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Analyzing Accessibility Using Parcel Data: Is There Still an Access–Space Trade-Off in Long Beach, California?

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NEW PERSPECTIVES ON URBAN ACCESSIBILITY USING HIGH-RESOLUTION PARCEL DATA: ARE CRACKS DEVELOPING IN THE ACCESS-SPACE TRADEOFF IN LONG BEACH, CALIFORNIA?

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ABSTRACT

This article analyzes the impact of changing housing and neighborhood characteristics on the accessibility of neighborhood businesses using Long Beach, California as a case study. While advocates of smart growth and New Urbanism encourage land use mixing, aggregate-level analysis can be too coarse to pick up on fine-grained aspects of urban streetscapes. This study uses assessor parcel records and a point-based business establishment dataset to analyze accessibility from individual dwelling units to 31 types of neighborhood businesses including grocery stores, service shops, drug stores, doctor's offices, and banks. Regression results compare parcel and neighborhood-level drivers of accessibility between 2006 and 2015 to gauge the effect of changes in real estate development patterns since the Global Financial Crisis. Larger homes in older, multi-unit buildings and higher-income neighborhoods show increases in accessibility to most establishment types, suggesting a trend toward both greater accessibility and larger dwelling units – despite the traditional tradeoff between access and space. Meanwhile neighborhood-level results raise some concerns over potential displacing effects of gentrification.

Keywords: Housing, accessibility, urban morphology, parcel-level analysis, Long Beach

Accessibility has always been one of the key determinants of urban spatial structure. Alonso's (1964) model of residential location posited a fundamental tradeoff between access and space: given a limited budget, a household choosing where to live decides between the size of a dwelling unit and the length of their work commute (Phe & Wakely, 2000). Though work travel may be the most essential type of transport for a household economy, modern cities are also heavily consumption-driven and residents have wide-ranging needs as well as preferences for urban amenities (Glaeser & Gottlieb, 2006; Scott, 1997). Shopping in particular is a key generator of non-work travel (Handy, 1993). Historically though, a combination of local zoning and development finance apparatuses led to an oversupply of suburban tract homes in the United States, generally with poor access to essentially all urban destinations (Levine, 2005). Urban growth patterns, particularly urban sprawl, have been considered as complex adaptive systems (Batty, 2005; Torrens, 2006), wherein combinations of market, institutional, and locational forces generate patterns which in turn generate outcomes such as accessibility.

Recent evolutions in housing and neighborhood characteristics are thought to be gradually changing the relationship between city neighborhoods, components of the built environment, and accessibility to local businesses. Contemporary planning theory, most notably New Urbanism, focuses on policy and design which promotes walkability (Knaap & Talen, 2005), while transportation planners have increasingly been aware of the built environment determinants of transportation demand (Cervero & Kockelman, 1997) and advocates of sustainable cities have touted the environmental benefits of proximity (Haughton & Hunter, 2004). Demographic shifts which change residential location preferences have also been taking place recently (Ehrenhalt, 2012), while multifamily home construction has been on the rise, even on the urban fringe (Atkinson-Palombo, 2010). A number of these urban changes have been linked to the Global Financial Crisis of the late 2000s or the housing bubble burst which precipitated it. Since changes in the built environment are durable and their effects persist for decades after construction takes place, land use changes that result in altered accessibility patterns can have long-lasting effects in cities.

This study investigates the contribution of some of these recent shifts to changing patterns of city-wide accessibility to neighborhood businesses using Long Beach, California as a case study. At ½-million residents, Long Beach is the fifth-largest city in California and stands out for its socioeconomic and built environment diversity. While widely recognized for its Pacific Ocean port, Long Beach is home to a rapidly revitalizing downtown, ghettoized enclaves, resort-style oceanfront homes, and large volumes suburban-style tract housing. First, we use point-based business establishment data to create a typology of 31 categories of neighborhood businesses for which accessibility might be beneficial for a resident. Next, we use parcel information from the Los Angeles County tax assessor in 2006 and 2015 to isolate the city's roughly 170,000 individual dwelling units, using a street network topology to generate measures of proximity between homes and each neighborhood business type. Most neighborhood spatial accessibility research relies on aggregate geographies such as census tracts, which can induce aggregation error particularly when destinations are abundant or clustered (Hewko, Smoyer-Tomic, & Hodgson, 2002). Moreover, this is too coarse a resolution to analyze the changing relationship between accessibility and individual dwelling unit characteristics such as size, value, age, and housing type. Regressions are used to relate these building-level characteristics as well as neighborhood socioeconomic indicators including income, race, and age structure to accessibility. While city-wide patterns of accessibility are outcomes of the spatial distribution of both homes and neighborhood businesses, results demonstrate the importance of built environment changes to urban spatial structure, and show a general trend toward higher accessibility to most types of local businesses.

Shifts in Accessibility Patterns – Contemporary Planning and Urban Policy

A number of recent changes in cities are thought to have altered the relationship between accessibility and the characteristics of neighborhoods and buildings. For one, planning theory and urban policy have become more attuned to the benefits of co-location. The legacy of so-called Euclidean zoning in the United States has fostered urban landscapes where physical separation between use types is the norm, with poor accessibility being one of many negative outcomes (Hall, 2007). Euclidean zoning is in part to blame for both a lack of affordable housing (Glaeser & Gyourko, 2002), and an oversupply of suburban-style, single-family housing (Levine, 1998) which have failed to satisfy the transportation and accessibility preferences of a large portion of the population (Levine, 2005). Contemporary planning policy has long since moved away from this. Both the New Urbanism and smart growth movements seek to transform cities to be more compact, diverse, and sustainable, emphasizing walkability, transit access, and decreased use type separation (Knaap & Talen, 2005). New Urbanists in particular advocate for changes in municipal zoning and building codes to deconstruct the hierarchical strictures of Euclidean zoning which artificially distances housing and neighborhood-level businesses (Duany, Speck, & Lydon, 2010).

Infill development – an alternative to Greenfield development – is one mechanism of accomplishing these goals. While the term "urban infill" is fairly broad, it's generally understood to describe the development of vacant or under-utilized property surrounded by existing development (Daisa & Parker, 2009). Adaptive re-use of the existing building stock is a form of infill development that can promote land use mix by converting an older building – usually a non-residential structure near a central city – into housing in area rich in retail and office uses (Bullen & Love, 2009; Heath, 2001). In particular, a resurgence of interest in the benefits of older buildings has been taking place (Powe et al., 2016), largely in the spirit of Jacobs' (1961) advocacy of their benefits. New mixed-use development is also increasingly promoted and explicitly addresses neighborhood accessibility by placing new homes and businesses in close proximity (*Mixed-Use Development Handbook*, 2003). However, Grant and Perrott (2010) highlight some of the challenges associated with the viability of mixed use – particularly on the retail side – given the contrast between the normative view of planners toward mixed-use benefits and the market orientation of consumers, who, in their view, continue to prefer big-box retail in separated areas. Nonetheless, retail businesses have long been seen as a component of neighborhood revitalization (Chapple & Jacobus, 2009), supported by policies like tax increment financing (Kane & Weber, 2015) and business improvement districts (Sutton, 2014), which focus on incentivizing consumer-facing, neighborhood-scale businesses in an attempt to revitalize communities.

Shifts in Accessibility Patterns – Demographic and Economic Changes

In addition to policy and planning, demographic and economic changes affect the nature of housing and its immediate environment. Ehrenhalt (2012) and Plane (2013) note the increasing desire of retirees and empty-nesters to live in areas with greater access to amenities, while an increasing proportion of young adults live alone longer and seek central cities and dense neighborhoods. The popularity of Walkscore (Redfin, 2016), a commercial tool which provides a summary measure of nearby urban amenities, suggests an increased awareness of accessibility as a component of a home's salient characteristics, in part spurred by increases in fuel price and thus transportation costs. The real estate development industry has begun to respond in kind (Brown, 2015) with an increase in multifamily residential construction, even in characteristically dispersed metros like Phoenix, Arizona (Atkinson-Palombo, 2010). Across the state of California, the share of new housing units that are multi-family (as opposed to single-family) was at least 54% in every year from 2011-2015. This contrasts with the period from 1991-2006 when this share was never above 30% (*California Housing Units*, 2016).

The Global Financial Crisis has been implicated in a number of these changes. Research has demonstrated a post-crash increase housing development near transit stations and non-residential uses in Phoenix (Kane et al., 2014), while more broadly the decreased ability of developers to realize quick returns from single-family housing is thought to have slowed the proliferation of this product type and nudged developers toward other opportunities, including multifamily, mixed-use, or transit-oriented development (Brown, 2015). Meanwhile urban economists such as Glaeser (2011) have also stressed how verticality, provided by developers in the form of residential high-rises and supported by less restrictive building codes, increases housing stock and keeps a city economy vibrant. Increases in high-rise construction have been seen especially in city centers; this development type typically tilts toward high-end units for middle- and high-income households and empty nesters, in contrast with previous eras of high-rise construction which were made up of more lower-end public housing (Fincher, 2007).

The neighborhood socioeconomic context of urban spatial structural change is important as well. In some contexts increased accessibility – and in particular New Urbanist or mixed-use developments – are seen as a harbinger of the displacement of existing populations in cities, often lower-income residents or racial minorities (Kenny & Zimmerman, 2004; Murphy, 2008).

Concerns have also been raised over so-called "retail gentrification," whereby neighborhood businesses and retail outlets are refashioned along the cultural and racial preferences of the gentrifying population (Chapple & Jacobus, 2009; Monroe Sullivan & Shaw, 2011).

This study does not explicitly consider specific policies, nor do we undertake a hedonic model to understand the market capitalization effects of accessibility. Conceptually, we follow Batty (2005), Torrens (2006), and others in the complex cities literature who contend that urban spatial structure represents a self-organizing system and can be observed as the interplay of natural, institutional, and market-based forces. The critical connection in this approach is a linkage between the change process and the observed spatial pattern. Parcel-level data are used to provide this linkage in land change science (Irwin, 2010) since the scale of the decision-maker (e.g., developing a parcel of land) is the same unit that generates the observed pattern. Since our focus is on correlates to accessibility, which involves the spatial distributions of both homes and business establishments, we sidestep an explicit simultaneous model of the two. Rather, we emphasize changes in the city-wide relationships between property and neighborhood characteristics and accessibility given recent changes in both. This also contrasts with most empirical studies of New Urbanism and its outcomes which typically focus on specific developments or neighborhoods (see, e.g., Filion, 2001; Trudeau & Kaplan, 2015).

Accessibility as an outcome measure

Previous studies which have measured city-wide accessibility to a particular destination type tend to focus on a single destination – often grocery stores – rather than being oriented toward broader questions of urban morphological change. Much of the literature on food deserts in particular uses areal units such as census tracts or ZIP codes as observations and regresses socioeconomic characteristics on a measure of distance from each ZIP code or census tract to its nearest grocery store or a weighted average of nearby stores (Walker, Keane, & Burke, 2010). Schuetz, Kolko, and Meltzer (2012) use this technique to investigate retail establishments more generally, relating tract-level socioeconomic characteristics to the prevalence of supermarkets, drugstores, clothing stores, food services, and laundry businesses to their prevalence across the spatial distribution of a city's census tracts. While Sparks, Bania, and Leete (2010) note that the use of aggregated geographies has minimal impact on the ability to identify key areas with poor access to healthy food, the authors echo Hewko, Smoyer-Tomic, and Hodgson (2002) who demonstrate that the use of aggregated geographies can result in error in measuring distances particularly when destinations are abundant or localized. Duncan et al.'s (2012) performance testing of Walkscore (Redfin, 2016) concluded that it too works better at larger spatial scales.

In this sense, aggregation error is regarded as a type of measurement error, in that levels of accessibility may be inaccurately identified. It can also present a statistical identification problem when assessing the correlates to accessibility: the omission of property-level variables, which are critical to understanding the contribution of housing characteristics to city-wide accessibility patterns, can bias estimates. For example, Sevtsuk's (2014) building-level analysis of retail location finds a diminished role for nearby population and household incomes when compared to studies using larger areal units. Home sales data, which is essential to the myriad hedonic studies which seek to examine the capitalization effects of neighborhood amenities (see, e.g., Bartholomew & Ewing, 2011; Song & Sohn, 2007) are essentially subsets of parcel-level data consisting only of homes that have recently revealed their true economic value.

Hypotheses

This study seeks to investigate changes in urban spatial structure by measuring the factors that contribute to changes in city-wide patterns of accessibility between dwelling units and neighborhood businesses. We hypothesize that a combination of evolving contemporary perspectives surrounding planning and policy, coupled with a financial crisis-affected shift in preferences for housing will result in greater accessibility to neighborhood-level businesses. In particular:

(1) An increase in accessibility for higher value dwelling units and in higher-income neighborhoods reflects a market-based preference for access, rather than physical separation from retail land use,

(2) Single-family homes and larger units will become more accessible as businesses move toward them and as densification in the form of high-rise construction, infill, and decreased separation by land use type increases, and

(3) Neighborhoods with higher median incomes, a greater share of white residents, and more retirement-age people will be the primary recipients of the benefits of increased proximity.

DATA AND METHODS

Study Area

At nearly ½ million residents Long Beach is the fifth-largest city in California, lying on the Pacific Coast twenty-two miles south of downtown Los Angeles. The city has a wide variety of neighborhood types including a historic downtown, traditional suburban enclaves, and disinvested, high-crime communities ("Intra City," 2016). Long Beach is very mixed along a number of socioeconomic indicators, with sizeable populations of all the region's racial groups, a variety of income levels, and a nearly even split between single-family and multi-family housing ("Profile of the City of Long Beach," 2015). In particular, the business-heavy downtown and nearby East Village neighborhoods are undergoing a residential building boom, with adaptive re-use of commercial high-rises taking place alongside new construction (Medzerian, 2014).

Residential Parcel Data

Parcel-level boundary files and data for 2006 and 2015 are available through Los Angeles County's open data initiative ("Los Angeles Open Data,") and include information on building age, housing type, assessed value, and other characteristics. A measure of the assessor's "effective year built" can be used to gauge whether a home has been renovated. We classify it as such if the effective year built is different from the structure's age, using three years of difference as a cutoff so as to avoid capturing any renovation projects that were essentially linked to original construction. Due to Proposition 13 in California, which caps annual assessment increases, assessor values are not dependent on market value; rather they depend heavily on the property's sale history. A back-calculation procedure was necessary to impute the market value of housing[i]. This study covers 106,758 land parcels in the cities of Long Beach and Signal Hill, a fraction of the roughly 2.4 million parcels in Los Angeles County. Signal Hill is a separate municipality with a population of roughly 11,000 that is completely surrounded by Long Beach and exists independently due to the legacy of a 1920s-era dispute over industrial zoning and tax revenue, however we include it in this study nonetheless.

As is often the case with tax assessor data, Los Angeles County's records reflect property ownership rather than individual dwelling units, necessitating standardization in order to conduct unit-level analysis. For example, a condominium building with 100 individually-owned units consists of 100 separate records, each considered a single-family residence with a property value and unit size (square footage) commensurate with an individual home (and therefore does not require adjustment). An otherwise identical apartment building of 100 units consists of a single record, requiring disaggregation in order to compare at the dwelling-unit level. This procedure identified 165,480 individual dwelling units (in 2006) which could be categorized as single-family detached homes, condominiums, large apartments (5 or more units), and a category we label "multiplex" to capture townhomes and small apartment buildings of fewer than 5 units.

Selected demographic data were joined to the parcel data at the census block-group level, the smallest spatial scale available. American Community Survey 2005-2009 data were matched to 2006 vintage parcels, while 2010-2014 data – the most recent available at the time of this study – were used to represent neighborhood characteristics in 2015. Consistent with extant studies of retail accessibility, we include median family incomes to help gauge whether certain businesses are considered amenities or disamenities. We include separately the percentage of households in poverty in order to distinguish whether access to particular establishments is available for those who may be most in need. Population density – expected to positively correlate with access – is included as a control. We also include racial composition and the proportion of residents over the age of 65 to gauge the relationship between demographic trends and accessibility.

Reference USA

The business establishment data used are 2005 and 2014 data from *ReferenceUSA* and provide coordinate data for every business establishment region-wide (Infogroup, 2015). While a wealth of information is available in these data, we use North American Industry Classification System (NAICS) codes to create a typology of 31 types of local businesses with the intent of identifying categories of consumer-facing businesses for which proximity to one's home might be beneficial. We loosely follow Porter's U.S. Cluster Mapping project (Porter, 2000), which separates NAICS codes based on whether businesses are interregional versus intraregional in nature. From Porter's 310 "local" clusters we eliminated establishments that were clearly business services, wholesaling, industrial production, construction, and utilities. The remainder were aggregated, guided by Porter's "subclusters," into 31 types of neighborhood, or consumer-facing businesses (Table 2). Appendix A links business types to their NAICS codes.

<< Table 2 About Here >>

Geoprocessing Methods

ArcGIS' Network Analyst was used in conjunction with a street network topology created from ESRI's "North America Detailed Streets" (ArcGIS, 2014). Street network distances were generated between parcels and businesses using a simple inverse distance, or gravity-based measure,

$$\sum_j \frac{1}{d_{ij}} \ \forall k$$

where d_{ij} is the distance in feet from parcel i to establishment j for all establishment types k. As a comparison, results are generated for two other common measures of proximity: the distance from each parcel i to its nearest establishment of type k, and a count of establishments of type k within one mile of each parcel i.[ii]

Regression Methods

The purpose of this study is to analyze the relationship between both neighborhood and built environment characteristics and the proximity of a residential dwelling unit to different types of local businesses. To do this, we estimate ordinary least squares regressions on the set of variables in Table 1. Since both parcel-level and block group-level covariates are investigated, cluster robust standard errors at the block group-level are reported. A Chow test is used to test the null hypothesis that an individual coefficient does not change over the study period. Coefficients are standardized in both independent and dependent variables to facilitate side-by-side comparison between coefficients in a model, but also between business categories (i.e. across separate regressions). Owing to the large number of regressions, only results for one establishment category – restaurants – are analyzed in full. The rest are presented in terms of the impact of covariates on the number of establishment types (0 to 31) which have a positive, negative, increased, or decreased effect on accessibility over 2006-2015. Businesses that lie outside the city limits of Long Beach, but within 1 mile, are included so as to accurately reflect the options for residents living near the city boundary.

RESULTS AND DISCUSSION

Descriptive Results

Table 1 highlights some trends in neighborhood businesses. The number of consumer-facing establishments in Long Beach (plus a 1-mile buffer) increases by 24% between 2006 and 2015, from 11,601 to 14,430. Hospitals, gas stations, and personal financial services (e.g. tax preparation services and insurance agents) saw the largest increases, while some categories including grocery stores, drinking places, and religious organizations declined. It is possible that some of these changes reflect NAICS reclassification or changes in the industrial organization of certain sectors.

<< Table 1 About Here >>

The level of accessibility of a business is a function of both its prevalence and spatial distribution. For example, even though the number of beer, wine, and liquor stores increased modestly from 153 to 159 establishments, a larger proportion of dwelling units did not have such a store within one mile (4.2% in 2006 and 6.5% in 2015). Over 99% of the dwelling units in Long Beach in 2015 had at least one restaurant, one specialty store, one hair care establishment, and one religious organization within a mile. The median distance from a home to nearly any of the 31 establishment types is below a half mile, while no home is more than 4.5 miles from anything city-wide: movie theaters are the most inaccessible establishment type, though there are only 12 theaters in 2005 and 10 in 2014. While there are more hospitals and medical laboratories by 2014, they tend to be localized in a few areas across the city resulting in fairly high median distances to homes. The clustering of these establishment types in medical campuses could explain poorer neighborhood-level access.

Focus on Restaurants

Prior to presenting results across all 31 establishment types, we discuss the detailed regression results for one category: restaurants (Table 2). While restaurants are common and often desirable to have nearby, their prominence in downtown revitalization efforts is often seen as emblematic of gentrification. "Limited-service food and beverage" consists of coffee, snack, and donut shops, while "Full-service restaurants" range from fast food to fine dining. The number of full-service restaurants in Long Beach increased from 1,070 in 2005 to 1,436 in 2014.

Figure 1 shows all restaurants within 1-mile of Long Beach in 2014 and parcels based on the inverse distance measure of proximity to restaurants. High scores correspond to high density restaurant areas, such as the downtown area in the town's Southwest corner and along some major roads. Areas further east in Long Beach are dominated by residential land use and have the lowest levels of restaurant access.

<< Figure 1 About Here>>

The regression results in Table 2 illustrate some of these regularities. The positive coefficient for building age suggests that restaurant access is greater in older housing units. This effect increases tenfold from 2006 to 2015, suggesting a systematic increase in restaurant presence near older structures. A dwelling unit's fair market value is positively related with accessibility to restaurants but this effect is not statistically significant. As expected, condos show a strong (and increasing) relationship to proximity compared with the reference category, large apartments. Detached, single-family homes have one of the strongest negative relationships with accessibility to restaurants in both years, while multiplexes have a significant negative coefficient, though not as strong as detached homes. The size of an individual dwelling unit (SQFT/unit) has a strongly negative relationship with accessibility to restaurants in 2006; however, by 2015 this effect becomes insignificant (and, in fact, positive at the mean). Larger homes were once further from restaurants but no longer. There are more than twice as many high-rise units in Long Beach in 2015 than 2006 (1.7% of total versus 0.7%); expectedly they have a positive and increasing relationship with restaurant access.

Turning to neighborhood characteristics, a negative coefficient in 2015 on the proportion of the population over 65 contrasts with the hypothesis of retirees increasingly inhabiting high-accessibility housing. A strong effect is seen for the percent of white, non-Hispanic population. Areas that are more heavily white are associated with restaurant access while the positive effect for percent black is not significant. The percent of population in poverty is not significantly related with accessibility to restaurants, while median family income shows a very weak negative effect in 2006 that disappears by 2015. This provides weak evidence that on average, restaurants are a negative externality and the wealthy would be more likely to prefer residential areas with lower restaurant density. The higher standard errors surrounding this coefficient estimate in 2015 suggest that if anything, this trend is dissipating. However, the same trend is not reflected using home value.

Varying Conceptualizations of Proximity - Restaurants

The above results use an inverse distance measure of accessibility, weighting nearer establishments heavily and those further (up to one mile) less. Since this study's main concern is analyzing trends in multiple types of businesses, results using two other conceptualizations of accessibility – the distance to the nearest establishment and the number of establishments within one mile – are relegated to Appendix B. While parameter estimates differ, many practical interpretations stay the same. We sidestep a discussion of specific results but emphasize that the differences could be informative in some instances. For example, the coefficient on property value is positive using the distance to the nearest establishment, suggesting that having a restaurant very close by is a negative externality, while the positive coefficient on the other two measures of access suggest restaurants within one mile are desirable.

All Establishment Types

Coefficient estimates and significance test results for all establishment types in 2006 and 2015 can be found in Appendix C. Table 4 summarizes, showing how many of the 31 establishment types are positively and negatively related to the building and neighborhood characteristics in either year in addition to indicating which covariates' coefficient estimates changed (significantly) from positive to negative or vice versa. Figures 3 and 4 provide graphical interpretations of the same, emphasizing overall trends across establishment types. Each plot represents a covariate and contains one line per establishment type. Lines extend from the 2006 (standardized) coefficient estimate on the left side to the 2015 estimate on the right side. Statistically insignificant ($p<0.05$) cases are omitted; however establishment types with a significant coefficient in only one year are shown in a lighter color.

<< Table 4 About Here >>

<< Figure 3 About Here >>

<< Figure 4 About Here >>

Property-Level Characteristics

Table 3 indicates that homes in older buildings are more proximate to 27 of the 31 establishment types in 2006 and 29 types in 2015. The exceptions, which show no significant relationship between residential building age and proximity are childcare services, coffee shops, gas stations (2006 only), and other educational (2006 only). Figure 3 indicates that the estimate for building age increased substantially in most cases[iii]. Similar to the results for restaurants alone, the relationship of building renovation decreases across most establishment types, switching from a positive to a negative predictor of accessibility in 21 cases: renovated buildings were systematically *further* from most types of neighborhood businesses in 2015. The lone positive sign in 2015 was for religious organizations, which remained significantly more accessible to renovated homes. Assessed property values are more often a negative predictor of accessibility, though this relationship is only significant in a few instances: in both years standardized coefficient estimates are positive for bars and negative for schools, religious organizations, and gas stations. While the estimate for property values might be seen as an indicator that establishments are more likely negative than positive externalities, that bars are positive and schools negative is unexpected. Further analysis is needed; this may reflect the synthetic nature of the property value measure used.

The overall relationship between housing type and accessibility remains fairly consistent over time, though results change for particular establishment types. Compared to large apartments, homes in condo buildings are increasingly proximate to more establishments in 2015 (20) than in 2006 (12), suggesting that individual ownership may be more closely linked to increasing accessibility. The negative impact of being in a detached home is very strong with standardized coefficients approaching -1 and is nearly universal: detached homes are further from 27 of 31 establishment types in 2015. The coefficient estimate for multiplexes becomes negative for an additional 7 establishment types in 2015 indicating poorer accessibility relative to larger apartments. Homes in buildings with a large number of dwelling units consistently show lower accessibility, indicating that such buildings may be in complexes isolated from nearby businesses, though this negative impact is seen for fewer business types in 2015 than 2006 (7 versus 17). This *is* consistent with the increasing number of high-rises in Long Beach over the study period; the impact of high-rises on accessibility is nearly universally positive by 2015. Meanwhile the relationship between unit size (SQFT) and accessibility changes dramatically. Several establishment types show a negative impact in 2006 that dissipates by 2015 including apparel and liquor stores, bars, restaurants, and hair salons, i.e. access to these businesses is no longer inversely related to home size. Meanwhile by 2015 several other establishment types: namely hospitals, medical labs, and recreational facilities are positively related to unit size. While average dwelling unit size increased modestly from 2006-2015, the bulk of larger units –

and new, larger units – were concentrated in the downtown area, along the oceanfront, and in a pocket in south-central Long Beach. Generally, these were also areas of increased neighborhood business density, which contrasts with areas further north in Long Beach that were more typically suburban and characterized by smaller, midcentury tract homes with fewer nearby establishments and little rebuilding or new construction.

Neighborhood-Level Characteristics

We expect population density to be positively correlated with accessibility; this is true in virtually all establishment types and very few decreases are seen. Results do not support Ehrehalt's (2012) "urban inversion" perspective that retiring Baby Boomers increasingly choose central cities due to the accessibility benefits. Rather, an increasing number of establishment types (up from 9 to 20) have a negative relationship between retirement-age population and accessibility. The relationship to percent in poverty is generally positive, likely reflecting the smaller, older, denser housing often characteristic of poorer areas. However, by 2015 only banks, doctor's offices, hospitals, and specialty food stores exhibit positive relationships between in-poverty population and access, suggesting a shifting distribution of accessibility away from high-poverty areas. Median income is negatively related to accessibility in 16 cases in 2006 but only 5 cases in 2015 (auto services, bars, liquor and convenience stores, home products, and personal services), suggesting that wealthy homeowners may prefer isolation from certain establishments, but less so recently.

The relationship of percent white, non-Hispanic to accessibility supports the contention of Monroe Sullivan and Shaw (2011) that retail gentrification can refashion neighborhoods along racial group preferences. While we do not investigate causality, by 2015 a higher percentage of white population is associated with better access to 19 establishment types and poorer access to just three: auto services, grocery stores, and religious establishments. Standardized estimates are generally higher than for the percentage of black, non-Hispanic population, which by 2015 is associated with better access only to child care, convenience stores, coffee shops, and movie theaters. While a more targeted research design is needed, these results demonstrate a general trend toward greater accessibility in predominantly white areas.

CONCLUSIONS

This study sought to analyze the accessibility of neighborhood business establishments in the context of evolving housing and neighborhood characteristics. Changing trends in residential development and business location interact to generate these outcomes and changes in urban morphology more generally: access is a function of residential location and the prevalence and spatial distribution of destinations. This study's use of higher-resolution data allow for the consideration of built environment characteristics alongside neighborhood level measures while reducing aggregation error and improving statistical identification. Mirroring broader trends toward more multifamily housing and standing out for its socioeconomic and built environment diversity, Long Beach, California is a parsimonious case study.

Descriptive results supported our hypothesis of increased overall accessibility between homes and neighborhood businesses. Older buildings show an increasing positive relationship with accessibility to neighborhood businesses, which inherently cannot be explained by new residential construction. Though adaptive reuse of nonresidential buildings occurred, the more likely explanation is an increase in neighborhood businesses in areas with older buildings. The strong relationship between age and accessibility suggests that business location rather than new residential construction plays an outsized role in promoting accessibility, though a future study could jointly consider these two processes in a simultaneous equation setting. The increase in high-rise construction can explain some of the accessibility increase found for larger homes. While Glaeser (2011) notes the benefits of high-rises to a city's economy, this study goes further, demonstrating an increasing ability to have both accessibility *and* personal space. In other words, the outcome of a decade of changes in residential and business location appears to be a decreased need to trade between these two main determinants of residential location (Alonso, 1964; Phe & Wakely, 2000). Levine (2005) lamented that the hegemony of single-family homes constrained housing choice – these results suggest more combinations of access and space may now be available. Further research is required to assess whether *particular* business types are positive or negative externalities: although higher income areas appear slightly less "repelled" by neighborhood businesses since 2006 – a positive sign for advocates of use mixing – were home values not muddied by Proposition 13 they may have demonstrated the same. Results do not support the hypothesis that retirees may be reaping accessibility benefits, but they do support the notion of "retail gentrification." Socioeconomic results are much weaker than for building age and home size, but a trend toward decreasing accessibility in nonwhite and high-poverty neighborhoods is a serious concern and reveals a potential risk stemming from urban morphological change.

Further work is needed to identify causal processes. For example, examining accessibility between luxury high-rise condominiums, loft conversions, and upmarket shops can provide insights into the dynamics of gentrification while comparing affordable housing's changing accessibility to basic needs could help parse between two potentially divergent processes. This study's analytical framework can facilitate closer analysis of recent development trends and land use changes to planners, at whose disposal much these data are available. This high-resolution analysis using parcels and points provides a clear and practical way to understand the impacts of the changing spatial distributions of housing and neighborhood businesses.

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APPENDIX A: NAICS CODES WHICH COMPRISE EACH NEIGHBORHOOD BUSINESS TYPE

Num.	Business Category Name	6-digit NAICS Codes (2012 Series)
1	Apparel Retailing	448110, 448120, 448130, 448140, 448150, 448190, 448210
2	Auto Services	532111, 441310, 441320, 811111, 811112, 811113, 811118, 811121, 811122, 488410, 811191, 811192, 811198
3	Beer, Wine, and Liquor Stores	445310
4	Child Care Services	624410
5	Convenience Stores	445120
6	Deposit-taking Institutions	522110, 522130
7	Drinking Places (Alcoholic Beverages)	722410
8	Drug Stores	446110
9	Elementary and Secondary Schools	611110
10	Full-Service Restaurants	722511, 722513, 722514
11	Gas Stations	447110, 447190
12	General Merchandise Retailing	452111, 452112, 452910, 452990, 453310
13	Groceries	445110
14	Hair Care Services	611511, 812111, 812112, 812113
15	Healthcare Provider Offices	621111, 621112, 621210, 621310, 621320, 621330, 621340, 621391, 621399, 621410, 621420, 621491, 621492, 621493, 621498, 621991, 621999
16	Home Products Retailing	453210, 443141, 442110, 442210, 442291, 442299, 444210, 444220, 444130, 444110, 444120, 444190
17	Hospitals	622110, 622210, 622310
18	Laundry	812320, 812310
19	Limited-Service Food and Beverage	722515
20	Medical Laboratories	339116, 621511, 621512
21	Movie Theaters	512131
22	Other Learning	611519, 624310, 611610, 611692
23	Other Personal Services	532220, 532299, 541940, 812191, 812199, 812910, 812990, 541921, 812921, 812922
24	Personal Financial	524210, 541213
25	Personal Products Retailing	453991, 446120, 446199, 453910, 453998
26	Recreational Facilities and Instruction	611620, 713910, 713940, 713950
27	Religious Organizations	813110
28	Repair Services	561622, 811212, 811310, 811411, 811412, 811211, 811213, 811420, 811430, 811490
29	Social Service Organizations	624110, 624120, 624190, 624210, 624221, 624229, 624230, 813212, 813219, 813311, 813312, 813319, 813410, 813990
30	Specialty Food	311811, 445210, 445220, 445230, 445291, 445292, 445299, 446191
31	Specialty Retailing	451211, 451212, 443142, 451140, 451110, 451120, 532230, 446130, 453220, 453110, 448310, 448320, 451130

APPENDIX B: FULL REGRESSION RESULTS FOR RESTAURANTS USING ALTERNATIVE PROXIMITY MEASURES

	2006		2015		
DV: Count of Restaurants in One Mile	Estimate (RSE)	t value	Estimate (RSE)	t value	Chow Test (X^2)
(Intercept)	0.21 (0.294)	0.7	-0.07 (0.342)	-0.2	
Property Characteristics					
Building Age	0.029 (0.006)	4.9***	0.349 (0.05)	7***	48.35***
Renovated (1/0)	0.065 (0.021)	3.1**	-0.077 (0.033)	-2.4*	29.13***
Fair Market Value/Unit (log)	-0.4 (0.322)	-1.2	-0.659 (0.411)	-1.6	16.37**
Condo (vs. Lg. Apt)	0.358 (0.091)	3.9**	0.676 (0.142)	4.8***	31.92***
Detached (vs. Lg. Apt)	-0.405 (0.069)	-5.9***	-0.638 (0.093)	-6.9***	5.2*
Multiplex (vs. Lg. Apt)	-0.183 (0.038)	-4.8***	-0.352 (0.061)	-5.8***	10.38**
Number of Units	-0.051 (0.021)	-2.4*	-0.009 (0.042)	-0.2	11.51**
SQFT/unit (ln)	-0.238 (0.142)	-1.7.	0.364 (0.199)	1.8.	8.74**
Historic (1/0)	1.054 (0.257)	4.1***	1.45 (0.37)	3.9**	4.07*
Pool (1/0)	-0.227 (0.046)	-4.9***	-0.332 (0.07)	-4.8***	30.59***
High rise (1/0)	0.899 (0.258)	3.5**	2.109 (0.364)	5.8***	2.54
Neighborhood Characteristics					
Percent Over 65 Yrs. Age	-0.021 (0.033)	-0.6	-0.039 (0.061)	-0.6	0.11
Percent Black (non-hisp)	0.03 (0.041)	0.7	0.021 (0.038)	0.6	0.14
Percent White (non-hisp)	0.279 (0.048)	5.8***	0.266 (0.054)	4.9***	0
Population Density	0.374 (0.046)	8.2***	0.471 (0.055)	8.5***	2.81.
Percent in poverty	0.043 (0.041)	1.1	0.07 (0.056)	1.2	0.1
Median Family income	-0.153 (0.052)	-2.9**	-0.047 (0.09)	-0.5	1.24
Notes: Coefficients standardized. RSE stands for block group-level cluster robust standard errors.	*n =*	*165,480*	*n =*	*170,019*	
	R^2 =	0.5060	R^2 =	0.5167	
	*. p<0.10, * p<0.05, ** p<0.01, *** p<0.0001*				

	2006		2015		
DV: Distance to Nearest Restaurant (ft)	Estimate (RSE)	t value	Estimate (RSE)	t value	Chow Test (X^2)
(Intercept)	-0.874 (0.233)	-3.8**	0.33 (0.663)	0.7	
Property Characteristics					
Building Age	-0.023 (0.006)	-3.7**	0.059 (-3.974)	-4**	15.32**
Renovated (1/0)	-0.026 (0.018)	-1.4	0.043 (2.773)	2.8**	9.33**
Fair Market Value/Unit (log)	0.168 (0.258)	0.7	0.324 (-0.249)	-0.2	12.99**
Condo (vs. Lg. Apt)	-0.138 (0.119)	-1.2	0.129 (0.004)	0	0.06
Detached (vs. Lg. Apt)	0.487 (0.073)	6.7***	0.098 (5.188)	5.2***	10.65**
Multiplex (vs. Lg. Apt)	0.127 (0.04)	3.2**	0.054 (3.337)	3.3**	1.04
Number of Units	0.05 (0.03)	1.7	0.101 (-1.384)	-1.4	9.45**
SQFT/unit (ln)	0.689 (0.186)	3.7**	0.251 (-0.462)	-0.5	1.14
Historic (1/0)	-0.223 (0.161)	-1.4	0.217 (-0.409)	-0.4	2.51
Pool (1/0)	0.098 (0.045)	2.2	0.161 (2.236)	2.2*	3.45.

High rise (1/0)	-0.344 (0.203)	-1.7.	0.749 (-2.255)	-2.3*	3.64.
Neighborhood Characteristics					
Percent Over 65 Yrs. Age	0.027 (0.051)	0.5	0.074 (1.436)	1.4	1.11
Percent Black (non-hisp)	-0.029 (0.035)	-0.8	0.029 (-0.205)	-0.2	0.75
Percent White (non-hisp)	-0.078 (0.057)	-1.4	0.047 (-2.561)	-2.6*	1.26
Population Density	-0.183 (0.037)	-4.9***	0.044 (-3.248)	-3.2**	1.89
Percent in poverty	0.022 (0.036)	0.6	0.044 (-0.797)	-0.8	1
Median Family income	0.058 (0.05)	1.2	0.106 (0.344)	0.3	0.06
Notes: Coefficients standardized. RSE stands for block group-level cluster robust standard errors.	*n =*	*165,480*	*n =*	*170,019*	
	R^2 =	0.2167	R^2 =	0.2326	
	*. p<0.10, * p<0.05, ** p<0.01, *** p<0.0001*				

APPENDIX C: COEFFICIENT ESTIMATES AND SIGNIFICANCE TEST RESULTS FOR ALL ESTABLISHMENT CATEGORIES USING INVERSE DISTANCE MEASURE

2006	Apparel Retailing	Auto Services	Beer, Wine, and Liquor Stores	Child Care Services	Convenience Stores	Deposit-taking Institutions	Drinking Places (Alcoholic Bev.)	Drug Stores	Elementary and Secondary Schools	Full-Service Restaurants	Gas Stations	General Merchandise Retail	Groceries	Hair Care Services	Healthcare Provider Offices	Home Prod
Building Age	0.032***	0.019***	0.03***	0.009	0.02**	0.02**	0.027***	0.023***	0.012*	0.035***	0.01	0.029***	0.018***	0.032***	0.015**	0.019**
Renovated (1/0)	0.084**	0.043	0.078*	0.06	0.011	0.011	0.039	0.031	0.094*	0.076**	0.015	0.073**	0.097***	0.058*	0.01	0.06
Value/Unit (ln)	0.603	0.074	0.393	-0.771	0.248	0.656	0.971**	0.376	-1.966**	0.558	-1.039*	0.499	-0.615	0.529	-0.49	-0.161
Condo (1/0)	0.085	0.202**	0.064	-0.17	0.019	0.154	0	-0.014	0.315**	0.217*	0.086	0.128	0.222**	-0.091	0.118	0.136
Detached (1/0)	-0.723***	-0.583***	-0.57***	-0.129	-0.661***	-0.328**	-0.78***	-0.569***	0.085	-0.736***	-0.17	-0.787***	-0.275**	-0.648***	-0.241**	-0.449***
Multiplex (1/0)	-0.156**	-0.065	-0.115*	0.013	-0.178**	-0.168**	-0.214***	-0.134**	-0.02	-0.202***	-0.121	-0.186***	-0.02	-0.165**	-0.106**	-0.047
Number of Units	-0.072**	-0.067*	-0.102**	-0.117**	-0.1**	0.039	-0.033	-0.042	-0.265***	-0.054	-0.078	-0.107*	-0.032	-0.049*	-0.016	-0.056**
SQFT/unit (ln)	-0.686**	-0.171	-0.678**	0.048	-0.25	-0.545**	-0.653**	-0.285	0.304	-0.771**	-0.044	-0.141	-0.231	-0.683**	0.206	-0.382
Historic (1/0)	0.706***	0.522***	0.705***	-1.231	0.711***	0.745***	0.649***	0.108	0.503*	0.762***	0.721**	0.659***	0.622***	1.047	0.108	0.279**
Pool (1/0)	-0.304***	-0.072	-0.16*	-0.01	-0.012	-0.107	-0.129**	-0.17**	0.048	-0.217**	0.045	-0.179**	-0.186***	-0.227***	-0.029	-0.118
High rise (1/0)	0.684***	0.608**	0.711*	0.555*	0.589**	0.585*	0.431**	0.337	0.765*	0.774***	0.534	0.843**	0.328	0.141	0.313	0.506*
Percent Over 65 Yrs. Age	-0.151*	-0.084	-0.138**	-0.128	-0.041	-0.027	-0.092*	-0.093	0.021	-0.084	-0.17*	-0.201**	-0.043	-0.098	0.043	-0.172**
Percent Black (non-hisp)	0.006	-0.035	0.033	0.111**	0.14**	0.179**	-0.034	0.073	-0.039	0.027	0.117*	0.048	0.029	0.041	0.014	0.039
Percent White (non-hisp)	0.065	-0.274***	0.05	-0.068	0.018	0.474***	0.077	0.179*	-0.08	0.175**	0.237**	0.067	-0.242**	0.202**	0.104	0.067
Population Density	0.255***	0.142**	0.25***	0.015	0.231***	0.191**	0.265***	0.164**	0.109*	0.31***	0.056	0.204***	0.228***	0.231***	0.097*	0.179***
Percent in poverty	0.05	0.104*	-0.017	-0.047	0.045	-0.029	-0.016	0.171**	0.092*	0.022	0.009	-0.024	0.061	0.036	0.154**	-0.014
Median Family income	-0.087	-0.116	-0.22**	-0.183*	-0.197*	-0.066	-0.124*	-0.083	-0.218**	-0.114	-0.209*	-0.259*	-0.127*	-0.185*	-0.042	-0.257**
2015																
Building Age	0.285***	0.106**	0.33***	0.197***	0.125**	0.091	0.28***	0.234***	0.1*	0.315***	0.1**	0.175***	0.201***	0.331***	0.216***	0.192***
Renovated (1/0)	-0.045	-0.043*	-0.114**	-0.012	-0.049*	-0.028	-0.13***	-0.057*	0.035	-0.091**	-0.027	-0.034	-0.04	-0.099**	-0.072	-0.049
Value/Unit (ln)	0.282	-0.732*	0.447	-0.258	-0.305	-0.167	1.269**	0.626	-2.081***	0.302	-1.275**	0.246	-0.289	0.929*	0.121	0.004
Condo (1/0)	0.259**	0.266***	0.072	0.129	0.146	0.27**	0.185	0.147	0.363**	0.268**	0.252**	0.212**	0.283***	0.123	0.133	0.36**
Detached (1/0)	-0.665***	-0.369**	-0.759***	-0.299**	-0.352**	-0.333*	-0.935***	-0.748***	0.064	-0.71***	-0.145	-0.572***	-0.453***	-0.918***	-0.454**	-0.537***
Multiplex (1/0)	-0.272***	-0.07	-0.242***	-0.117*	-0.146**	-0.198**	-0.347***	-0.273***	-0.009	-0.28***	-0.064	-0.199***	-0.148**	-0.29***	-0.158*	-0.19**
Number of Units	-0.101	-0.031	-0.064	-0.153**	-0.07	-0.033	0.017	-0.041	-0.175*	0.041	-0.066	-0.128*	-0.023	-0.045	-0.163*	-0.024
SQFT/unit (ln)	-0.189	0.413	0.018	-0.022	0.011	0.1	0.01	0.234	0.578	0.225	0.059	0.046	0.267	-0.119	0.191	0.06
Historic (1/0)	1.156	0.524**	1.333	0.212	0.599***	0.277	0.765***	0.386**	0.213	0.543***	0.562**	0.433**	0.531***	1.066	-1.253	0.73**
Pool (1/0)	-0.199**	-0.082	-0.257*	-0.163	0.057	-0.111	-0.191**	-0.155**	0.095	-0.268**	-0.029	-0.141*	-0.117**	-0.173**	-0.149	-0.158*
High rise (1/0)	1.449***	0.77***	1.865***	1.157***	1.021***	1.144**	0.891***	0.555*	1.234**	1.617***	1.428**	1.211***	0.7***	0.788***	0.24	1.108***
Percent Over 65 Yrs. Age	-0.221**	-0.145**	-0.229**	-0.139*	-0.142**	-0.048	-0.107*	-0.105	-0.114	-0.157**	-0.122**	-0.2***	-0.087*	-0.149**	-0.012	-0.177**
Percent Black (non-hisp)	0.032	0.009	0.036	0.143**	0.083*	-0.031	0.044	0.078	-0.04	0.023	0.056	0.047	-0.007	0.005	-0.109	0.033
Percent White (non-hisp)	0.177**	-0.169**	-0.06	0.082	0.005	0.359***	0.262***	0.159*	-0.043	0.23***	0.051	0.137**	-0.264***	0.167**	0.047	0.143*
Population Density	0.239***	0.139**	0.223***	0.119**	0.192***	0.196**	0.344***	0.221***	0.149**	0.291***	0.088*	0.204***	0.216***	0.223***	0.238***	0.163**
Percent in poverty	-0.038	0.029	-0.016	-0.01	-0.064	0.165**	0.011	0.065	-0.03	0.017	0.028	0.067	0.038	0.007	0.14*	-0.05
Median Family income	-0.176	-0.189*	-0.118	-0.138	-0.193*	0.029	-0.15*	-0.096	-0.243	-0.164	-0.133	-0.152	-0.149	-0.118	0.089	-0.276*

2006	Hospitals	Laundry	Limited-Service Food and Beverage	Medical Laboratories	Movie Theaters	Other Learning	Other Personal Services	Personal Financial	Personal Products Retailing	Recreational Facilities and Instruction	Religious Organizations	Repair Services	Social Service Organizations	Specialty Food	Specialty R
Building Age	0.019**	0.03***	0.031***	0.012	0.02**	0.006	0.03***	0.024**	0.033***	0.018**	0.019**	0.013*	0.029***	0.022***	0.03***
Renovated (1/0)	-0.047	0.064*	0.052	0.006	0.089**	0.046	0.047*	0.032	0.086**	0.054*	0.158***	0.085*	0.091**	0.073*	0.115**
Value/Unit (ln)	-0.932**	0.38	-0.249	-0.497	-1.014*	0.51	0.643	0.115	0.603	-0.756*	-1.737***	-0.651	-0.099	-0.109	0.198
Condo (1/0)	0.393***	-0.069	0.243**	0.027	0.49***	0.022	0.139	0.224*	0.173	0.2**	0.254**	0.304**	0.258**	0.131	0.138
Detached (1/0)	-0.341***	-0.604***	-0.528***	-0.147	-0.031	-0.427***	-0.797***	-0.512***	-0.707***	-0.306**	0.088	-0.377**	-0.6***	-0.273**	-0.625***
Multiplex (1/0)	-0.156**	-0.157**	-0.198***	-0.102	-0.064	-0.075	-0.291***	-0.17**	-0.209***	-0.166**	0.044	-0.111	-0.199**	-0.024	-0.202***
Number of Units	-0.048	-0.041*	-0.055	-0.077*	0.035	-0.127**	-0.104*	-0.076	-0.148**	-0.083	-0.121***	-0.193**	-0.07*	-0.035	-0.104
SQFT/unit (ln)	0.672**	-0.637*	-0.244	0.3	-0.026	-0.77**	-0.4	-0.14	-0.609	0.009	0.002	-0.147	-0.073	-0.628	-0.588**
Historic (1/0)	1.057**	0.433**	0.701***	0.188	1.118***	0.438**	0.853***	0.488*	0.593**	0.062	0.474**	0.421*	0.618***	0.497*	0.619**
Pool (1/0)	-0.049	-0.162**	-0.04	-0.112	-0.164	-0.021	-0.113	-0.027	-0.268**	0.007	-0.255**	-0.093	-0.316*	-0.254*	-0.179
High rise (1/0)	0.825**	0.209	0.724**	0.449	0.839*	0.659*	0.683**	0.555	0.991**	0.626**	1.233**	1.139***	1.271***	0.388	0.903**
Percent Over 65 Yrs. Age	0.044	-0.085	-0.069	0.036	-0.069	-0.063	-0.134*	-0.113	-0.172*	-0.07	-0.037	-0.094	0.007	-0.058	-0.131*
Percent Black (non-hisp)	0.01	0.09*	0.052	0.028	0.145*	0.081	0.084	0.062	0.023	-0.02	0.051	-0.001	-0.003	-0.033	-0.007
Percent White (non-hisp)	-0.115	0.208**	0.285***	0.191*	0.325***	0.297**	0.437***	0.281**	0.258**	0.381***	-0.169**	0.091	0.233***	-0.098	0.181**
Population Density	0.086	0.18***	0.22***	0.019	0.423***	0.148**	0.216***	0.194**	0.202***	0.107*	0.161**	0.097*	0.293***	0.204***	0.291***
Percent in poverty	0.213**	0.03	-0.019	0.185**	-0.246***	0.023	-0.022	-0.088	0.004	0.099*	0.022	0.094*	0.133**	0.19***	0.059
Median Family income	0	-0.128	-0.129	-0.103	-0.309**	-0.049	-0.136*	-0.188*	-0.202	-0.146*	-0.131	-0.282**	-0.084	0.107	-0.163*
2015															
Building Age	0.201***	0.212***	0.243***	-0.031	0.267***	0.201***	0.184***	0.176***	0.169***	0.25***	0.178***	0.157**	0.27***	0.242***	0.241***
Renovated (1/0)	-0.122***	-0.073**	-0.1**	-0.012	-0.074*	-0.061*	-0.052*	-0.051	-0.001	-0.089**	0.059*	-0.007	-0.075*	-0.047	-0.05
Value/Unit (ln)	-0.247	0.534	0.409	-1.581**	-0.407	0.644	0.404	0.165	-0.251	0.388	-1.637***	-0.417	0.212	0.403	0.282
Condo (1/0)	0.201*	0.079	0.053	-0.162	0.633***	-0.074	0.316**	0.334**	0.271**	0.296**	0.331***	0.396**	0.285**	0.154*	0.439**
Detached (1/0)	-0.785***	-0.656***	-0.924***	0.08	-0.393**	-0.733***	-0.726***	-0.54***	-0.437***	-0.832***	0.029	-0.455***	-0.897***	-0.644***	-0.694***
Multiplex (1/0)	-0.271***	-0.18**	-0.306***	0.064	-0.219**	-0.266***	-0.275***	-0.215***	-0.134**	-0.373***	0.022	-0.132**	-0.336***	-0.18**	-0.285***
Number of Units	-0.031	-0.028	0.024	-0.059*	0.061	-0.155**	-0.067	-0.009	-0.044	0.015	-0.061*	-0.116	-0.033	-0.022	-0.035
SQFT/unit (ln)	0.882***	-0.19	0.514*	0.935**	0.511*	-0.067	0.022	0.35	-0.068	0.816**	0.465	0.282	0.539*	0.309	-0.035
Historic (1/0)	0.446**	0.352*	0.277*	-0.7**	1.134***	0.018	0.612**	0.387*	0.719**	0.414**	0.285*	0.614**	0.359*	0.501	0.742**
Pool (1/0)	-0.17*	-0.23**	-0.254	0.199*	-0.26***	-0.126	-0.09	-0.05	-0.154**	-0.142	-0.146*	-0.296*	-0.199**	-0.219**	-0.146*
High rise (1/0)	0.819**	0.384*	1.748**	-0.165	1.512***	0.756*	1.139***	0.894**	1.134***	0.875***	1.036***	1.714***	1.015***	0.739***	1.317***
Percent Over 65 Yrs. Age	0.051	-0.131*	-0.149*	-0.12	0.049	-0.092	-0.209**	-0.13**	-0.149**	-0.169**	-0.103	-0.14*	-0.062	-0.06	-0.107*
Percent Black (non-hisp)	-0.001	0.005	0.099*	-0.012	0.118**	0.076	-0.02	0.065	0.013	0.031	-0.026	0.009	0.032	-0.046	-0.002
Percent White (non-hisp)	0.085	0.142*	0.367***	-0.073	0.214**	0.358***	0.462***	0.211**	0.106*	0.459***	-0.161**	0.129*	0.157**	-0.08	0.242***
Population Density	0.232***	0.274***	0.208***	-0.073	0.361***	0.18**	0.246***	0.201***	0.168***	0.249***	0.163**	0.162***	0.33***	0.221***	0.308***
Percent in poverty	0.167**	0.016	0.027	-0.08	-0.156*	-0.012	-0.012	-0.026	-0.025	-0.017	-0.058	0.001	0.029	0.088*	-0.004
Median Family income	0.049	-0.18	-0.021	-0.031	-0.063	-0.133	-0.204*	-0.133	-0.141	-0.133	-0.201	-0.175	-0.073	-0.077	-0.081

Notes: Coefficient estimates are standardized. The dependent variable is a weighted inverse distance measure for establishments of the above-listed type within one mile of all dwelling units, i.e. each column and year is a separate OLS regression. Significance assessed using a cluster robust standard errors at the block group level using a t-test. *p<0.05, **p<0.01, ***p<0.0001.

TABLES

TABLE 1: BUSINESS ESTABLISHMENT TYPES IN LONG BEACH AND THEIR PROXIMITY TO DWELLING UNITS

			Establishments within one mile				Miles to nearest establishment			
	Number of establishments		2006		2015		2006		2015	
Business Establishment Type	**2006**	**2015**	**Pct w/none**	**Median**	**Pct w/none**	**Median**	**Median**	**Max**	**Median**	**Max**
Apparel Retailing	445	430	4.6%	11	3.7%	11	0.3	2.3	0.3	2.2
Auto Services	908	911	3.0%	18	1.9%	21	0.3	2.1	0.3	2.2
Beer, Wine, and Liquor Stores	153	159	4.2%	5	6.5%	5	0.3	2.0	0.3	2.0
Child Care Services	136	162	7.6%	4	5.1%	6	0.4	2.3	0.4	2.3
Convenience Stores	65	83	17.8%	3	12.6%	3	0.5	3.0	0.5	2.8
Deposit-taking Institutions	109	143	20.6%	2	22.6%	3	0.7	2.6	0.6	2.9
Drinking Places (Alcoholic Beverages)	101	69	13.7%	4	26.9%	3	0.5	2.6	0.6	2.9
Drug Stores	115	136	11.1%	3	9.7%	4	0.5	3.1	0.4	3.0
Elementary and Secondary Schools	286	273	2.0%	9	1.4%	8	0.3	2.2	0.3	2.2
Full-Service Restaurants	1070	1436	0.5%	33	0.5%	47	0.2	1.8	0.2	1.8
Gas Stations	100	173	11.3%	3	4.3%	4	0.5	2.8	0.4	1.9
General Merchandise Retailing	210	268	9.1%	7	3.1%	9	0.4	2.3	0.3	1.9
Groceries	258	249	6.8%	7	6.4%	8	0.3	2.4	0.3	2.4
Hair Care Services	775	839	1.0%	26	0.6%	31	0.2	2.1	0.2	2.1
Healthcare Provider Offices	2548	3731	1.1%	52	9.1%	73	0.3	1.8	0.2	2.0
Home Products Retailing	446	568	2.1%	13	1.5%	16	0.3	2.0	0.3	1.9
Hospitals	40	81	54.5%	0	27.5%	2	1.1	3.6	0.7	2.4
Laundry	172	169	2.7%	6	3.6%	6	0.4	2.3	0.4	2.3
Limited-Service Food and Beverage	172	182	2.1%	6	3.0%	6	0.4	2.5	0.4	1.9
Medical Laboratories	68	69	38.3%	1	36.0%	1	0.8	3.5	0.8	3.2
Movie Theaters	12	10	72.2%	0	75.4%	0	1.6	4.5	1.7	4.2
Other Learning	78	101	12.7%	3	11.4%	3	0.6	3.0	0.5	2.7
Other Personal Services	262	335	4.7%	8	3.9%	10	0.4	2.2	0.3	2.6
Personal Financial	475	758	3.5%	11	1.2%	23	0.3	2.1	0.3	2.6
Personal Products Retailing	230	338	4.3%	7	1.6%	10	0.4	2.2	0.3	2.2
Recreational Facilities and Instruction	148	196	6.6%	4	9.0%	5	0.5	2.6	0.4	2.5
Religious Organizations	472	453	0.9%	14	0.7%	14	0.3	2.3	0.3	1.8
Repair Services	272	374	3.5%	7	1.7%	10	0.4	2.3	0.3	2.2
Social Service Organizations	429	590	1.2%	14	1.0%	18	0.3	2.0	0.3	2.1
Specialty Food	212	250	6.0%	5	5.1%	7	0.4	2.2	0.4	2.3
Specialty Retailing	834	894	0.6%	24	0.1%	28	0.2	1.7	0.2	1.8
Total:	11,601	14,430								

A typology of 31 categories of consumer-facing, neighborhood-scale business establishments was created, loosely following Porter

(2000). A count of the number of business establishments in Long Beach (plus a one-mile buffer from the city boundary) is included in the first two columns. The next four columns indicate, in 2006 and 2015, the percentage of residential dwelling units in Long Beach have none of the establishment type within one mile, as well as the count of that establishment type within one mile for the median dwelling unit. The final four columns indicate the median distance from a dwelling unit to the nearest establishment of that type, and the maximum distance from a dwelling unit to an establishment of that type.

TABLE 2: FULL REGRESSION RESULTS FOR PROXIMITY TO FULL-SERVICE RESTAURANTS

	2006		**2015**		
DV: Inverse Distance Weighted Proximity to Restaurants	Estimate (RSE)	t-value	Estimate (RSE)	t value	Chow Test (χ^2)
Intercept	0.117 (0.299)	0.4	-0.492 (0.308)	-1.6	-
Property Characteristics					
Building Age	0.035 (0.006)	5.7***	0.315 (0.039)	8.1***	67.98***
Renovated (1/0)	0.076 (0.024)	3.2**	-0.091 (0.028)	-3.23**	40.19***
Fair Market Value/Unit (log)	0.558 (0.358)	1.6	0.302 (0.448)	0.67	20.49***
Condo (vs. Lg. Apt)	0.217 (0.088)	2.5**	0.268 (0.091)	2.94**	3.08.
Detached (vs. Lg. Apt)	-0.736 (0.09)	-8.2***	-0.71 (0.124)	-5.73***	8.01**
Multiplex (vs. Lg. Apt)	-0.202 (0.038)	-5.3***	-0.28 (0.046)	-6.1***	0.46
Number of Units	-0.054 (0.03)	-1.8.	0.041 (0.052)	0.79	19.83***
SQFT/unit (ln)	-0.771 (0.224)	-3.4***	0.225 (0.27)	0.83	8.72**
Historic (1/0)	0.762 (0.151)	5.1***	0.543 (0.11)	4.95***	0.22
Pool (1/0)	-0.217 (0.062)	-3.5***	-0.268 (0.086)	-3.13**	9.63**
High rise (1/0)	0.774 (0.173)	4.5***	1.617 (0.363)	4.45***	4.88*
Neighborhood Characteristics					
Percent Over 65 Yrs. Age	-0.084 (0.056)	-1.5	-0.157 (0.054)	-2.92**	1.53
Percent Black (non-hisp)	0.027 (0.04)	0.7	0.023 (0.031)	0.74	0.06
Percent White (non-hisp)	0.175 (0.06)	2.9**	0.23 (0.057)	4.06***	1.14
Population Density	0.31 (0.037)	8.5***	0.291 (0.045)	6.52***	0.49
Percent in poverty	0.022 (0.036)	0.6	0.017 (0.044)	0.39	0.07
Median Family income	-0.114 (0.066)	-1.7.	-0.164 (0.151)	-1.09	0.09
Notes: Coefficients standardized. RSE stands for block group-level cluster robust standard errors.	*n =*	*165,480*	*n =*	*170,019*	
	R^2 =	0.4028	R^2 =	0.4236	
	*. p<0.10, * p<0.05, ** p<0.01, *** p<0.0001*				

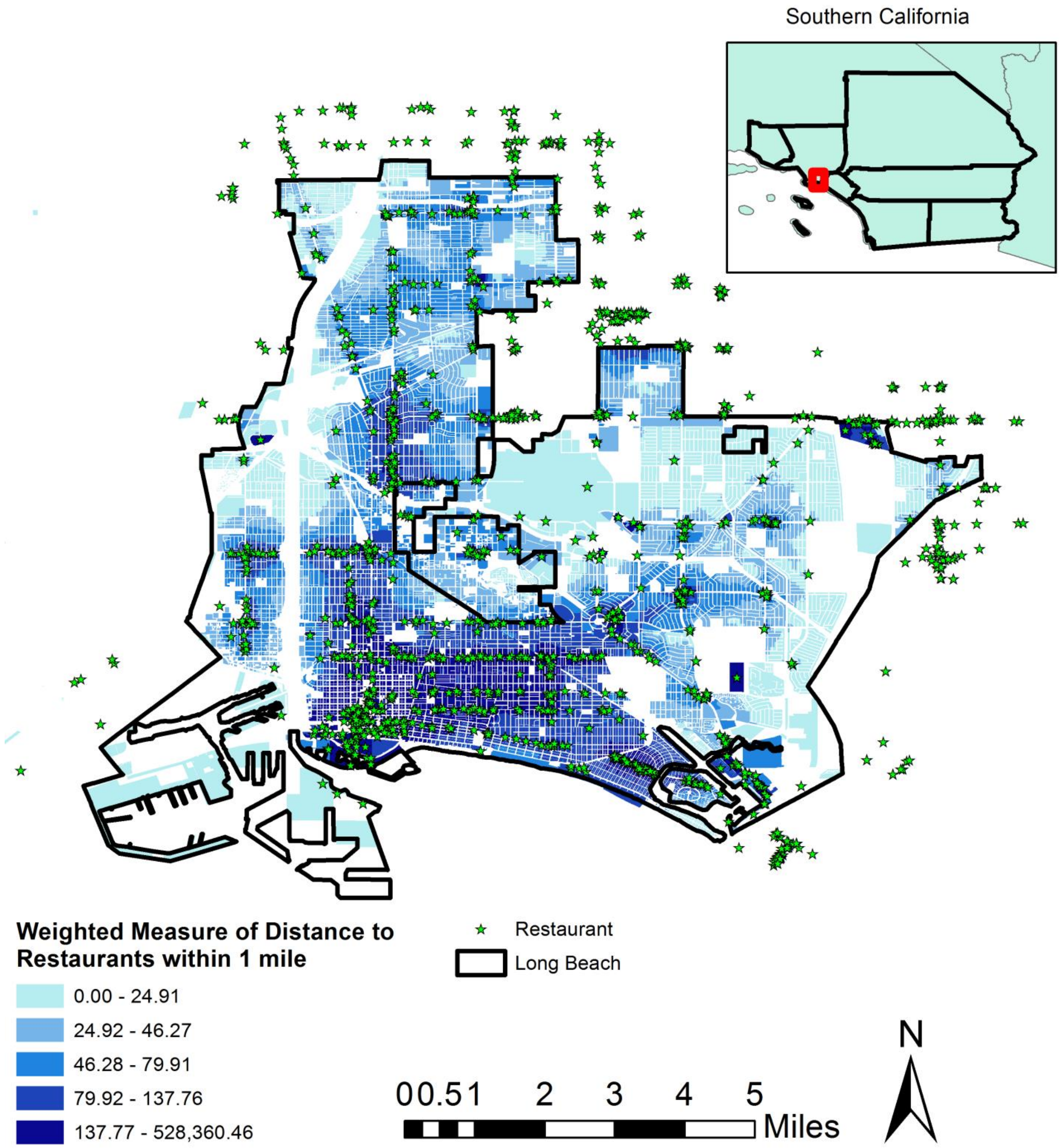
TABLE 3: COUNT OF NEIGHBORHOOD BUSINESS TYPES (OUT OF 31) BASED ON COEFFICIENT ESTIMATES

	2006		*2015*		*Signif.* & Sign Switch^*	
	*Positive and Significant**	*Negative and Significant**	*Positive and Significant**	*Negative and Significant**	*Negative to Positive*	*Positive to Negative*
Property Characteristics						
Building Age	27	0	29	0	0	0
Renovated (1/0)	17	0	1	15	0	21
Value/Unit (ln)	1	6	2	5	1	1
Condo (vs. Lg. Apt)	12	0	20	0	0	0
Detached (vs. Lg. Apt)	0	25	0	27	0	0
Multiplex (vs. Lg. Apt)	0	19	0	26	0	0
Number of Units	0	17	0	7	0	0
SQFT/unit (ln)	1	9	6	0	3	0
Historic (1/0)	25	0	21	1	0	1
Pool (1/0)	0	13	1	18	1	0
High rise (1/0)	22	0	29	0	0	0
Neighborhood Characteristics						0
Percent Over 65 Yrs. Age	0	9	0	20	0	0
Percent Black (non-hisp)	6	0	4	0	0	0
Percent White (non-hisp)	16	3	19	3	0	1
Population Density	27	0	30	0	0	0
Percent in poverty	10	1	4	1	1	2
Median Family income	0	16	0	5	0	0

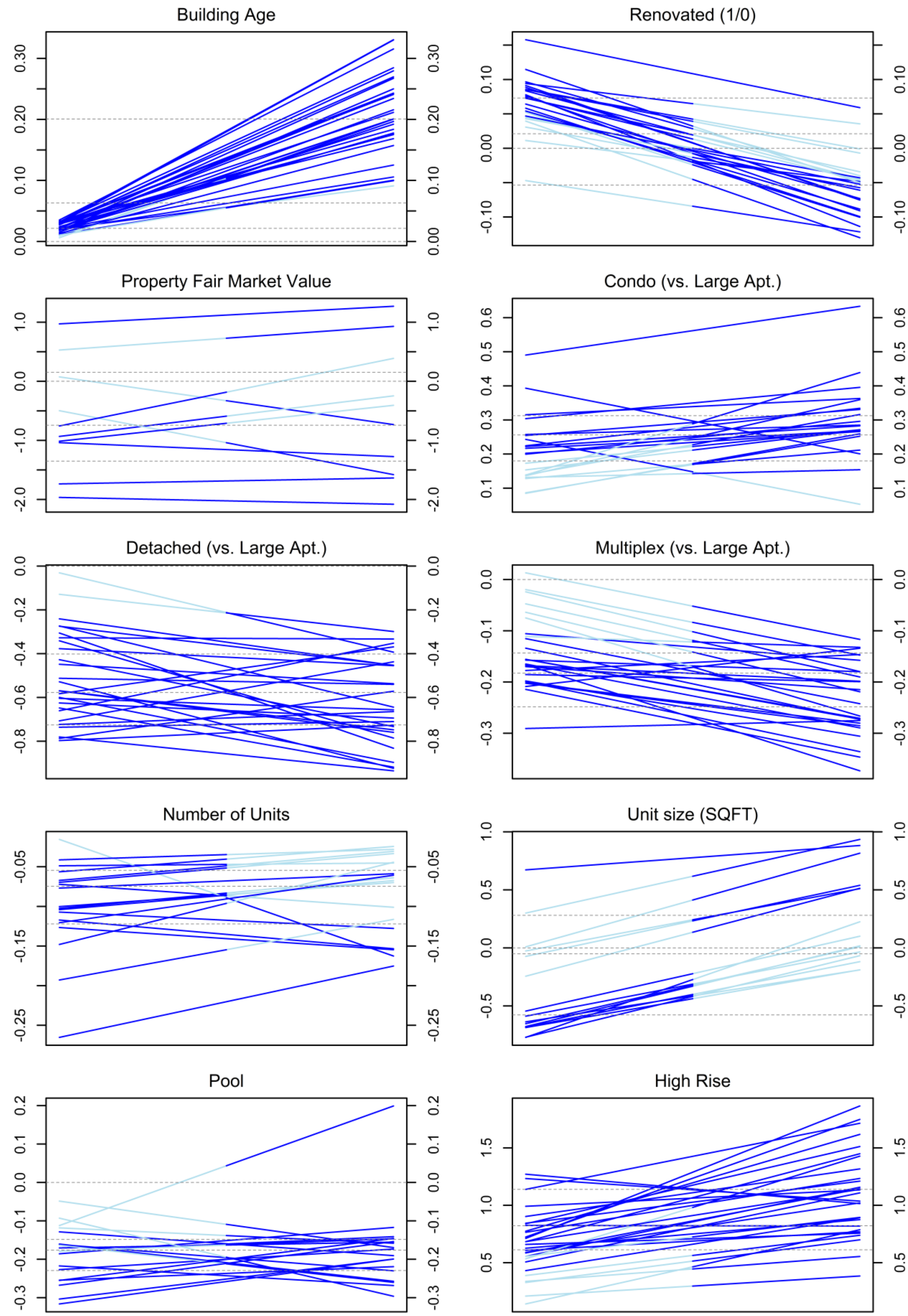
*significance defined as $p < 0.05$

^denotes coefficient was signficant in at least one year, change was significant, and sign switched from a positive predictor of accessibility to negative (or vice-versa)

FIGURES



Southern California
Weighted Measure of Distance to Restaurants within 1 mile
0.00 - 24.91
24.92 - 46.27
46.28 - 79.91
79.92 - 137.76
137.77 - 528,360.46
Restaurant
Long Beach
00.51 2 3 4 5
Miles
N


Building Age
0.00 0.10 0.20 0.30
Renovated (1/0)
-0.10 0.00 0.10
Property Fair Market Value
-2.0 -1.0 0.0 1.0
Condo (vs. Large Apt.)
0.1 0.2 0.3 0.4 0.5 0.6
Detached (vs. Large Apt.)
-0.8 -0.6 -0.4 -0.2 0.0
Multiplex (vs. Large Apt.)
-0.3 -0.2 -0.1 0.0
Number of Units
-0.25 -0.15 -0.05
Unit size (SQFT)
-0.5 0.0 0.5 1.0
Pool
-0.3 -0.2 -0.1 0.0 0.1 0.2
High Rise
0.5 1.0 1.5

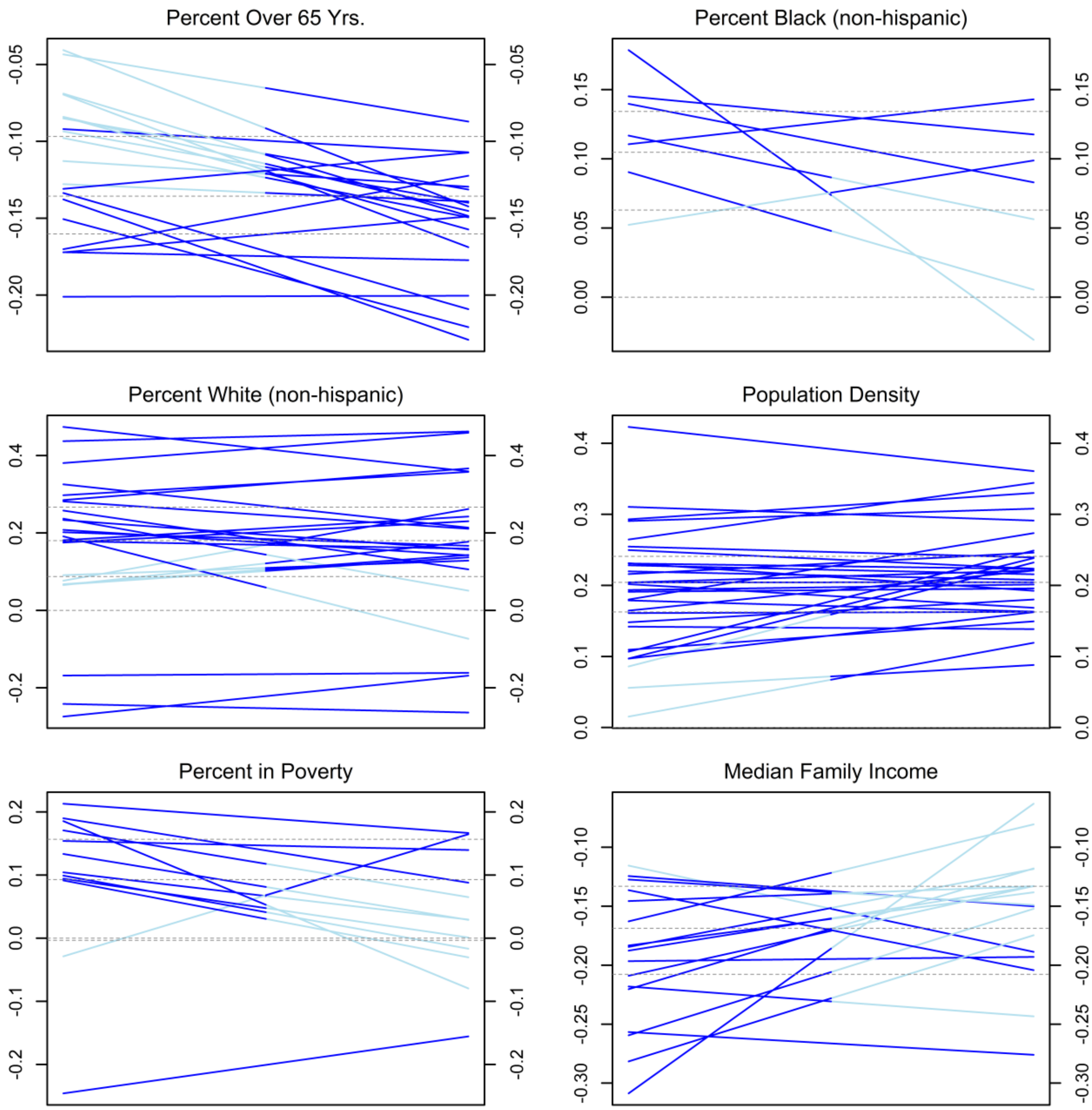

Percent Over 65 Yrs.
-0.05
-0.10
-0.15
-0.20
Percent Black (non-hispanic)
0.15
0.10
0.05
0.00
Percent White (non-hispanic)
0.4
0.2
0.0
-0.2
Population Density
0.4
0.3
0.2
0.1
0.0
Percent in Poverty
0.2
0.1
0.0
-0.1
-0.2
Median Family Income
-0.10
-0.15
-0.20
-0.25
-0.30

FIGURE CAPTIONS

Figure 1: Residential parcels in Long Beach, California based on their proximity to full-service restaurants.

Figure 2: The impact of property-level factors on homes' accessibility to 31 types of neighborhood business establishments, 2006 through 2015. The vertical axes represents that factor's standardized coefficient estimate in a multiple linear regression which measures its contribution to the inverse-distance weighted measure of accessibility (see Table 3 and Appendix B). The left-hand axis represents 2006 and the right-hand axis represents 2015. Establishment types are omitted if the factor is not statistically significant in both years. If a factor is only significant in one year, the insignificant year is colored a lighter shade of blue, e.g. a factor that became significant only in 2015 would be light blue on the left-hand side and dark blue on the right-hand side.

Figure 3: The impact of neighborhood-level factors on homes' accessibility to 31 types of neighborhood business establishments, 2006 through 2015. The vertical axes represents that factor's standardized coefficient estimate in a multiple linear regression which measures its contribution to the inverse-distance weighted measure of accessibility (see Table 3 and Appendix B). The left-hand axis represents 2006 and the right-hand axis represents 2015. Establishment types are omitted if the factor is not statistically significant ($p<0.05$) in both years. If a factor is only significant in one year, the insignificant year is colored a lighter shade of blue, e.g. a factor that became significant only in 2015 would be light blue on the left-hand side and dark blue on the right-hand side.

[i] A thorough discussion of Proposition 13's impact on local public finance and zoning decisions can be found in (Fischel, 2001). Following the so-called "Taxpayer's Revolt" of the mid-1970s, California passed Proposition 13 in

a voter referendum. As of 1975, county tax assessors statewide were only permitted to reassess properties at market value if a property was sold. Otherwise, assessment increases were capped at 2% per year or the level of inflation, whichever was lower (Prang, 2015). The result is that similar properties can have very different assessed values, especially since Proposition 13 incentivizes long-term ownership. Since this paper relies on assessed values rather than home sales as a measure of fair market value (FMV), assessed values were adjusted by back-calculating the effects of Proposition 13. Using the Federal Housing Finance Agency's index for home price appreciation in the Los Angeles-Long Beach-Glendale metropolitan area, we estimated the appreciation expected of homes since their last tax assessment year based on region-wide trends (FHFA, 2016). Removing the Proposition 13-based appreciation formula of 2% per year or the level of inflation (whichever is lower in a given year) yields an estimate of fair-market value for properties that have not been reassessed since their last sale. The synthetic nature of Proposition 13-based home values is also reflected in their poor correlation with block group-level median family income (-0.06 in 2006 and 0.04 in 2015).

[ii] Since establishment data is most recently available in 2014 while parcel data first becomes available in 2006, establishments in 2005 are related to 2006 parcels, while 2014 establishments are related to 2015 parcels

[iii] This study does not consider potential nonlinear effects – for example, buildings developed during certain periods may have unique characteristics that are not reflected in a single, continuous measure of building age (Kane, Connors, & Galletti, 2014).