the property, in thousands of employees	LEHD, 2011
Amenity_Emp	Density of retail, food, and services employment (NAICS codes 44-45, 71-72, 81) within a half mile of the property, weighted by distance from the property, in thousands of employees	LEHD, 2011

\*Omitted dummy variables. Coefficients for dummy variables in the regression models should be interpreted in relation to these variables; for example, coefficients for the Class A and B variables should be interpreted in relation to Class C office buildings. Acronyms and abbreviations: BOMA – Building Owners and Managers Association; ESRI – Esri North America Streets file; SE – Strategic Economics; LEHD – U.S. Census Bureau, Longitudinal Employer-Household Dynamics program.

**Figure A-4. Variable Summary Statistics**

Variable	Mean or Percent of Total Rentable Building Area	
	East Bay	East Bay and North San Mateo County
Rent per sq. ft.	25.6	26.4
<b>Transportation Accessibility Variables</b>		
Dist. to freeway	1.1	1.0
<1/4 mi BART	15%	14%
1/4 - 1/2 mi BART	15%	13%
>1/2 mi BART	70%	74%
	0%	0%
<b>Building and Lease Attributes</b>		
	0%	0%
Class A	28%	31%
Class B	60%	57%
Class C	12%	12%
Sublet	17%	18%
Direct lease	83%	83%
Flex building	12%	11%
Office building	88%	89%
Stories	6.3	6.2
Percent leased	78.8	79.1
Latest construction	1987	1987
<b>Location Controls</b>		
Submarket_San Leandro	6%	5%
Submarket_Pleasanton	11%	10%
Submarket_ECCC	1%	1%
Submarket_Fremont	11%	10%
Submarket_NAlameda	28%	24%
Submarket_Concord	10%	9%
Submarket_NSMC	0%	12%
Submarket_SanRamon	9%	8%
Submarket_Richmond	3%	3%
Submarket_Lamorinda	1%	1%
Submarket_WalnutCreek	13%	11%
Submarket_SOak	7%	6%
Office_Emp	13.8	12.7
Amenity_Emp	3.6	3.4

Sources: CoStar, 2014; Strategic Economics, 2015.



## MODEL RESULTS

Figure A-5 provides the complete outputs from the East Bay and East Bay/North San Mateo County models. The coefficients can be interpreted as follows:

- **Continuous variables:** The coefficients represent the difference in the predicted asking annual average rent of an office property for every one unit difference in the given variable, if all other variables remain constant. For example, in the East Bay, a one mile increase in distance from a freeway on-ramp is associated with a \$0.225 increase in asking rents, all else being equal.
- **Categorical (dummy) variables:** The coefficients can be interpreted as the difference in predicted asking annual average rent associated with the given variable, compared to the relevant omitted variable. For example, office properties in the East Bay that are located within a quarter mile of the nearest BART station rent for \$4.02 more per square foot than properties located more than a half mile from a station.

The R-squared for both models is about 0.55, meaning that the models explain about 55 percent of the variation in asking rents. This R-squared is in line with those achieved in other studies of office rents.<sup>57</sup> R-squared is only one measure of a model's explanatory power; the models were also tested for other measures of validity (including normality and homoscedasticity) in order to ensure that they were as robust as possible. Most coefficients are statistically significant (Figure A-5).

The results related to proximity to the BART stations are discussed in detail in Chapter III. Other coefficients are generally in the expected directions. For example, Class A space, newer construction, and higher intensity development (more stories) are associated with higher rents. Sublet space is associated with lower rents compared to directly leased space, as is flex space compared to traditional office space. Locations in the North Alameda, San Ramon/Danville, Lamorinda, and Walnut Creek submarkets are associated with particularly high rents.

A few coefficients require additional explanation:

- The coefficient for the distance from the nearest freeway is positive, indicating that rents are actually higher at longer distances from freeway on-ramps. Several other studies have also found that closer proximity to a highway has a neutral or even slightly negative effect on office values.<sup>58</sup> In the Bay Area, highway access may be sufficiently common that employers are not willing to pay a premium for slightly better access.
- The coefficient for office-based employment density is negative, suggesting that rents are lower in places with greater concentrations of office-based employment, all else being equal. This variable was hypothesized to have a positive effect on rents, because of the agglomeration benefits associated with concentrations of office space such as sharing a labor pool and knowledge spillovers. However, there are also costs associated with being located in a dense agglomeration of office space; for example, traffic and parking may be more challenging, and employers may have to pay higher wages to workers to compensate for longer commutes. Outside of the largest employment centers in a region (such as Downtown San Francisco), the costs associated with agglomeration may outweigh the benefits.<sup>59</sup> Moreover, some types of office-based employers that may be most likely to locate in the East Bay and northern San Mateo County – such as medical offices, real estate brokers, and back offices – may not experience significant benefits from being located near other, similar firms.

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<sup>57</sup> For example, in *BART at 20*, Landis and Loutzenheiser reported R-squared values ranging from 0.39 to 0.75. Nelson et al. report R-squared values of about 0.5.

<sup>58</sup> Cervero and Duncan, "Rail Transit's Value-Added: Effects of Proximity to Light and Commuter Rail Transit on Commercial Land Values in Santa Clara County, California"; Weinberger, "Light Rail Proximity."

<sup>59</sup> DiPasquale and Wheaton, *Urban Economics and Real Estate Markets*.

Figure A-5. Office Model Outputs

Variable	East Bay Model Coefficients	East Bay and North San Mateo County Coefficients
<b>Transportation Accessibility Variables</b>		
Dist. to freeway	0.225	0.067
<1/4 mi BART <sup>(a)</sup>	4.022*	3.162*
1/4 - 1/2 mi BART <sup>(a)</sup>	2.437*	1.757*
<b>Building and Lease Attributes</b>		
Class A <sup>(b)</sup>	3.263*	3.239*
Class B <sup>(b)</sup>	0.145	0.869
Sublet <sup>(c)</sup>	-2.989*	-2.359*
Flex building <sup>(d)</sup>	-2.316*	-2.458*
Stories	0.238*	0.271*
Percent leased	0.013	0.007
Latest construction	0.087*	0.103*
<b>Location Controls</b>		
Submarket_San Leandro <sup>(e)</sup>	0.090	0.273
Submarket_Pleasanton <sup>(e)</sup>	3.804*	3.765*
Submarket_ECCC <sup>(e)</sup>	1.015	1.490
Submarket_Fremont <sup>(e)</sup>	1.470	1.466
Submarket_NAlameda <sup>(e)</sup>	8.219*	7.962*
Submarket_Concord <sup>(e)</sup>	-0.870	-0.738
Submarket_NSMC <sup>(e)</sup>	N/A	10.333*
Submarket_SanRamon <sup>(e)</sup>	7.559*	7.576*
Submarket_Richmond <sup>(e)</sup>	3.064*	3.176*
Submarket_Lamorinda <sup>(e)</sup>	9.896*	10.381*
Submarket_WalnutCreek <sup>(e)</sup>	8.168*	8.467*
Office_Emp	-0.171*	-0.158*
Amenity_Emp	0.092	0.145
Constant	-154.252*	-185.193*
<b>R-Squared</b>	<b>0.551</b>	<b>0.556</b>

\*Statistically significant at the 95% confidence level.

(a) Compared to properties located more than a half mile from BART.

(b) Compared to Class C properties.

(c) Compared to direct leases.

(d) Compared to office buildings.

(e) Compared to Submarket\_SOak (South Oakland/Alameda submarket).

Sources: CoStar, 2014; Strategic Economics, 2015.

## CALCULATING OFFICE RENT PREMIUMS

Figure A-6 shows the rent premiums predicted for office properties located at different distance from BART. The dollar value premiums are the coefficients for the “<1/4 mi BART” and “1/4-1/2 mi BART” variables, as shown in Figure A-5 above. The predicted average annual rents at different distances from BART were calculated by assuming the mean values for all other variables in the model, shown in Figure A-4. The percentage premiums were calculated as the percent difference between the predicted average annual rent in each distance category (within 1/4 mile of BART and 1/4-1/2 mile of BART, respectively) and the predicted average annual rent for properties located more than a half mile from BART.

For example, assuming the mean values for the variables in the East Bay model, the predicted annual rent for an average apartment building within a quarter mile of a BART station is \$26.07. The predicted rent for a property located more than a half mile from a station is \$22.05. The percent difference (18.2%) is the average percentage premium associated with locations within a quarter mile of a station.

*Figure A-6. Predicted Office Rents and Proximity to BART (2014 Rents)*

	East Bay & North San Mateo County	East Bay
<u>Predicted Average Annual Rent<sup>(a)</sup></u>		
Within 1/4 Mile of BART	\$26.19	\$26.07
1/4-1/2 Mile of BART	\$24.78	\$24.49
More than 1/2 Mile from BART	\$23.03	\$22.05
<u>BART Proximity Premium</u>		
<u>Average Dollar Value Premium<sup>(b)</sup></u>		
Within 1/4 Mile of BART	\$3.16	\$4.02
1/4-1/2 Mile of BART	\$1.76	\$2.44
<u>Percentage Premium<sup>(c)</sup></u>		
Within 1/4 Mile of BART	13.7%	18.2%
1/4-1/2 Mile of BART	7.6%	11.1%

(a) Full service equivalent. Calculated by assuming mean values for all variables except distance from BART.

(b) Compared to properties located more than ½ mile from BART. These are the coefficients from the regression model (see Figure A-5).

(c) Compared to properties located more than ½ mile from BART. Calculated as the percent difference between the predicted average annual rent in each distance category (within ¼ mile of BART and ¼-½ mile of BART, respectively) and the predicted average annual rent for properties more than ½ mile from BART.

Source: Strategic Economics, 2015.

In order to estimate the aggregate value of the BART proximity premium for all apartment properties in the East Bay, Strategic Economics multiplied the East Bay dollar value premiums (shown in Figure A-6) by the total office building inventory within a quarter and a quarter to a half mile of the BART stations, and then subtracted a factor for vacancy in each submarket (shown in Figure A-1).

## APPENDIX B: APARTMENT REGRESSION ANALYSIS

This appendix provides a technical description of the hedonic regression analysis discussed in Chapter IV.

### APARTMENT DATA

The analysis is based on data purchased from realAnswers (formerly RealFacts), a data vendor focused on the multi-family apartment market. The data used for this analysis includes asking rents and occupancy rates for the second quarter of 2014. The realAnswers database only includes apartment complexes with 50 or more units. Figure B-1 shows the number of apartment complexes and units in the dataset, by county and road distance.

Only apartments in Alameda and Contra Costa County were included in the model, because there are only five apartment complexes located within a half mile of a BART station in San Mateo County.

*Figure B-1. Apartment Complexes and Units by County and Road Distance from the Nearest BART Station*

	Road Distance from the Nearest BART Station				
	<1/2 mile	1/2-1 mile	1-2 miles	2-5 miles	>5 miles
Alameda County					
Apartment Complexes	35	46	111	77	20
Apartment Units	7,134	6,906	16,948	12,720	2,705
Contra Costa County					
Apartment Complexes	15	21	41	54	42
Apartment Units	3,768	2,468	4,838	11,406	6,566
East Bay Total					
Apartment Complexes	50	67	152	131	62
Apartment Units	10,902	9,374	21,786	24,126	9,271

Sources: realAnswers, 2Q 2014; Strategic Economics, 2015.

### FORM OF THE STATISTICAL MODEL

The regression analysis modeled the average asking rent per square foot in an apartment complex as a function of three types of attributes – transportation accessibility, building and lease characteristics, and location within the region – using the general form:

$$P_i = f(T, B, L)$$

Where

$P_i$  = the average, monthly, per-square foot asking rent in a given complex (property  $i$ ).

T = transportation accessibility variables, including road distance from property  $i$  to the nearest BART station.

B = characteristics of complex  $i$ , such as year built, number of stories, and range of amenities.

L = controls for where the building is located, including submarket and neighborhood income.

The model was estimated using a weighted least squares model, weighted by the total number of units in each complex. This model was found to fit the data well, creating a model that meets the assumptions about linearity, normality of errors, and homogeneity of variance required for regression analysis to provide a valid, statistically significant result.

## **INDEPENDENT VARIABLES**

Figure B-2 describes the independent variables that were included in the model. Figure B-3 shows the submarket geographies, which were defined based on spatial patterns observed in average rents. Note that the apartments immediately adjacent to the U.C. Berkeley campus were grouped in a submarket separate from the rest of North Alameda County. The U.C. Berkeley submarket was intended to control for the influence of proximity to the campus on rents; apartment buildings near the campus have some of the highest rents in the region.

Many other variables were tested but ultimately excluded because they were either not statistically significant, or strongly correlated with proximity to BART. These included various building characteristics such as building class (A, B, and C) and other amenities (e.g., dishwashers, disposals, swimming pools), as well as a continuous variable that modeled accessibility to jobs within a 10 mile commute shed of each apartment building (calculated with a gravity model). Distance from BART was modeled using a continuous linear variable; a continuous variable transformed with a quadratic function; and with a variety of different distance bands. Ultimately, five distance bands (less than a half mile, a half to one mile, one to two miles, two to five miles, and more than five miles from the nearest BART station) were found to fit the data best.

Figure B-2. Independent Variables Included in the Model

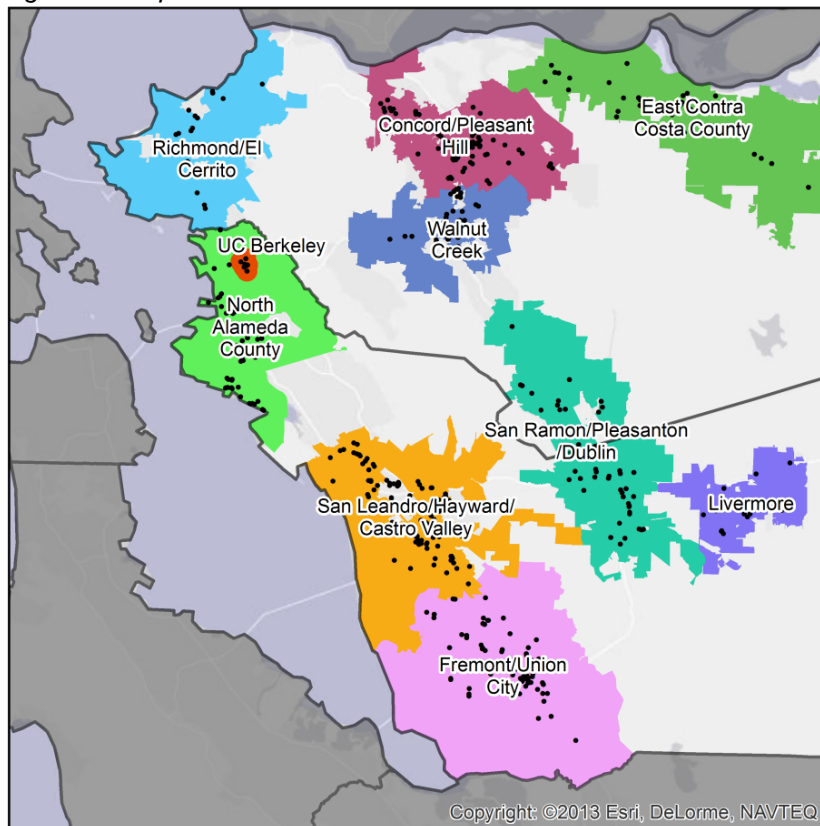
Variable	Description	Data Source
<b>Dependent Variable</b>		
Rent per sq. ft.	Average asking monthly rent per square foot for the apartment complex	realAnswers, 2014
<b>Transportation Accessibility</b>		
Dist. to freeway	Road distance to nearest freeway on-ramp (miles)	ESRI 2013
<1/2 mi BART	Property located within 1/2 road mile of nearest BART station (0=no; 1=yes)	BART 2014; ESRI 2013
1/2-1 mi BART*	Property located within 1/2-1 road mile of nearest BART station (0=no; 1=yes)	BART 2014; ESRI 2013
1-2 mi BART	Property located within 1-2 road miles of nearest BART station (0=no; 1=yes)	BART 2014; ESRI 2013
2-5 mi BART	Property located within 2-5 road miles of nearest BART station (0=no; 1=yes)	BART 2014; ESRI 2013
>5 mi BART	Property located more than 5 road miles from nearest BART station (0=no; 1=yes)	BART 2014; ESRI 2013
<b>Apartment Characteristics</b>		
1-2 stories	Apartment complex with 1 to 2 stories	realAnswers, 2014
3-5 stories	Apartment complex with 3 to 5 stories	realAnswers, 2014
6+ stories*	Apartment complex with 6 or more stories	realAnswers, 2014
Pct studio	Studios as a percent of all units in apartment complex	realAnswers, 2014
Pct one bdrm	One-bedroom units as a percent of all units in apartment complex	realAnswers, 2014
Pct two bdrm	Two-bedroom units as a percent of all units in apartment complex	realAnswers, 2014
Pct three bdrm	Three-bedroom units as a percent of all units in apartment complex	realAnswers, 2014
Pct four bdrm	Four-bedroom units as a percent of all units in apartment complex	realAnswers, 2014
Built before 1960	Complex built in or before 1960	realAnswers, 2014
Built 1961-84	Complex built between 1961 and 1984	realAnswers, 2014
Built 1985-98	Complex built between 1985 and 1998	realAnswers, 2014
Built after 1998*	Complex built in or after 1999	realAnswers, 2014
Air conditioning	Apartment units are air conditioned (0=no; 1=yes)	realAnswers, 2014
Storage	Apartments units have extra storage (0=no; 1=yes)	realAnswers, 2014
Garage	Apartment complex has garage parking (0=no; 1=yes)	realAnswers, 2014
Parking charge	Separate charge (in addition to rent) for parking (0=no; 1=yes)	realAnswers, 2014
Laundry	Washer/dryer or washer/dryer hookups provided in each unit (0=no; 1=yes)	realAnswers, 2014
Social	Number of social/fitness amenities provided in complex (e.g., swimming pool, fitness center, club house)	realAnswers, 2014

Figure B-2, cont'd.

Variable	Description	Data Source
<b>Location Controls</b>		
Submarket_San Leandro	Property located in San Leandro/Hayward/Castro Valley submarket (0=no; 1=yes)	SE, 2015
Submarket_Fremont	Property located in Fremont/Union City submarket (0=no; 1=yes)	SE, 2015
Submarket_Livermore	Property located in Livermore submarket (0=no; 1=yes)	SE, 2015
Submarket_NAlameda	Property located North Alameda County submarket (0=no; 1=yes)	SE, 2015
Submarket_ECCC	Property located in East Contra Costa County submarket (0=no; 1=yes)	SE, 2015
Submarket_Richmond	Property located in Richmond/EI Cerrito submarket (0=no; 1=yes)	SE, 2015
Submarket_PleasantHill	Property located in Pleasant Hill/Concord submarket (0=no; 1=yes)	SE, 2015
Submarket_SanRamon	Property located in San Ramon/Pleasanton/Dublin submarket (0=no; 1=yes)	SE, 2015
Submarket_UCB	Property located in U.C. Berkeley submarket (0=no; 1=yes)	SE, 2015
Submarket_WalutCreek*	Property located in Walnut Creek submarket (0=no; 1=yes)	SE, 2015
Median Income	Median income in Census tract in which property is located (in thousands of dollars)	2008-2012 ACS
Amenity_Emp	Density of retail, food, and services employment (NAICS codes 44-45, 71-72, 81) within a half mile of the property, in thousands of employees, weighted by distance from property.	LEHD, 2011

\*Omitted dummy variables. Coefficients for dummy variables in the regression models should be interpreted in relation to these variables; for example, coefficients for year built variables should be interpreted in relation to properties built after 1998. Acronyms and abbreviations: ESRI – Esri North America Streets file; SE – Strategic Economics; LEHD – U.S. Census Bureau, Longitudinal Employer-Household Dynamics program; ACS – U.S. Census Bureau, American Community Survey.

Figure B-3. Apartment Submarkets



## MODEL RESULTS

Figure A-4 provides the complete outputs. The coefficients can be interpreted as follows:

- **Continuous variables:** The coefficients represent the difference in the predicted asking monthly average rent of an apartment complex for every one unit difference in the given variable, if all other variables remain constant. For example, a one mile increase in distance from a freeway on-ramp is associated with a \$0.004 increase in monthly rents, all else being equal.
- **Categorical (dummy) variables:** The coefficients can be interpreted as the difference in predicted asking annual average rent associated with the given variable, compared to the relevant omitted variable. For example, apartments built before 1960 rent for \$0.35 per square foot less per month than apartments built in or after 1999.

The model fits the data very well, with an R-squared of 0.745 (meaning that the model explains about 75 percent of the variance in asking rents). The model was also tested for other measures of validity (including normality, homoscedasticity, and multi-collinearity) in order to ensure that it was as robust as possible.

Most coefficients are statistically significant and in the expected direction. Development density and year built have some of the largest impacts, with older, lower density complexes renting for less than newer, higher density complexes. For example, apartments built in or before 1960 rents for \$0.35 per square foot per month less than apartments built in order after 1999. Apartment complexes with one to two stories rent for \$0.29 per square foot per month less than apartments with six or more stories. Air conditioning, extra storage, garage parking, and in-unit laundry facilities are associated with higher rents, while charging for parking is associated with reduced rents. Compared to properties in Walnut Creek, apartments in North Alameda County and near U.C. Berkeley rent for a significant premium, while properties in most other submarkets rent for a discount. Apartments in locations with higher densities of employment in retail, restaurants, and amenities also rent for a statistically significant premium.

However, after holding other factors constant, properties located within a half mile of BART did not rent for significantly more than properties located one-half to one mile from a station. At distances greater than one mile from a station, rents appear to increase slightly (although this effect is also not statistically significant). The challenge in obtaining statistically significant results appeared to be related to two main factors:

1. The limited number of observations, especially within close to proximity to BART. As shown in Figure B-1, there are only 50 large apartment complexes located within a half mile of the stations in the East Bay.<sup>60</sup>
2. Interactions between proximity to BART and other variables. While tests for multicollinearity did not indicate problematic levels of collinearity in the model, buildings near BART tend to be built more recently and have higher development densities; these factors are also associated with higher rents. These types of interaction among key variables in a hedonic regression analysis makes it difficult to separate out the influence of different factors on the dependent variable (rents).

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<sup>60</sup> The realAnswers database provides information on average rents in each apartment complex, as well as data on the range of rents for each unit type (e.g., studios, one bedroom/one bathrooms, two bedrooms/two bathrooms, etc.) in each apartment complex. Early iterations of the model included each complex/unit type combination as a separate observation, resulting in a larger sample size. However, this resulted in high levels of spatial clustering (the Global Moran's I statistic indicated that spatial autocorrelation of the residuals was statistically significant at the 5% level). In order to reduce spatial clustering to acceptable levels, the apartment complexes were treated as the individual observations in the final version of the model.



Figure A-4. Apartment Model Outputs

Variable	Coefficients
<b>Transportation Accessibility</b>	
Dist. to freeway	0.004
<1/2 mi BART <sup>(a)</sup>	0.011
1-2 mi BART <sup>(a)</sup>	0.066
2-5 mi BART <sup>(a)</sup>	0.055
>5 mi BART <sup>(a)</sup>	0.11
<b>Apartment Characteristics</b>	
1-2 stories <sup>(b)</sup>	-0.296*
3-5 stories <sup>(b)</sup>	-0.301*
Pct studio	0.174
Pct one bdrm	-0.095
Pct two bdrm	-0.19
Pct three bdrm	-0.586
Pct four bdrm	-2.281
Built before 1960 <sup>(c)</sup>	-0.353*
Built 1961-84 <sup>(c)</sup>	-0.236*
Built 1985-98 <sup>(c)</sup>	-0.143*
Air conditioning	0.092*
Storage	0.092*
Garage	0.078*
Parking charge	-0.123*
Laundry	0.081*
Social	0.006
<b>Location Controls</b>	
Submarket_San Leandro <sup>(d)</sup>	-0.215*
Submarket_Fremont <sup>(d)</sup>	0.106
Submarket_Livermore <sup>(d)</sup>	-0.147
Submarket_NAlameda <sup>(d)</sup>	0.276*
Submarket_ECCC <sup>(d)</sup>	-0.782*
Submarket_Richmond <sup>(d)</sup>	-0.523*
Submarket_PleasantHill <sup>(d)</sup>	-0.405*
Submarket_SanRamon <sup>(d)</sup>	-0.035
Submarket_UCB <sup>(d)</sup>	1.626*
Median Income	0.001
Amenity_Emp	0.021*
Constant	2.884*
<b>R-squared</b>	<b>0.745</b>

(a) Compared to 1/2-1 mile from BART.

(b) Compared to complexes with 6 or more stories.

(c) Compared to complexes built in or after 1999.

(d) Compared to complexes in Submarket\_10 (Walnut Creek).

Source: Strategic Economics, 2015.

## APPENDIX C. BIBLIOGRAPHY

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