The Review *of* Economics *and* Statistics

VOL. CI JULY 2019 NUMBER 3

VESTIGES OF TRANSIT: URBAN PERSISTENCE AT A MICROSCALE

Leah Brooks and Byron Lutz*

Abstract—We document intracity spatial persistence and its causes. Streetcars dominated urban transit in Los Angeles County from the 1890s to the early 1910s, and were off the road entirely by 1963. However, we find that streetcars' influence remains readily visible in the current pattern of urban density and that this influence has not dissipated in the sixty years since the streetcar's removal. We examine land use regulation as both a consequence of streetcars and a mechanism for the persistent effect of streetcars. Our evidence suggests that the streetcar influences modern behavior through the mutually reinforcing pathways of regulation and agglomerative clustering.

I. Introduction

HOW persistent is the past? If the past is persistent, why? And what does a persistent past mean for economic outcomes today? Across many domains, researchers show that century- and decade-old decisions determine modern economic outcomes.[1] Spatial persistence is particularly well documented. Bleakley and Lin (2011a) document that cities that formed at canoe portage sites persist long after portage's obsolescence.[2] Such persistence is not limited to cities and regions (as in Davis & Weinstein, 2002) but appears within them as well (Rosenthal & Ross, 2015). For example, neighborhoods near natural amenities are more likely to be persistently high income over time (Lee & Lin, 2018). Intraurban persistence is economically meaningful because the highly local distribution of individuals and firms is a key input into economic activity and growth (Glaeser, Kolko, & Saiz, 2001; Arzaghi & Henderson, 2008; Rosenthal & Strange, 2003, 2001, 2004).

We evaluate the existence and strength of intraurban persistence by assessing whether long-extinct Los Angeles streetcars continue to influence modern land use decisions, and if so, why. We complement the existing literature on within-city persistence by examining the long-run impact of a very high-value amenity, the streetcar, that becomes entirely obsolete. By doing so, we illuminate mechanisms that may yield persistence even in the absence of the initial cause. Most notable, and novel in the literature, we explore land use regulation as both a consequence of the streetcars and as a mechanism for their persistent effect.[3]

Received for publication August 17, 2016. Revision accepted for publication April 20, 2018. Editor: Amit K. Khandelwal.

*Brooks: George Washington University; Lutz: Federal Reserve Board of Governors.

We are very appreciative of the many research assistants who worked on this project. Our historical mapping research assistant (RA), Jordan Hale, did stupendous work digitizing streetcar maps. At the Federal Reserve Board, Jeff Groesbeck, Gage Love, and Jessica Zehel worked on the digitization of major roads in the 1930s, Jessica Hayes helped with the historical Census data, and Jack Popper collected transit ridership. Jessica Zehel had a particularly clever idea for displaying density, for which we are very appreciative. Lena Yemelyanov and Dharani Ranganathan did yeoman's work in the digitization of the 1922 zoning map. We are grateful to librarians and staff at the LA City Public Library, the Dorothy Peyton Gray Transportation Library, the Huntington Library, and the City of Los Angeles Department of Planning for the historical sources on which our work is based. Federal Reserve Board RAs Paul Eliason, Waldo Ojeda, Shoshana Schwartz, and Jessica Zehel labored over our codification of zoning. University of Toronto RAs Rita Barua, Liz Kagedan, Tatyana Leykekhman, Erin Mitchell, and Evgueni Sapojnikov also worked on the codification of the zoning; their work was made possible in part by the Lincoln Institute of Land Policy, to which we are very grateful. We thank conference participants at the All-UC Economic History Conference, AREUEA Annual, Mid-Year and International Conferences, Barcelona Institute of Economics Urban Economics Conference, Lincoln Institute Urban Economics and Public Finance Conference, NARSC Annual Meeting, the NBER Summer Institute (Real Estate and History Sessions), and the UCLA Alumni Conference, including discussants Gabriel Ahlfeldt, Leah Boustan, Gilles Duranton, Stephen Redding, Albert Saiz, Jon Sonstelie, Daniel Strum, and Coretin Trevien. Finally, we thank seminar participants at Drexel University, the Federal Reserve Board, George Washington, George Mason, Georgetown, NYU, University of Illinois, University of Illinois–Chicago, and University of Pittsburgh/Carnegie Mellon. The analysis and conclusions set forth are our own and do not indicate concurrence by the board of governors of the Federal Reserve.

A supplemental appendix is available online at http://www.mitpressjournals.org/doi/suppl/10.1162/rest_a_00817.

[1]See the seminal work of Davis and Weinstein (2002) and Nunn (2014) for a thorough overview.

[2]See also Redding, Sturm, and Wolf (2011), Miguel and Roland (2011), Hanlon (2017), and Michaels and Rauch (2018).

[3]The approach of examining persistence due to an obsolete amenity follows the influential work of Bleakley and Lin (2011a) focused on across-city persistence. Although this type of macrolevel persistence has been documented in several settings, it is not obvious that the causes of macroscale persistence will also be in play at our substantially more microscale. Two contemporaneous working papers, like this paper, also examine within-city persistence due to obsolete amenities. Villarreal (2014) shows that properties near Manhattan's long-ago odiferous swamps remain lower-valued today, and Ambrus, Field, and Gonzalez (2015) provide evidence that a nineteenth-century cholera outbreak in London affects contemporary real estate prices. However, both papers focus on preferences related to neighborhood income as the mechanism for persistence, whereas we focus on a novel institutional explanation, zoning, and also explore agglomerative forces affecting both residential and commercial uses. Turning to the more general literature on within-city persistence, Rosenthal and Ross (2015) note that many locations exhibit extreme persistence in economic status. Although Rosenthal (2008) emphasizes mean revision in neighborhood income over time, the results can also be viewed as providing evidence of moderate neighborhood income persistence. Additional papers on intracity persistence include Hornbeck and Keniston (2014), Ahlfeldt et al. (2015), and Redfearn (2009).

The Review of Economics and Statistics, July 2019, 101(3): 385–399

doi:10.1162/rest_a_00817

Streetcars were built between 1890 and 1910 in many cities around the world. We focus on Los Angeles County, which had the world's most extensive system and where streetcars were particularly influential due to the coincidence of their technological dominance and the initial era of extremely rapid population growth (Crump, 1962). Due to the rise of alternative technologies, streetcar ridership was in decline by the late 1910s, buses began replacing streetcar routes in the 1920s, and the very last Los Angeles streetcar ran in 1963.

To examine whether these vestiges of transit affect the modern city, we present a simple theoretical framework. The framework predicts that in streetcars' heyday, when areas near streetcars had faster and cheaper access to the central business district, streetcar areas are denser. After streetcars are replaced by the speed and convenience of the car, and assuming that urban congestion imposes costs on workers and residents, the framework predicts that density near streetcars should converge to that of nearby locations that are otherwise identical save for the presence of the defunct streetcar stop.

We test this convergence hypothesis using digitized historical maps and data on the 2.3 million properties in Los Angeles County. Despite the fact that streetcars have been gone entirely for over fifty years, and replaced as a primary means of transit for much longer, we document that the streetcar's imprint remains readily visible in day Los Angeles today. Areas near streetcar stops are substantially denser now in both people and buildings than areas farther from the extinct streetcar.

While this correlation is compelling, such an unconditional relationship between distance to the streetcar and density could easily be driven by features that determine both historic streetcar location and modern density. To explore this possibility, we use a more structured empirical strategy. We compare parcels in a small circle (0.5 km radius) around the stop, the treatment area, to parcels in an equal-sized concentric ring, the control area. This method nets out many features common to parcels in both the treated and control areas and finds that areas close to the streetcar are denser than control areas. Further, these results hold even when we restrict the analysis to areas undeveloped before the streetcar's arrival, where we can be sure that no preexisting features determine later outcomes. Thus, we decisively reject the prediction that the density near streetcars converges to the average density in the poststreetcar era.

Given this rejection of the convergence prediction, we explore several mechanisms to explain persistence, marshaling a wealth of additional data on building age, proximity to modern and historic public investments, and property-level land use regulation, both historic and modern, to do so. In particular, our granular data on property-level zoning, combining modern and historic attributes, are new to the literature.[4]

We first assess whether density near the streetcar is due to lingering initial investments in private and public durable capital that are not yet sufficiently depreciated for replacement.[5] We find that structures built in the poststreetcar era are constructed as relatively densely as were the streetcar-era structures, ruling out legacy capital as the exclusive explanation for persistent density at streetcars. If private investments are not the key explanation, perhaps streetcar-era investments in long-lived public infrastructure yield persistent density. For instance, roads placed alongside streetcars could anchor modern density. We find that public infrastructure accounts for at most 10% of modern density near streetcars. Thus, the historical persistence we document is only partially explained by persistent, durable private and public investments.

We next explore the parallel hypotheses that the public sector coordinates the density at the streetcar stops through land use regulation and that the private market coordinates the density in response to agglomerative forces. We first examine land use regulation, specifically zoning.[6] Zoning regulates the permissible density on individual parcels of land. Our data show that modern zoning allows more density near the streetcar. In addition, controlling for zoning eliminates the density premium associated with streetcar proximity. This would be a trivial result if density were strictly binding in all cases; it is not. These findings are consistent with zoning causing persistent density around the streetcars.

How do we interpret this role of modern zoning? Modern zoning could be a result of changes in the zoning code over the past century or merely an ossification of the initial zoning designation. We use our digitization of Los Angeles's initial 1922 zone code, adopted just after the streetcars' heyday, to discriminate between these explanations. While we find that the 1922 zoning initially ratified the density pattern laid out by the streetcar, we also find that controls for 1922 zoning do not erase the modern density premium to streetcar proximity. Moreover, changes to the zoning code in the nearly one hundred years since its introduction have allowed greater density near the defunct streetcar stops than elsewhere. Thus, our evidence strongly suggests that zoning changed over the century so as to accommodate the modern density near the streetcar.

We conclude by assessing whether private market forces also coordinate density at the streetcar. In the presence of

[4] Gyourko and Molloy (2015) note that data on land use regulation are quite limited and that parcel-level panel data like ours are virtually nonexistent. The only other use of historic, geographically fine-grained zoning data of which we are aware include Shertzer, Twinam, and Walsh (2016), which examines the influence of initial zoning on modern land use category in Chicago. Unlike our focus on persistence, Shertzer et al. (2016) examine the role of historic zoning in inducing changes in land use over time. McMillen and McDonald (2002) explore the effect of the introduction of zoning on historic land values in Chicago.

[5] Recent work suggests that durable private capital inhibits cities' ability to adapt to economic changes (Hornbeck & Keniston, 2014; Glaeser & Gyourko, 2005; Siodla, 2015).

[6] Land use regulation is of significant interest to economists because it has been viewed as both a value-destroying restraint on trade (Turner, Haughwout, & van der Klaauw, 2014; Glaeser, Gyourko, & Saks, 2005) and a welfare-enhancing regulation, solving problems of collective action and externalities in the location of economic activity (Lucas & Rossi-Hansberg, 2002; Rossi-Hansberg, Sarte, & Owens, 2010; McMillen & McDonald, 2002). Fischel (2005) argues that in the absence of a market for home value insurance, zoning serves as a de facto substitute. Modern land use regulation in Los Angeles is widely considered to be among the most stringent in the United States (Glaeser et al., 2005; Saiz, 2010).

increasing returns to density, the historical accident of the streetcar stops may help resolve a multiple equilibria environment by selecting locations for density to form. Such agglomerative forces should be particularly important for nonresidential land uses, as intracity density can generate substantial positive externalities in the production of both tradable goods and services (Arzaghi & Henderson, 2008; Rosenthal & Strange, 2003) and local consumer amenities such as retail and restaurants (Glaeser et al., 2001). Consistent with this, we find that land near the streetcar is substantially more likely to be in nonresidential use than other land and, furthermore, that nonresidential properties are more spatially concentrated near the streetcar.

Overall, we believe the evidence suggests that both public forces (zoning) and private forces (agglomeration) coordinate density at the defunct streetcar. However, strictly parsing the relative contributions of these two channels is extremely difficult in our setting, and our evidence is insufficient to do so. Our best reading of this suggestive evidence is that these channels are mutually reinforcing.

In addition to furthering our understanding of historical persistence and the mechanisms behind it, our findings also contribute to the very limited empirical literature on the determinants of land use regulation (Saks, 2008; Hilber & Robert-Nicoud, 2013). As a growing body of work argues that land use regulation reduces housing affordability and restrains economic growth (e.g., Glaeser et al., 2005; Ganong & Shoag, 2017; Hsieh & Moretti, 2017), understanding the causes and determinants of land use regulation is of significant interest.

In the next section, we describe the historical development of streetcars in Los Angeles. Section III outlines a theoretical framework with which to interpret the empirical results, and section IV describes our data. Section V documents the correlation between modern density and the distance to the streetcar. Section VI tests whether this correlation is explained by features that pre- or postdate the streetcar and whether it is driven by old structures. Section VII explores the zoning and agglomeration hypotheses. Section VIII concludes.

II. Historical Context

We begin by discussing five key facts about Los Angeles in the era of streetcar development. First, Los Angeles was relatively unpopulated before the arrival of the streetcar. Second, the streetcar was the dominant mode of transit in its heyday. Third, the interurban rail was developed in a way that makes it particularly useful for analysis: built largely to unpopulated areas and in a manner not overly concerned with direct profitability. Fourth, the system was in decline as early as the late 1910s. Fifth, land use regulation postdates streetcar investment.

Before the arrival of streetcars, the population in the Los Angeles basin was quite small. Appendix figure 1a presents the populations of the city and county from 1890 to 1950. At the dawn of the streetcar era in 1890, the city of Los Angeles had a population of about 50,000, and the county 100,000. As the streetcars multiplied, so did Angelenos. By 1930, at the close of the streetcar era, the city had grown over twenty times to 1.2 million inhabitants; the county grew at roughly the same proportional pace to 2.2 million people.

From the 1890s to the late 1910s, as the Los Angeles area population blossomed, the streetcar was the dominant mode of urban transit and played a key role in determining land use patterns. Electric streetcars were first successfully employed in Richmond, Virginia, in 1888. Relative to their immediate predecessors—horsecars, cable cars, and human locomotion—they were a quantum leap forward in speed and cost.[7] As cities grew, streetcars created a land use pattern that mirrored their delivery of speed.[8] It was well understood that proximity to the streetcar raised value. Advertising commonly highlighted proximity to the streetcar, as in "all lots [are] within 600 feet of the new car line" (Post, 1989, p. 22; Fogleson, 1967, p. 87; Jackson, 1985). It was not until the early 1920s that contemporaries began to acknowledge the threat that auto and bus posed to urban passenger rail (Hilton & Due, 1960).

Los Angeles had two distinct types of urban rail. The Los Angeles Railway, known as the "yellow cars," provided service in the downtown core and surrounding neighborhoods. The yellow cars had no discrete stops: "Up to the advent of the automobile [the cars] stopped anywhere for a lady; in the middle of the block, in the intersection of streets, as well as at corners. . . . The active man seldom stopped the car to board it, or to get off" (Cowan, 1971, p. 2). The Pacific Electric, known as "red cars," provided interurban service, similar in some locations to a urban system and in other locations to "a suburban electrified main-line service" (Hilton & Due, 1960, p. 406). At its peak of 1,164 miles, the Pacific Electric—just the interurban half of the Los Angeles rail network—was "the largest electric railway in the world" and constituted roughly 5% of the total track in the entire country (Crump, 1962; Post, 1989; Fischel, 2004). Unlike the yellow cars, the Pacific Electric had discrete stops for entry and exit.

The Pacific Electric was built largely to unoccupied areas and in a pattern not necessarily directly concerned with rail profitability. These features make it, from an empirical standpoint, a useful case to analyze. In particular, that the system was built largely to unoccupied areas makes it easier to pinpoint the red cars as a causal mechanism for development. In their comprehensive history of interurban railroads, Hilton and Due (1960, p. 407) write, "No other area of the country ever had such an intensive network of lines built largely

[7] Motorized public transit in Los Angeles County actually began in 1885 with the cable car, which was propelled by gripping and ungripping a continuously moving underground cable (Walker, 2007, p. 7). The cost of the cable and the construction necessary to lay it made cable cars very capital intensive to build. The cars could climb steep grades, but they ran at a maximum speed of roughly eight miles per hour (Post, 1989, p. 96). Before the cable car was the horsecar, a train pulled along a train-like track by a horse. Horsecars were even slower, less reliable, and subject to stoppage due to equine infection.

[8] Gin and Sonstelie (1992) and Fischel (2004) describe the spatial income pattern this speed delivers.

ahead of the growth of population." This pattern of development was made possible by the fact that the system was built largely by Henry E. Huntington, the nephew of one of the great railroad robber barons, the inheritor of the bulk of his uncle's fortune, and a railroad financier in his own right. About his investment strategy, he wrote, "It would never do for an electric line to wait until the demand for it came. It must anticipate the growth of communities and be there when the builders arrive—or they may very likely never arrive at all, but go to some other section already provided with arteries of traffic" (Friedricks, 1992, p. 7). Huntington took his own advice in developing what is now known as Huntington Beach. The Pacific Electric's terminus in this city anticipated the development of what remains the modern downtown.

Huntington turned his attention to urban rail in Los Angeles when personal disputes prevented him from ascending to the presidency of his uncle's railway (the Southern Pacific). Huntington's deep pockets and business acumen yielded two anomalous conditions for development. First, Huntington's large personal fortune made him less dependent on the demands of the capital markets than other investors and better able to build to suit his personal tastes. Second, he controlled three tightly interwoven companies. In addition to the rail assets of the Los Angeles Railway and the Pacific Electric, he owned a land development company (Huntington Land and Improvement) and a power company (Pacific Light and Power Company). From Huntington's perspective, it was sufficient to maximize profits across these three enterprises. The location of the streetcar lines should therefore be responsive to Huntington's total portfolio rather than to specific interurban profitability (Friedricks, 1992). In fact, the Pacific Electric was almost never profitable, whereas the Los Angeles Railway (also Huntington controlled, but only after its major development) was profitable for much longer (Friedricks, 1992).

Streetcars were in decline as the dominant mode of transit at least as early as the late 1910s. Streetcar construction peaked nationally in 1906 (Fischel, 2004). Appendix figure 1b shows ridership on the Pacific Electric (in red) and the Los Angeles Railway (in yellow) between 1910 and 1940. In Los Angeles, rides per capita were surely declining by 1920—in an era of great population growth—and possibly even earlier. As early as 1922, Los Angeles Railway was using "motor coaches" (buses) for new routes (Walker, 2007). By the late 1920s, new lines were exclusively bus and not streetcar (Post, 1989), and riders were abandoning urban rail for the automobile (Walker, 2007).[9] The final streetcar trip in Los Angeles took place in 1963, though the vast majority of the system had been already been dismantled. Thus, streetcars were both dominant and short-lived.

[9]Interestingly, an earlier challenge was posed to the streetcar system by buses know as jitneys in 1914. The city responded with a 1917 ordinance banning the jitneys from the downtown core, and they ceased to compete (Walker, 2007).

Finally, it is important to note that the institutions of land use regulation postdate the introduction of streetcars. Fischel (2004) defines modern zoning as the restriction of uses or building on all land rather than an ad hoc approach for industries or structures.[10] Defined in this way, zoning arrived in Los Angeles in 1922, when the city delineated five zoning districts: single family, multifamily, commercial, limited industrial, and unlimited (Whittemore, 2010).[11] Zoning generally, and in Los Angeles specifically, grandfathers in old uses and structures.[12] Therefore, initial zoning reflects contemporary land use and not vice versa.[13]

III. Theoretical Framework

With this historical background in mind, we now present a set of simple theoretical conditions to establish two hypotheses to frame the empirical work. First, areas near streetcar stops should be denser than other comparable locations in the streetcar era, as suggested by the historical record. Second, density at the streetcar stops should converge with density elsewhere in the poststreetcar era. Finally, we establish conditions under which density in the poststreetcar era does not converge to that elsewhere in the city.

A. Streetcar and Auto Eras

We focus on residential location choice among a population of identical individuals. We consider two locations, l, one with access to a streetcar stop, S, and one without access, NS (for "no streetcar"). We examine two eras: the streetcar era and the poststreetcar era. We make four assumptions:

1. Locations l have two characteristics: population density, D_l, and commuting costs, C_l.
2. In the streetcar era, commuting costs are lower near the streetcar, or $C_S < C_{NS}$. In the poststreetcar era, commuting costs equalize across the two locations, or $C_S = C_{NS}$.
3. Utility at location l, $U_l(D_l, C_l; .)$, is strictly decreasing in both D_l and C_l.

[10]Historians date zoning to the late 1800s in Germany and the passage of a zoning law in Frankfurt in 1891 (Burgess, 1994).

[11]At the end of the first decade of the 1900s, Los Angeles was a patchwork of districts outlawing specific industries, such as brickyards or horse and mule keeping (Whittemore, 2010).

[12]With the exception of a minimum lot width and a limit of one family per lot, in both the single-family zone, density and bulk were not regulated (Whittemore, 2010). McMillen and McDonald (1999) document that the initial zoning code in Chicago grandfathered in old uses and structures.

[13]The historical record suggests the waning of the streetcar era sparked the introduction of zoning in Los Angeles. Fischel (2004) argues that zoning was actually unnecessary until after the decline of the streetcar. Streetcars yielded homogeneous suburbs without the necessity of zoning. They kept out noxious commercial uses, as producers would have been hard put to transport inputs and finished goods via the streetcar in and out of outlying neighborhoods. Fischel (2004) blames the truck, which "liberated heavy industry from close proximity of downtown railroad stations and docks," thereby threatening residential areas. Buses, with their flexible routes, posed a later, similar threat to higher-income areas by lower-income interlopers.

4. In equilibrium, utility is equalized across locations at a reservation level of U^*.

The first assumption delineates our area of focus: we are interested in the relationship between density and commuting costs. The second condition makes the noncontroversial assumption that commuting costs, equivalent to forgone leisure, are lower near streetcar stops in the streetcar era. In the auto era, however, location near a streetcar node conveys no commuting cost advantage. The third condition states that returns to density are strictly decreasing: as density increases, the disutility of density rises more rapidly than does the utility gain from positive density amenities. Positive density amenities may include a greater variety of shops or longer store hours, while the disutility from density may reflect noise and crowding. Finally, the fourth condition requires that in spatial equilibrium, individuals are indifferent across locations l.

As commuting costs are lower at location S in the streetcar era, locational equilibrium requires greater density near streetcars, or $D_S > D_{NS}$. Intuitively, when the streetcar is introduced, individuals move to location S in order to obtain utility above U^*—increasing density at S—until the additional disutility of density exactly offsets the utility gain from lower commuting costs. After the arrival of the auto, commuting costs converge, and locational equilibrium requires that density equalize across locations ($D_S = D_{NS}$). The first half of the empirical work in this paper is devoted to testing exactly this hypothesis. Specifically, we test the hypothesis that in the poststreetcar era, the density of an area near a stop should converge to the density of nearby locations that are otherwise identical save for the presence of the defunct streetcar stop.[14]

B. *Causes of Reconvergence Failure*

We now turn to five explanations for why density may fail to reconverge after the streetcar's obsolescence: persistent locational amenities, follow-on public investment, the persistence of initial durable capital, and the parallel coordination mechanisms of increasing returns to density and land use regulation.

First, streetcar stops may fail to equalize in density with other areas because the stops were built in locations with persistently valuable amenities, such as proximity to natural amenities (e.g., the coast) or access to roads that predated the streetcar. Such persistent amenities could alone cause persistent density near streetcars. In terms of our framework, this is a failure of the first condition, in that locations may have important characteristics other than density and commuting costs. Our empirical work aims to rule out this possibility.

Alternatively, density could persist near the streetcar because the streetcar yields follow-on public investment in roads and other forms of public transit, and it is this later investment, rather than the streetcar, that causes density to persist. This would violate the third condition, since commuting costs would not equalize in the auto era ($C_S \neq C_{NS}$). We take this possibility seriously and aim to bound its magnitude in our empirical work.

Third, density may persist near streetcars because the initial commuting advantage motivated the construction of large, dense structures that still exist (Brueckner, 1980a, 1980b). This is analogous to the hypothesis that urban decline is not a mirror image of urban growth due to the presence of durable capital in declining cities (Glaeser & Gyourko, 2005). In this view, economic fundamentals are consistent with less capital intensive structures, but the time for capital replacement has not yet arrived. Thus, density near streetcar stops will eventually converge to density elsewhere, but the long run in which this occurs has not yet come to pass. If this is true, new structures near defunct streetcars should be substantially less capital intensive than older structures. We test this contention empirically.

A fourth explanation is agglomeration, which our structure frames as the external benefits exerted by residents or firms on one another that increase more rapidly than congestion costs. In other words, the third condition is violated, as for some $0 < D_L < \infty$, $U_l(D_l, C_l; .)$ is weakly increasing in D_l.[15] Were there external benefits, a stable locational equilibrium could exist in which utilities and commuting costs equalize ($U_S = U_{NS}$ and $C_s = C_{NS}$) but density does not ($D_S \neq D_{NS}$). We develop this possibility further in appendix section 12 and look to the data for evidence consistent with agglomerative behavior.

A fifth reason for persistent streetcar density is the presence of land use regulations such as zoning. If zoning follows the pattern of density laid out by the streetcar, is binding, and allows greater density near streetcars than elsewhere, it will impede density equalization ($D_S = D_{NS}$). We turn to historical and contemporary evidence on zoning to provide evidence consistent with this final claim.

IV. Data

Our data consist of four major components: cross-sectional property data, historical streetcar routes, geographically consistent historic census data, and zoning information. The data cover Los Angeles County, which contains 88 incorporated cities and a large unincorporated area. The cross-sectional property data contain information on legally defined pieces of land, or parcels. We observe structure, lot size, and other property information for each of the roughly 2.3 million parcels existing in Los Angeles County from 1999 to 2011.

To document historical streetcar routes, we digitized historical maps showing the red and yellow cars of Los Angeles

[14] While we view this as a reasonable hypothesis, some readers may view a strict reading of the hypothesis as unrealistic. In this case, the hypothesis provides a useful baseline from which to interpret the empirical results.

[15] If returns to density increased over the entire range $0 < D_L < \infty$, all individuals would choose to locate in a single location.

County to approximate the fullest extent of the network.[16] Appendix figure 2 gives a graphical representation of the extent of this work. Los Angeles Railway lines are in the center in yellow; Pacific Electric lines and stops are in red. The rest of the map shows how we placed the lines. The yellow cars are drawn on top of a georeferenced 1914 system map. Behind the system map are georeferenced topographic maps from the 1920s and 1930s. The lowest layer is modern major roads in blue. In addition to the streetcars, we also digitized the network of major roads circa 1925 and 1934. We list the specific maps and documents used in the data appendix.

Any analysis of population density over time must consider consistent geographic units. Were we to use census tract boundaries as defined for each census year, our analysis would be confounded by the fact that the Census defines tract boundaries in part on the basis of population. Therefore, we construct a panel of tract-level data consistent with 1940 Census boundaries, the first year for which census data cover the entire county (the city was first tracted in 1930).[17] Using digital maps from the National Historic Geographic Information Systems Center, we allocate the land area of tracts from 1950 to 2010 to the 1940 borders (due to the demise of the decennial long form, "2010" is the American Community Survey, 2007–2011). We attribute consistent variables to these 1940-boundary tracts.

Our final major data collection is on land use regulation. The first part of this is our analysis of municipal zoning restrictions. Each parcel in each city is associated with a zone code (e.g., R-1 or C-2), and this code is reported in the parcel data. These codes are not consistent across cities in the sense that the restrictions for R-1 in Los Angeles are not the same restrictions for R-1 in the city of Long Beach. Parcels in roughly fifty cities and the unincorporated area (covering approximately 70% of all parcels) have reliable information on zone codes in our cross-sectional parcel data. For those cities, we collected the "meaning" of each code from 2010 municipal documents. Specifically, for each code, we collected maximum units allowed, maximum height allowed, maximum floor area ratio (structure square footage divided by lot square footage) allowed, minimum lot size required, and minimum covered and uncovered parking spots required. Not all cities require all of these elements for all codes. However, missing values in the zone code still contain information: when an element is not limited, behavior is unrestricted.

The second part of our land use regulation data collection is our digitization of a map of the earliest zoning designations in the county: the 1922 City of Los Angeles zone code. Appendix figure 3 shows one page of the 1922 zoning map book. We use GIS techniques to connect 1922 zoning to modern parcels.

To find a measure of distance to the streetcar, we calculate the shortest distance from the center of each parcel to the nearest streetcar. For the Los Angeles Railway, we very closely approximate the shortest distance to the rail line;[18] for the Pacific Electric, we measure distance to the nearest stop.

Appendix table 1 shows that being near a streetcar is not a historical anomaly that affects a small part of the county. The average distance to a Pacific Electric stop is about $6\frac{1}{2}$ kilometers, and about one-fifth of all parcels in the county are within half a kilometer of a Pacific Electric stop. Almost 70% of county parcels are within 3 kilometers of a stop.[19] The Los Angeles Railway lines were not so widespread; the larger standard deviation in this row shows that many parcels are close to the yellow car lines, and many quite far away, for an average of 18 kilometers. The final row of the table presents the measure we will use in many of the figures in the paper: the minimum of the distance to either a yellow line or red car stop; figures in this row are mostly driven by variation in distance to the Pacific Electric stops.

We also calculate the shortest distance from each parcel to modern major roads, major roads circa 1925 and 1934 (from maps we digitized), major road intersections in 1934, modern inter- and intraurban rail, the coast, downtown, and highway entrance or exit.[20]

V. Establishing Persistence

In this section, we illustrate the strong correlation between the distance to the extinct streetcar and 2010 population density. We then demonstrate that this relationship is due to the density of structures rather than the density of people per structure. Finally, we show that the pattern of density near the streetcar has failed to moderate over time.

Figure 1 presents the striking relationship between current density and distance to the now-extinct streetcar. Distance to the streetcar is on the horizontal axis, and population density, measured in thousands of people per square kilometer, is on the vertical axis.[21] The negative relationship between density and distance to the streetcar is clearly visible.

To make a legible figure from the county's 2.3 million parcels, this and all following similar figures present means by distance-to-streetcar bins. We sort parcels by distance to the streetcar and allocate an equal number of parcels into each of 6,000 bins by distance to the streetcar. Each bin has slightly fewer than 400 parcels. This figure presents (as do

[16] "We" here means University of Toronto student Jordan Hale, who did marvelous work digitizing hard-to-read maps.

[17] Unfortunately, finely grained geographic data are either not available or not digitized before 1930. In the prestreetcar era, Los Angeles 1880 Census microdata are no longer available, and the 1890 Census manuscripts burned (leading to the founding of the National Archives).

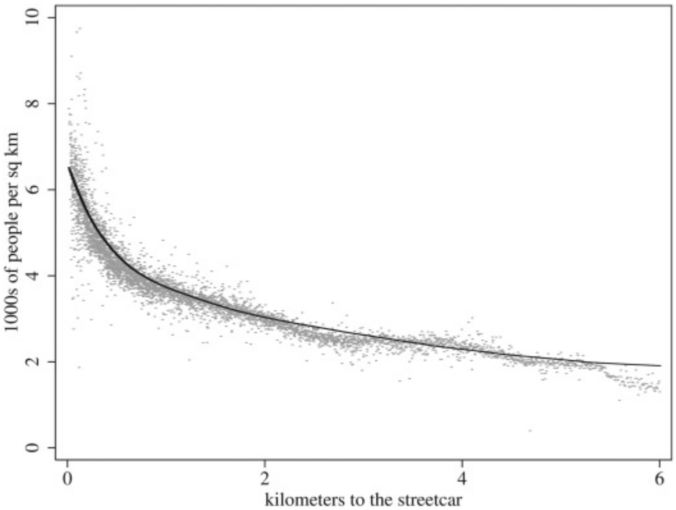
[18] Mechanically, we transform the line into discrete points at a distance of 200 feet and calculate the shortest distance to any one of these points.

[19] Stops are sufficiently close that if we redo this table with distance to the line rather than the stop, the results are quite similar.

[20] For features that are lines, we use the same technique as in note 19.

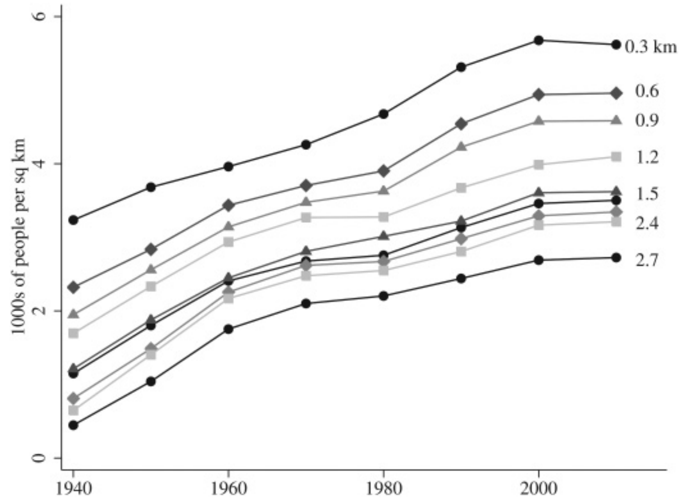
[21] This and all similar figures measure distance to the streetcar as the minimum of a parcel's distance to the Los Angeles Railway line or the Pacific Electric stop (the final row in appendix table 1).

FIGURE 1.—MODERN POPULATION DENSITY STRONGLY RELATED TO STREETCAR LOCATION



The figure shows a pattern of declining 2010 population density with distance to the streetcar. Each point is the average tract density of approximately 400 parcels. The line is a local linear regression estimated with a tricube weight and a bandwidth of 0.3.
Sources: Density information comes come from the 2007–2011 American Community Survey census tract level data, expressed in terms of 1940 census tract boundaries. We calculate distance to the streetcar for each parcel in the county based on our digitization of streetcar maps.

FIGURE 2.—DENSITY SHIFTS UPWARD EVERYWHERE



The figure shows a pattern of declining 2010 population density with distance to the streetcar. Each point is the average tract density of approximately 400 parcels in the horizontal axis year at the marked distance from the streetcar.
Sources: Density information comes come from the 2007–2011 American Community Survey census tract level data, expressed in terms of 1940 census tract boundaries. We calculate distance to the streetcar for each parcel in the county based on our digitization of streetcar maps.

subsequent ones) the mean of the vertical axis variable by bin.[22]

Population density is quite high near the extinct streetcar and tapers off rapidly with distance. By about 2 kilometers from the streetcar, density is less than half of its streetcar location peak. The slope is particularly steep very close to the streetcar.

Are the areas near the streetcar densely populated because they have many housing units or because the housing units are more densely occupied? To explore the source of population density, we note that population density is a function of people per housing unit and housing units per land area: population density $= \left(\frac{\text{people housing}}{\text{units}}\right)\left(\frac{\text{housing units}}{\text{land area}}\right)$. We plot each of these components in 2010 versus distance from the streetcar in appendix figure 4.

Appendix figure 4a shows no negative association—and if anything, a positive one—between people per housing unit and distance to the streetcar. In contrast, appendix figure 4b shows a strong negative relationship between housing units per land area and distance to the streetcar. Comparing figure 1 and appendix figure 4, it is clear that the relationship between population density and the streetcar is driven by the capital intensity of land use, not by greater population per housing unit. This finding motivates our principal focus on structural capital for most of the remainder of the paper.

[22]Density is a feature of census tracts, not parcels (pictures using block group density are virtually identical; we use tract density to make historically consistent pictures). Instead of reporting the mean population density by distance to the streetcar, we could have reported the mean distance to the streetcar by Census tract. We prefer to aggregate by distance to the streetcar, since it preserves the most variation in the key variable of interest.

Finally, we consider how the relationship between streetcars and density has evolved over time using decennial census data from 1940 to 2010. In other words, we consider whether what we show is truly persistent, or merely a muted echo of the past. Figure 2 summarizes the streetcar gradient over time. The top line in figure 2 plots the density by decade at a distance of 0.3 kilometer from the streetcar by decade from 1940 to 2010. Each subsequent line traces out the density at an additional 0.3 kilometer from the streetcar (so the second line is 0.6 km, the third 0.9 km, and so on).

This comparison yields two findings. First, in all decades, areas closer to the streetcar are more densely populated than areas far from the streetcar. Second, over time, density increases at all locations within the 3 kilometer radius of streetcar stops (recall that such locations account for 70% of county parcels). Stated differently, as the county became denser at all locations, the greater relative density near the streetcar was preserved. Using the data in figure 2, we cannot reject that the slopes of all lines in the figure are equal or that density increases equally over time at all distances from the streetcar. Data allow us to go back one decade further for the city of Los Angeles only (see appendix figure 5), and the pattern for these data are very similar to what we see in figure 1.

VI. Structured Analysis of Streetcar Influence on Modern Density

The previous section shows that distance to the extinct streetcar is strongly associated with higher density. In this section, we adopt a more structured empirical strategy in order to rule out several possible explanations for the density near the streetcars, including natural amenities, durable private capital, and modern transportation capital such as roads.

A. Empirical Strategy

While the pattern in figure 1 strongly suggests a relationship between extinct streetcars and modern population density, this relationship could simply be due to a correlation between prestreetcar factors and streetcar location rather than the effect of streetcars themselves. For example, streetcars may have been laid out near major roads, and these major roads, not the streetcars, drive the pattern we document. We view these preexisting factors as an econometric identification problem, as our theoretical framework assumes that initial density is caused by the streetcar. In contrast, we view subsequent investments generated by streetcars as a potential mechanism for persistent streetcar density. We aim to quantify the importance of such investments.

To isolate streetcars' effect on density, we draw a circle around each red car stop—the dark-shaded region in appendix figure 6. We compare the density within this circle to the ring surrounding the circle—the lightly shaded region in the figure. We call the circle the "treatment" area and the ring the "control." Our goal in this comparison is to hold most features that define the locational amenities of a small neighborhood—its location in the city, its distance to parks and businesses—constant and isolate the effect of the streetcar stop. We set the radius of the control ring—the distance from the streetcar stop to the outer edge of the control area—so that the treatment circle and control ring have equal areas. Thus, the strategy compares the area immediately surrounding a streetcar stop to the closest possible area of the same size.[23] Importantly, major roads running through the treatment area will almost always pass through the control region.

We implement this procedure by estimating

$$outcome_{is} = \gamma_0 + \gamma_1 Treatment\ Circle_{is} + \delta_s + \gamma_2 P_{is} + \gamma_3 D_{is} + \epsilon_i, \quad (1)$$

where s denotes the nearest streetcar stop to parcel i. Our sample is limited to parcels in the treatment circle or control ring: we drop parcels in the gray area in appendix figure 6. The variable $Treatment\ Circle_{is}$ is an indicator variable equal to 1 if parcel i is located within the treatment circle s. The omitted category is the control ring. The fixed effect δ_s is specific to each streetcar stop and controls for differences across streetcar stop areas s. The coefficient γ_1 therefore measures the mean difference in $outcome_{is}$ between the treatment and control regions.

We control for a robust set of parcel-specific distances to amenities. The vector P_{is} is streetcar predecessors—locational features that predate the arrival of the streetcar. We include ruggedness of terrain, and cubics in elevation, distance to the coast, distance to downtown, distance to a major road in 1925, and distance to a major intersection in 1934. We include elevation and ruggedness to control for the possibility that streetcar lines were laid out to avoid significant changes in elevation and to control for any amenities, such as views, that are conveyed by elevation.[24]

We include distance to a 1925 major road to increase the odds that we isolate the historical influence of streetcar stops from the historical influence of major roads, which may independently affect both historical and modern density. Ideally, we would control for the road network circa 1890, since using 1925 roads likely controls for roads that were themselves determined by streetcar routes. Unfortunately, road maps as we now know them—with sufficient detail to locate major roads—are available only starting in the 1910s (Ristow, 1946; Redmill, 1932).[25] We also control for the distance to the nearest 1934 major intersection in case the intersection, rather than the road, is the key determinant of density. Thus, we believe these variables "overcontrol" for preexisting roads and therefore yield lower bound estimates on streetcars' persistent effects.

The vector $D_{i,s}$ contains follow-on public capital, or streetcar descendants—variables that postdate the streetcar and could plausibly be streetcar caused and themselves cause persistence. The vector consists of cubics in distance to a modern major road, distance to a Metro rail line, distance to a Metrolink line, and distance to a highway entrance.[26] This vector includes the key elements of the modern transit system, all of which may have roots in the system initially defined by streetcars.

We weight parcel observations by lot size, normalized so that weights within each streetcar stop treatment area and each streetcar stop control area sum to 1. As a result of the normalization, we can interpret each streetcar stop as a separate "experiment" contributing equal weight to the estimation of γ_1. We cluster standard errors by streetcar stop s. Finally, we limit our sample to stops where both the treatment and control rings have at least ten parcels to ensure a sufficiently large sample for analysis.

This strategy focuses solely on red car stops. Yellow car lines did not have stops and are therefore not amenable to the circle estimation strategy, which requires a focal point (the stop). As appendix figure 2 shows, the yellow cars operated very densely in the historic downtown. Because of this location pattern, our strategy might also struggle to distinguish between the effects of the downtown location and the yellow cars. It is also possible that the existence of nearby intraurban

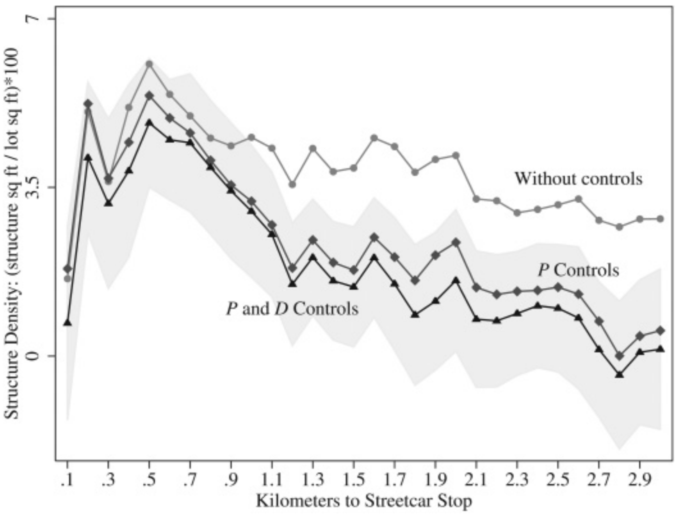
[23] The control radius equalizes the two areas in theory, setting $\pi r_t^2 = \pi r_c^2 - \pi r_t^2$, where r_t and r_c are the treatment and control radii, respectively. In practice, though, not all of the treatment and control areas contain equal areas. For instance, roads are not part of the sample. Moreover, streetcar stops that are closer together than 0.7 kilometer will have truncated control (and possibly treatment) regions as we assign each parcel to its closest streetcar stop.

[24] Historically, streetcars need not have been laid out to avoid changes in elevation; one of the advantages of streetcars was their ability to traverse steep slopes.

[25] As a sign of streetcars' dominance, builders referred to building a streetcar line as "building a road."

[26] Metro Rail and MetroLink are Los Angeles's modern intra- and interurban rail systems. MetroRail formed in 1990 and MetroLink in 1991.

FIGURE 3.—STREETCAR PROXIMITY RELATED TO GREATER DENSITY



Gray bands are 95% confidence intervals around the "P and D Controls" estimates. Regressions are as described in table 1, using the sample in column 2. Vectors *P* and *D* are described in the note to table 1. Sources: Los Angeles parcel data; streetcar maps.

rail reduced the locational advantage of red car stops. As a result, in most specifications, we omit any red car stops that have a yellow car line running through either the treatment or control area.[27]

The key remaining choice in estimating the model is the radius of the treatment circle (recall that because the treatment circle and control ring are of equal area, this choice also determines the size of the control ring). The historical record tells us that a streetcar stop was valuable only to properties within walking distance. We therefore expect no effect outside a treatment radius of roughly 2 kilometers (1.25 miles). The pattern of results at different radii is also a test of the validity of our approach. If structure density is influenced by distance to the streetcar, estimations using very small radii should have small and insignificant coefficients, because they compare the treated area with what is essentially another treated area. At very large radii, the estimation compares a mix of treated and control areas with control areas and should also yield small and insignificant coefficients. At some "middle" radius that maximizes the difference between treatment and control, the coefficients should be the largest. Theoretically, we expect this middle radius to be within easy walking distance to the streetcar stop. To test this prediction, and hone in on what this middle distance is, we turn to the data and examine the effect at different radii.

B. Results

Figure 3 presents results from estimating equation (1) thirty times, including both P_{is} and D_{is} (pre- and poststreetcar locational variables), and varying the radius of the treatment circle from 0.1 kilometer to 3.0 kilometers (see the red line labeled "P and D Controls"). The outcome variable is a parcel-specific measure of density: structure square feet divided by lot square feet. The radius of the treatment circle is on the horizontal axis, and the estimate of γ_1 is on the vertical axis; the 95% confidence interval is in gray.

The effect of a streetcar stop on density increases rapidly as the treatment circle radius increases from 0.1 to 0.5 kilometer. The effect reaches a maximum at 0.5 kilometer and there is a rough plateau in the effect from 0.5 to 0.7 kilometer. These maxima are at the radii where the mean difference between the treatment and control densities is greatest, conditional on the covariates in equation (1). The effect declines gradually as the treatment circle expands beyond 0.7 kilometer. Around 2 kilometers from the streetcar stop, the density effect is no longer distinguishable from 0. This inverted U shape is consistent with an effect that peaks at a comfortable walking distance from the streetcar and aligns with the historical narrative.

Figure 3 also presents results without controls and with only the P controls. Although the controls do attenuate the results slightly over the first half kilometer or so, the results with and without controls are qualitatively similar in this range. Farther from the stop, the controls become progressively more important. The figure also makes clear that the *D* covariates, which measure follow-on public capital, have a very limited effect on the magnitude of our finding in a relevant range of distance to the streetcar. We leave the interpretation of this result to section VI.C.[28] We turn to controlling for bus stops, which presents data challenges, at the end of this section.

Given that the treatment radius of 0.5 kilometer maximizes the density treatment effect (figure 3), is within the range where the effect is relatively less sensitive to the inclusion of controls, and is well within the plausible walking distance to the stop, we present all remaining results from the circle-ring identification strategy using a treatment circle radius of 0.5 kilometer. Appendix table 2 displays summary statistics for the treatment and control areas defined in this way. For comparison purposes, the first three columns display the same statistics for all county parcels. Columns 4 to 9 compare our outcome variables for the treatment and control areas. Relative to the control area, the treatment region has more dense capital, more valuable capital, is less likely to have residential properties, and is zoned more permissively.

Table 1 presents our main results.[29] Panel A shows unconditional results (equation [1] without *P* or *D*); panel B shows results conditional on predecessor features (*P*), and panel C presents results conditional on both predecessor and descendants (*P* and *D*). Column 1 includes the whole sample; results in column 2 omit streetcar stops with a yellow car

[27] We reproduce figure 1, omitting parcels within 0.1 kilometer of yellow car lines in appendix figure 7; the pattern is very similar to figure 1's original relationship.

[28] To examine the effect of these covariates on the continuous relationship displayed in figure 1, appendix figure 8 presents figure 1 conditional on P_i and D_i. The gradient is attenuated relative figure 1 but still clearly visible.

[29] Results are quantitatively and qualitatively robust to specifying the dependent variable in logs; see appendix table 3.

TABLE 1.—STREETCAR STOP DENSITY EFFECT, 2011

	Dependent Variable Is Structure Density (1)	(2)
A. No covariates		
Treatment Circle$_{i,s}$	5.49	5.72
	(0.76)	(0.65)
Parcels	452,509	405,249
Streetcar stops	1,061	907
B. Controlling for predecessors		
Treatment Circle$_{i,s}$	5.12	5.1
	(0.78)	(0.68)
Parcels	452,509	405,249
Streetcar stops	1,061	907
C. Controlling for predecessors and descendants		
Treatment Circle$_{i,s}$	4.34	4.52
	(0.77)	(0.66)
Parcels	452,509	405,249
Streetcar stops	1,061	907
Streetcar stop fixed effects	X	X
Stops near LA railway Excluded		X

Standard errors clustered by streetcar stop in parentheses. Structure density is (structure square feet/lot square footage) × 100. The unit of observation is the 2011 parcel. All estimates are weighted by lot size, normalized such that each streetcar treatment and control area has a total weight of 1. Each column contains the largest possible consistent sample. Column 2 omits any streetcar stops that have a yellow car route in either the treatment or control area. The sample is parcels within 0.7 kilometer of the nearest streetcar stop (the distance at which the treatment area, with radius 0.5 kilometer, is the same size as the control area). We further restrict the sample to streetcar stops where both treatment and control areas have a minimum of ten parcels. "Predecessor" controls are measure of ruggedness of terrain and cubics of elevation, distance to downtown (proxied by Los Angeles City Hall), distance to the coast, distance to a 1925 major road, and distance to a 1934 major intersection. "Descendant" controls are cubics in distance to a modern major road, distance to a Metro rail line, distance to a Metrolink line, and distance to a highway entrance. We set missing values for elevation and ruggedness equal to 0 and include an indicator variable equal to 1 when they are missing.

route in either the treatment or control area (figure 3 uses the specification in column 2).

Comparing estimates including and excluding parcels near yellow car lines (columns 1 to 2), the results are slightly larger when we exclude parcels near yellow car lines. This may be because red car lines exerted a more powerful influence on initial density when they were the only transport option available.

The estimates in column 2, conditional on all covariates, suggest that being near a streetcar stop is associated with an increase in structure density of around 4.5, or about 14% of the control area mean (note that we multiply structure density by 100). The qualitative pattern of the results is consistent across columns: streetcar stops are associated with persistent effects on density. We interpret these results as a firm rejection of the reconvergence hypothesis.

While our primary estimation strategy provides a precise, plausible treatment and control group and yields a single estimated parameter of interest,[30] it requires an arbitrary choice of treatment circle radius and does not report a continuous spatial treatment effect. To address these concerns, we present continuous treatment effect estimates in appendix section 10.

C. Durable Capital and Persistence

One widely cited mechanism for the persistence of the past is the long life of capital, including roads and structures. Following this hypothesis, modern density could be due exclusively to initial investments in durable capital—private structures or public infrastructure—that have not yet depreciated sufficiently to be replaced. When replacement time arrives, the streetcar-motivated density pattern may change.

Considering public infrastructure, we believe that the evidence in favor of the durability of public capital as the exclusive or predominant mechanism for the persistence of density is weak. Figure 3 shows that the addition of poststreetcar era public capital controls has only a small impact on the coefficient. Comparing results conditional on preexisting features to those additionally conditional on poststreetcar transit (panel B to panel C in table 1), modern covariates related to roads and transit explain roughly 10% of the relationship between distance to the streetcar and modern density. We interpret this as evidence that a limited amount of streetcars' persistent effect is due to their influence on the geographic location of later transit. This portion of the persistent density could be due to market access, as in Redding and Sturm (2008). This is certainly not immaterial, yet a large majority of the streetcars' influence remains unexplained.

However, this leaves lingering private capital as a culprit. The first panel of appendix table 4 restricts the sample to parcels with structures built after 1963 (the year the last streetcar was removed) in order to test the hypothesis that the persistent density around the streetcar stops is caused by old, dense structures that have not yet reached time for redevelopment. Column 1 in this table presents results without covariates, column 2 with predecessor controls, and column 3 with predecessor and descendant covariates (as in table 1, panels A–C). Comparing the three estimates in the top panel to those in column 2 of table 1, the differences are small. On average, new structures near streetcars are as relatively dense as all structures near streetcar stops. We interpret this as a rejection of the hypothesis that the density near the streetcars is driven mostly by older structures that have not yet reached redevelopment.

In sum, durable capital alone cannot explain the persistent density near the streetcar. Initial investments in durable capital surely play a role, but they are not sufficient.

We explore and address additional challenges to the validity of the estimates in online appendix 11. Specifically, we more carefully consider whether the preexisting development accounts for density by restricting the estimation sample to areas that were undeveloped prior to the arrival of the streetcar. We also consider the role of density at points of interconnection by using an alternative measure of major intersections, we assess whether density changes are economically meaningful by measuring capital in dollar terms, and we consider the role of modern transit via a control for bus stops. Our results are robust to these modifications.

VII. Public and Private Coordination

In this section, we evaluate evidence on public and private coordination of activity around the obsolete streetcar stops.

[30] Indeed, this approach is "standard" (Diamond & McQuade, 2016).

To fix ideas, consider the streetcar stop in what is now downtown Whittier. The downtown grew up after and around the stop at Greenleaf Avenue and Philadelphia Street. The close-by Whittier College, which existed before the streetcar, grew over the next decades in the direction of the streetcar stop. We consider whether public coordination associated with the evolution and development of land use regulation and market-driven coordination due to agglomerative forces drove this type of development pattern.

A. *Land Use Regulation*

Government can directly coordinate behavior through regulation. In the urban case, the institution of land use regulation constrains structure size, structure height, and many other aspects of land use. In this section, we test whether modern zoning permits greater density near the stop than farther away. We then evaluate whether this modern pattern is an ossification of initial zoning choices or whether institutional change acts to reinforce the density pattern.

We start by verifying a necessary condition for land use regulation to be an explanation for the density near the defunct streetcar stops: zoning near the stops must allow more density. To test this, we use our detailed zoning characteristic data. Appendix table 5 reports whether the underlying attributes of zone codes vary by distance to the streetcar using the circle identification strategy. Parcels within 0.5 kilometer of a streetcar stop are 3 percentage points more likely to be zoned for nonresidential uses than are parcels in the control ring (column 1). This effect is large, equal to almost one-third of the control region dependent variable mean. A nonresidential designation often allows for greater density than does a residential designation.

Similarly, residential locations near a streetcar stop are zoned significantly more permissively in terms of number of units allowed (see columns 2 of appendix table 5). Specifically, parcels near the streetcar allow roughly $2\frac{1}{4}$ more units per parcel than more distant parcels, an increase of nearly 50% relative to the control region dependent variable mean. Parcels within the streetcar circle also allow taller structures, although the size of this effect is modest (see column 3). Finally, relative to the control mean, parcels near streetcars are required to provide about a tenth of a parking spot less (per unit, for residential uses), or 7% of the control area requirement. Anecdotally, urban developers perceive minimum parking requirements to be substantial hindrances to development. Parking spots crowd out structure square footage and (or) increase the cost of a project. In sum, these results reveal that the regulatory environment permits substantially more density near the stops than farther away.

We next explore whether there is a density premium near streetcar stops when we control for parcel-specific zone codes. Panel A of table 2 shows that in a strictly statistical sense, zoning explains almost all of streetcar's relationship to density. Panel A, column 1 replicates our main results for the sample for which we observe detailed zoning information.

TABLE 2.—ZONING STATISTICALLY EXPLAINS THE DENSITY EFFECT

	Dependent Variable Is Structure Density			
	(1)	(2)	(3)	(4)
A. Sample with Modern Zoning Information				
1. Controlling for modern zoning				
Treatment Circle$_{i,s}$	4.74	2.29	1.30	0.76
	(0.69)	(0.55)	(0.50)	(0.47)
Parcels	280,975	246,023	280,975	280,975
Streetcar stops	619	520	619	619
2. Using Post-1963 construction only				
Treatment Circle$_{i,s}$	5.29	3.11	1.42	1.89
	(1.50)	(1.51)	(1.37)	(1.38)
Parcels	72,300	56,459	72,300	72,300
Streetcar stops	375	278	375	375
B. 1922 Zoning Sample				
1. Controlling for modern zoning				
Treatment Circle$_{i,s}$	3.53	0.13	1.08	0.81
	(1.95)	(1.27)	(1.53)	(1.32)
Parcels	33,993	29,125	33,993	33,993
Streetcar stops	113	89	113	113
2. Controlling for 1922 zoning				
Treatment Circle$_{i,s}$	3.53	4.46	1.68	2.53
	(1.95)	(1.79)	(1.86)	(1.73)
Parcels	33,993	32,014	33,990	33,993
Streetcar stops	116	105	116	116
3. Controlling for 2013 zoning in 1922 terms				
Treatment Circle$_{i,s}$	3.53	2.39	2.70	1.89
	(1.95)	(1.65)	(1.73)	(1.51)
Parcels	33,993	32,020	33,990	33,993
Streetcar stops	127	108	127	127
Streetcar stops fixed effects	X	X	X	X
Only parcels with zones in circle and ring		X		
Zone code fixed effects			X	
Streetcar stop × Zone code FE				X

All estimates exclude streetcar stops that have a yellow car route in either the treatment or control area, use a treatment radius of 0.5 kilometer, and control for P and D, as defined in table 1.

Despite the change in sample, the coefficient estimate is very similar to our main result (see table 1, panel C, column 2, 4.5 versus 4.7). Column 2 limits the sample to parcels with zone codes that appear in both the treatment circle and control ring. Although this restriction drops less than 15% of the sample, the magnitude of the coefficient drops by roughly half. This indicates that about half of the density effect is driven by zones exclusive to either the treatment circle or the control ring.

Column 3 tests whether parcels with the same zoning designation have different densities near and far from the streetcar. To do this, we use the full sample from column 1 and add municipality-specific zone code fixed effects (e.g., different fixed effects for Los Angeles R-1 and Pasadena R-1, which may have entirely different restrictions). The streetcar stop coefficient is now one-quarter of its original magnitude and is only marginally significant. The final column controls for streetcar stop–specific zoning fixed effects (i.e., the effect of each zoning designation is allowed to vary by stop). Here we find no difference at all in the density near and far from the streetcar; the streetcar coefficient is equal to around 15% of its initial magnitude and is insignificantly different from 0. Thus, the remainder of the density effect in column 2 is driven by the differential distribution of the same zoning designations in the treatment circle and the ring rather than by different density within zone designations.

Is this pattern driven exclusively by older structures? To test this possibility, the second portion of panel A reports results from performing the previous analysis, but where the sample is limited to parcels with structures built after 1963. These results have roughly the same pattern as the sample of all structures.

In order to interpret the table 2 results, it is important to note that density is not a strict function of the zone codes captured in our data. The claim that zoning is not strictly binding is supported by two pieces of evidence. First, there is substantial variation in density within zoning designations and the zone code distributions have significant overlap (see appendix figure 9). Second, many density gradients with respect to distance to amenities (e.g., the coast) are robust to controlling for the zone codes (results available on request). Were density strictly a function of zone code, the finding that controlling for zoning eliminates the streetcar density premium would be trivial. In contrast, in our setting, where zoning does not strictly bind, we view the result that zoning statistically explains the streetcar density effect as suggestive, but not definitive, evidence that zoning is a mechanism behind the persistent density.

Permissive modern zoning near the streetcar may be due to the ossification of the initial zoning designations. Alternatively, zoning may have modified over the century to perpetuate the streetcar pattern. These are very different institutional routes to greater density near the streetcar. To discriminate between these alternatives, we first evaluate whether initial zoning was motivated by streetcar-driven land use and then assess the extent to which the zoning code has changed over the nearly century since its inception. Finally, we explore initial zoning's ability to explain the modern density pattern around the streetcar.

To do this, we turn to our digitization of the 1922 City of Los Angeles zone code—the county's first zone code. The 1922 code had no limits on size or bulk and only five use categories: single family, multifamily, commercial, manufacturing, and "anything not prohibited by law."[31] Unfortunately, the area of the city zoned in 1922 only partially overlaps with the estimation sample we use in prior estimates. Our previous estimates omitted parcels near yellow cars out of a concern that they could confound the estimation. However, a comparison of columns 1 and 2 in table 1 shows that omitting parcels near yellow cars has only a small effect on the estimated streetcar coefficient.

[31] It was not until the 1950s and 1960s that zoning as we know it today, with more elaborate restrictions on structure size and bulk, became widespread (Longtin, 1999).

In order to obtain a reasonable sample size when using the 1922 data, we include areas near yellow car routes. To avoid the portion of the city built prior to the streetcar era, though, we omit all parcels within 6 kilometers of Los Angeles City Hall as a proxy for downtown. In the prior samples, we omitted these parcels when we excluded parcels near yellow car lines. The first row of table 2, panel B shows that we can roughly replicate the density and modern zoning findings (from the first row, panel A) in the much smaller sample of the 1922 city. (The density effect without zoning controls, column 1, is precise at the 7% significance level.) Here again, controlling for modern zoning completely explains the density pattern near the streetcar in a statistical sense.

We begin by assessing the claim from the historical literature that initial zoning grandfathered in existing uses (Kolnick, 2008; Whittemore, 2010). Column 1 of appendix table 6 shows relatively more nonresidential zoning near the streetcar in 1922. Being near the streetcar is associated with a 2.2 percentage point increase in the likelihood of being designated nonresidential in 1922, an extremely large increase of 75% relative to the control region sample mean (displayed in the bottom row of the table). This is consistent with an institutional ratification of the streetcar density pattern.

Next, we begin to assess the process of institutional change: Is modern zoning a direct descendant of 1922 decisions? Appendix table 7 relates the 1922 zone code to its 2013 equivalent for parcels within the treatment and control areas. We find that roughly one in three parcels changed broad category of permitted use. Thus, over the long run, zoning around the stops has been somewhat malleable, not perfectly static.

Given this, we turn to analysis of how zoning changed. Appendix table 6, column 2, examines whether proximity to the stops affects the probability of zoning change. Although the estimate suggests that areas nears the streetcar were around 10% more likely to change zoning designations (relative to the control area mean), it is not precisely estimated. Column 3 examines the prevalence of changes from residential to nonresidential and finds precise evidence that land near the streetcar was more likely to convert to a nonresidential designation. Nonresidential uses are often quite dense. As a result, the shift from residential to nonresidential should increase allowable density.

This pattern of changes suggests that 1922 zoning, relative to modern zoning, should be more limited in its ability to explain streetcar-related density. To test this idea, the second set of rows of table 2, panel B replaces modern zoning controls with 1922 zoning controls. Indeed, the 1922 zone code has very limited explanatory power for the modern density around the streetcar: controlling for historic zoning causes the streetcar coefficient to decline by only about 30% (comparing columns 1 and 4).

Finally, we examine whether the lower explanatory power of the 1922 code, relative to modern zoning, is attributable to the coarse nature of the 1922 code. To do this, we collapse the modern zoning designations into the 1922 categories (as in appendix table 7). Comparing columns 1 and 4 in the third set of rows of panel B suggests that modern zoning, defined in 1922 terms, can statistically account for roughly half of the modern density near streetcars. The remaining greater explanatory power of the modern code relative to the 1922 code is, by inference, due to zoning's shift to finer gradations. In particular, modern zoning has a multitude of limits and restrictions, such as height limits and lot coverage limits, that allow for far more nuanced differences than permitted by the coarse 1922 use designations.

In sum, we conclude that the substantial change in land use regulation since 1922 worked to permit greater relative density near the streetcar. Specifically, both parcel-specific changes in permitted use and an evolution toward more multidimensional regulation have yielded more allowable density near defunct streetcars.[32]

B. *Agglomeration*

In this section, we explore whether the evidence is consistent with agglomeration: coordinated private activity near streetcar stops due to increasing returns to density. In line with much of the literature on agglomeration, we anticipate that such benefits are likely to be particularly pronounced for nonresidential land uses, and we focus our analysis in this section on such uses. Clearly, however, agglomeration is not the only possible explanation for our results on use patterns in this section; zoning could cause these findings, and the evidence is also consistent with both zoning and agglomeration playing a role.

We begin by testing whether land use near the streetcar—the actual use of the land, not the zoned use—is more likely to be nonresidential. (Uses can diverge from zoning designation because zoning designations are hierarchical. For example, a parcel zoned nonresidential can almost always be used for a residential purpose, but a residentially zoned parcel cannot be used for a nonresidential purpose.) We use the basic specification from equation (1). Results in column 1 of panel A, table 3 reports that properties near streetcars are 6% more likely to be nonresidential. This is a large effect, equal to nearly 30% of the control area dependent variable mean (at the bottom of the panel). Among residential properties, those near the streetcar are 70% more likely to be in multifamily use (column 2); this is equal to 21% of the control region dependent variable mean.[33]

TABLE 3.—THERE ARE MORE NONRESIDENTIAL PARCELS NEAR STREETCARS, AND THEY ARE MORE CONCENTRATED

A. Land Use Near Streetcar

	Dependent Variable Is Land Use	
	1{Nonresidential} (1)	1{Multifamily, If Residential} (2)
Treatment Circle$_{i,s}$	0.059	0.068
	(0.009)	(0.007)
Parcels	405,249	370,928
Streetcar stops	907	815
Mean, control dependent variable	0.211	0.324

B. Concentration of Land Use Near Streetcar

	Dependent Variable Is Number of Nonresidential Parcels within x Meters, Where x is		
	50 (1)	100 (2)	200 (3)
Treatment Circle$_{i,s}$	0.020	0.032	0.189
	(0.012)	(0.032)	0.089
Parcels	32,577	32,577	32,577
Streetcar stops	100	129	103
Mean, control dependent variable	1.249	2.196	5.228
Streetcar stop fixed effects	X	X	X

Given the substantially smaller number of nonresidential parcels, we require a minimum of five (rather than ten) parcels in the treatment and control areas. Standard errors clustered by streetcar stop in parentheses. The unit of observation is the 2011 parcel. All columns are weighted by lot size, normalized such that each streetcar treatment and control area has a total weight of 1. All estimates exclude streetcar stops that have a yellow car route in either the treatment or control area and use a treatment circle radius of 0.5 kilometer. Further, all estimates control for P and D, as defined in table 1.

However, agglomeration is primarily about concentration. It is possible that the larger number of nonresidential properties near the streetcar are no more concentrated than nonresidential properties far from the streetcar. To test this possibility, for each parcel in our sample, we count the number of parcels within a 50-meter radius in nonresidential use. We then use this "number of nonresidential parcels in close proximity" as our dependent variable and limit the sample to nonresidential properties. Relative to the dependent variable mean, nonresidential properties near the streetcar have about 2% more nonresidential neighbors (column 1). When we expand the "nearby" radius to 200 meters (column 3), this result intensifies to 4%. This concentration result need not mechanically follow from the greater number of nonresidential parcels near the defunct streetcar.

VIII. Interpretation and Conclusion

Since its invention in 1888 through the early 1910s, the fast, cheap streetcar dominated urban transit. Despite its short heyday and later extinction, we document that the streetcar continues to exert a powerful influence on modern land use in Los Angeles. Notably, building activity since the removal of the

[32] A possible avenue for assessing the effect of zoning on land use patterns is to examine land prices. Zoning could affect land values through two channels (Turner et al., 2014). First, by constraining the range of uses, zoning may decrease its value (an "own lot" effect). Second, the zoning of neighboring parcels may influence land value either positively or negatively by regulating spillovers (an "external" effect). Unfortunately, in our setting, it is not clear that an external zoning effect on land values can be disentangled from an agglomerative effect, as both are forms of spillovers. If zoning is misallocated near the streetcar, the "own lot" zoning effect may be more negative near the stop than farther away. We test for this possibility, and the results are imprecise (available from the authors on request).

[33] Whatever these potential agglomerative externalities are, they do not seem to attract the wealthy. From 1950 to 2010, people with income less than the median are more likely to live near the streetcar, a finding consistent with the prevalence of high-density, multifamily residential structures in these areas. Figures available on request.

last streetcar has maintained the density near streetcars. Our evidence suggests that only a limited portion of the persistent influence of the streetcar is explained by durable capital, in the form of either private structures or public infrastructure such as roads. Putting the remaining findings together, our evidence is consistent with both zoning and agglomeration causing persistent density.

Strictly parsing out the relative contributions of regulation and agglomeration is extraordinarily difficult, and our evidence is insufficient to do so. It is possible, though it strikes us as unlikely, that just one of these explanations is the sole cause of the persistent density near the streetcar. Perhaps persistent density is caused by agglomeration, and zoning regulations merely reflect market demand (Wallace, 1988; Munneke, 2005). We find that zoning altered over the century to allow more density at streetcar stops; one interpretation of this evidence is that zoning responds endogenously to agglomeration pressures. That said, there is substantial evidence that land use regulation binds in Los Angeles and itself has an impact on market outcomes (Glaeser et al., 2005; Brooks & Lutz, 2016). In addition, evidence from Chicago suggests that historical zoning choices have long-run effects on land use patterns (Shertzer et al., 2016).

Overall, we view the weight of the evidence as most consistent with land use regulation and agglomeration acting as mutually reinforcing pathways. For example, zoning regulations may generate expectations of future density in certain locations, thereby reinforcing agglomeration. In turn, agglomeration may reinforce zoning by creating benefits for landowners, who then lobby to maintain those benefits via regulation.

REFERENCES

Ahlfeldt, Gabriel M., Stephen J. Redding, Daniel M. Sturm, and Nikolaus Wolf, "The Economics of Density: Evidence from the Berlin Wall," *Econometrica* 83:6 (2015), 2127–2189.

Ambrus, Attila, Erica Field, and Robert Gonzalez, "Loss in the Time of Cholera: Long-Run Impact of a Disease Epidemic on the Urban Landscape," MIT working paper (2015).

Arzaghi, Mohammad, and J. Vernon Henderson, "Networking Off Madison Avenue," *Review of Economic Studies* 75:4 (2008), 698–701.

Bleakley, Hoyt, and Jeffrey Lin, "Portage and Path Dependence," *Quarterly Journal of Economics* 127 (2011), 587–644.

Brooks, Leah, and Byron Lutz, "From Today's City to Tomorrow's City: An Empirical Investigation of Land Assembly," *American Economic Journal: Economic Policy* 8:3 (2016), 69–105.

Brueckner, Jan K., "Residential Succession and Land-Use Dynamics in a Vintage Model of Urban Housing," *Regional Science and Urban Economics* 10 (1980a), 225–240.

——— "A Vintage Model of Urban Growth," *Journal of Urban Economics* 8 (1980b), 389–402.

Burgess, Patricia, *Planning for the Private Interest: Land Use Controls and Residential Patterns in Columbus, Ohio, 1900–1970* (Columbus: Ohio State University Press, 1994).

Cowan, Robert G., *On the Rails of Los Angeles: A Pictoral History of the Street-Cars* (Los Angeles: Historical Society of Southern California, 1971).

Crump, Spencer, *Ride the Big Red Cars: How Trolleys Helped Build Southern California* (Los Angeles: Crest Publications, 1962).

Davis, Donald R., and David E. Weinstein, "Bones, Bombs, and Break Points: The Geography of Economic Activity," *American Economic Review* 92:5 (2002), 1269–1289.

Diamond, Rebecca, and Tim McQuade, "Who Wants Affordable Housing in Their Backyard? An Equilibrium Analysis of Low Income Property Development," NBER working paper (22204).

Fischel, William A., "An Economic History of Zoning and a Cure for Its Exclusionary Effects," *Urban Studies* 41:2 (2004), 317–340.

——— *The Homevoter Hypothesis: How Home Values Influence Local Government Taxation, School Finance and Land-Use Policies* (Cambridge, MA: Harvard University Press, 2005).

Fogleson, Robert M., *The Fragmented Metropolis: Los Angeles 1950–1930* (Cambridge, MA: Harvard University Press, 1967).

Friedricks, William B., *Henry E. Huntington and the Creation of Southern California* (Columbus: Ohio State University Press, 1992).

Ganong, Peter, and Daniel Shoag, "Why Has Regional Income Convergence in the U.S. Declined?" *Journal of Urban Economics* 102 (2017), 76–90.

Gin, Alan, and Jon Sonstelie, "The Streetcar and Residential Location in Nineteenth Century Philadelphia," *Journal of Urban Economics* 32 (1992), 92–107.

Glaeser, Edward, and Joseph Gyourko, "Urban Decline and Durable Housing," *Journal of Political Economy* 113:2 (2005), 345–375.

Glaeser, Edward, Joseph Gyourko, and Raven Saks, "Why Is Manhattan So Expensive? Regulation and the Rise in Housing Prices," *Journal of Law and Economics* 48 (2005), 331–369.

Glaeser, Edward, Jed Kolko, and Albert Saiz, "Consumer City," *Journal of Economic Geography* 1 (2001), 27–50.

Gyourko, Joseph, and Raven Molloy, "Regulation and Housing Supply," in Gilles Duranton, J. Vernon Henderson, and William C. Strange, eds., *The Handbook of Regional and Urban Economics* (Amsterdam: Elsevier, 2015).

Hanlon, W. Walker, "Temporary Shocks and Persistent Effects in Urban Economies: Evidence from British Cities after the U.S. Civil War," this REVIEW 99:1 (2017), 67–79.

Hilber, Christian A. L., and Frederic Robert-Nicoud, "On the Origins of Land Use Regulations: Theory and Evidence from US Metro Areas," *Journal of Urban Economics* 75 (2013), 29–43.

Hilton, George W., and John F., Due, *The Electric Interurban Railways in America* (Stanford, CA: Stanford University Press, 1960).

Hornbeck, Richard, and Daniel Keniston, "Creative Destruction: Barriers to Urban Growth and the Great Boston Fire of 1872," NBER working paper 20467 (2014).

Hsieh, Chang-Tai, and Enrico Moretti, "Housing Constraints and Spatial Misallocation," NBER working paper 21154 (2017).

Jackson, Kenneth T., *Crabgrass Frontier: The Suburbanization of the United States* (New York: Oxford University Press, 1985).

Kolnick, Kathy, "Order Before Zoning: Land Use Regulation in Los Angeles, 1880–1915," Ph.D. diss., University of Southern California (2008).

Lee, Sanghoon, and Jeffrey Lin, "Natural Amenities, Neighbourhood Dynamics, and Persistence in the Spatial Distribution of Income," *Review of Economic Studies* 85 (2018), 663–694.

Longtin, James, *150 Years of Land Use* (Berkeley, CA: Local Government Publications, 1999).

Lucas, Robert E., and Esteban Rossi-Hansberg, "On the Internal Structure of Cities," *Econometrica* 70:4 (2002), 1445–1476.

McMillen, Daniel, and John F. McDonald, "Land Use before Zoning: The Case of 1920s Chicago," *Regional Science and Urban Economics* 29 (1999), 473–489.

——— "Land Values in a Newly Zoned City," this REVIEW 84:1 (2002), 62–72.

Michaels, Guy, and Ferdinand Rauch, "Resetting the Urban Network," *Economic Journal* 128:608 (2018), 117–2012.

Miguel, Edward, and Gerard Roland, "The Long-run Impact of Bombing Vietnam," *Journal of Development Economics* 96:1 (2011), 1–15.

Munneke, Henry J., "Dynamics of the Urban Zoning Structure: An Empirical Investigation of Zoning Change," *Journal of Urban Economics* 58:3 (2005), 455–473.

Nunn, Nathan, "Historical Development" (pp. 347–402), in Phillipe Aghion and S. Durlauf, eds., *Handbook of Economic Growth* (Amsterdam: North-Holland, 2014).

Post, Robert C., *Street Railways and the Growth of Los Angeles* (San Marino, CA: Golden West Books, 1989).

Redding, Steven J., and Daniel M. Sturm, "The Costs of Remoteness: Evidence from German Division and Reunification," *American Economic Review* 98:5 (2008), 1766–1797.

Redding, Steven, Daniel M. Sturm, and Nicholas Wolf, "History and Industrial Location: Evidence from German Airports," this REVIEW 93:2 (2011), 814–831.

Redfearn, Chris, "Persistence in Urban Form: The Long-Run Durability of Employment Centers in Metropolitan Areas," *Regional Science and Urban Economics* 39:2 (2009), 224–232.

Redmill, Cecil E., "Road Maps," *Geography* 17:1 (1932), 46–48.

Ristow, Walter W., "American Road Maps and Guides," *Scientific Monthly* 62:5 (1946), 397–406.

Rosenthal, Stuart, "Old Homes, Externalities, and Poor Neighborhoods. A Model of Urban Decline and Renewal," *Journal of Urban Economics* 63:3 (2008), 816–840.

Rosenthal, Stuart S., and Stephen L. Ross, "Change and Persistence in the Economic Status of Neighborhoods and Cities" (pp. 1047–1120), in J. Vernon Henderson, Gilles Duranton, and William C. Strange, eds., *Handbook of Regional and Urban Economics* (Amsterdam: Elsevier, 2015).

Rosenthal, Stuart, and William Strange, "The Determinants of Agglomeration," *Journal of Urban Economics* 50 (2001), 191–229.

——— "Geography, Industrial Organization, and Agglomeration," this REVIEW 85:2 (2003), 377–393.

——— "Evidence on the Nature and Sources of Agglomeration Economies," in J. V. Henderson and J. F. Thisse eds., *The Handbook of Regional and Urban Economics* (Amsterdam: Elsevier, 2004).

Rossi-Hansberg, Esteban, Pierre-Daniel, Sarte, and Raymond Owens III, "Housing Externalities," *Journal of Political Economy* 118:3 (2010), 485–535.

Saiz, Albert, "The Geographic Determinants of Housing Supply," *Quarterly Journal of Economics* 125:3 (2010), 1253–1296.

Saks, Raven E., "Housing Supply," in Steven Durlauf and Larry Blume, eds., *The New Palgrave Dictionary of Economics* (Basingstoke, UK: Palgrave Macmillan, 2008).

Shertzer, Allison, Tate Twinam, and Randall P. Walsh, "Zoning and the Economic Geography of Cities," NBER working paper 22658 (2016).

Siodla, James, "Razing San Francisco: The 1906 Disaster as a Natural Experiment in Urban Redevelopment," *Journal of Urban Economics* 89 (2015), 48–61.

Turner, Matthew A., Andrew Haughwout, and Wilbert van der Klaauw, "Land Use Regulation and Welfare," *Econometrica* 82:4 (2014), 1341–1403.

Villarreal, Carlos, "Where the Other Half Lives: Evidence on the Origin and Persistence of Poor Neighborhoods from New York City 1830–2012," University of Illinois at Chicago working paper (2014).

Walker, Jim, *Los Angeles Railway Yellow Cars* (Charleston, SC: Arcadia, 2007).

Wallace, Nancy, "The Market Effects of Zoning Undeveloped Land: Does Zoning Follow the Market? *Journal of Urban Economics* 23 (1988), 307–326.

Whittemore, Andrew, "The Regulated City: The Poltics of Land Use Regulation in Los Angeles, 1909–2009," Ph.D. diss., University of California, Los Angeles (2010).