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From College to the City: Implications of Rail Transit on the Movement of the Young, College Educated Into the City Center

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Chapter 5
From College to the City:
Implications of Rail Transit on the Movement of the Young, College Educated Into the City Center

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ABSTRACT

This chapter focuses on how investment in the American rail infrastructure has shaped changes in the population and residential patterns. Specifically, the chapter examines the association between commuter rail systems, urban rail transit systems, and the movement of the college-educated young into the inner city. Two hypotheses are proposed about the characteristics of rail systems and the relationship to the growth in the percentage of young college graduates residing in close-in neighborhoods. Using a sample of central cities within the 51 largest metropolitan areas in the U.S., the chapter compares the growth in young college graduates (ages 25 to 34 years) across cities with the different transit configurations. Using correlation analysis, the chapter explores the relationship between the presence of rail transit and the residential location choices of this population group. In the discussion and conclusion, the findings are summarized and implications for policy and sustainability are discussed.

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INTRODUCTION

American cities experienced disinvestment and economic decline in the early decades of the post-World War II era when many in the middle class moved to the suburbs, leaving behind low-income residents and a deteriorating inner city. This produced an ongoing crisis in central cities as American cities, which tend to rely on property taxes to meet many of their responsibilities (Garvin, 1996), saw their housing stock and tax base deteriorate.

The mass migration of affluent urbanites to the suburbs had other adverse consequences. It fostered the widespread purchase of automobiles for commuting, which ultimately produced today's transportation bottlenecks, congestion, and infrastructure breakdowns. It consumed large amounts of farm and wild land, requiring the building of many miles of roadway with detrimental effects on the landscape and increased greatly the number of miles Americans drive (Gillham, 2002). Many of the affluent, college-educated, middle-class Americans now endure the wasted time and frustration of long commutes and time spent in traffic when driving into the city centers where many professional jobs are located.

In recent years, many cities have responded by adopting economic development policies to improve accessibility to the city center by fostering development closer to the city center through investments in light rail, transit-oriented development, and various downtown amenities. Presumably, these would attract talented, affluent residents and improve the tax base. Urban theorists assert that transportation accessibility to the urban core is one of the key generators of economic growth (Glaeser, 2011; Polèse, 2013). In their research on American cities, Florida and Adler (2018) found that the most advantaged Americans, primarily those with college degrees, tend to "locate in the most economically functional and aesthetically desirable places—in and around the urban core, along transit routes, close to universities and knowledge institutions, and along waterfronts and other natural amenities." (p. 610)

Rail transit, in particular, is often advanced as a means to attract high-income residents to downtown areas. Presumably, higher income residents will upgrade the housing stock and the overall inner-city tax base, rendering the inner city more prosperous and attractive to higher income residents. In addition to its contribution to sustainable city finances, rail transit can generate environmental sustainability, especially when it fosters high density development around transit stops. It can reduce the average urbanite's carbon footprint along with the number of miles he or she drives each year (Glaeser, 2011). In contrast to suburban sprawl, new lane miles may not be needed. All of this can enhance the quality of life and even contribute to a healthier populace because urban transit riders tend to get more physical activity as they walk to and from rail stops (Frank, Engelke, & Schmid, 2003).

This chapter begins with a background discussion of the American rail system to differentiate the commuter rail and urban rail transit system that are the chapter's focus. The chapter examines the association between commuter rail, urban rail transit, and the movement of the college-educated young into the cities. An overview of the literature on transportation and population movement provides the context for understanding how investments in rail systems fit within urban economic development and changes in population and residential patterns. The literature is used to set up two hypotheses about characteristics of rail systems and effects on the population of young college graduates residing in close-in neighborhoods. Using a sample of central cities within the 51 largest metropolitan areas in the U.S., the chapter compares the growth in young college graduates (ages 25 to 34 years) across cities with the different transit configurations. Using correlation analysis, the chapter explores the relationship between the presence of rail transit and the residential location choices of this population group. In the discussion and conclusion, the findings are summarized and implications for policy and sustainability are discussed.

BACKGROUND

Four Categories of Rail Transport

American rail systems can be organized into four broad categories: freight rail, passenger rail, commuter rail, and urban rail transit (Brock & Souleyrette, 2013), as shown in Table 1. These categories include freight rail, passenger rail, commuter

Table 1. Categories of U.S. rail systems

	Sub-categories	Geographic Scale
Freight Rail	• Class I • Regional Rail • Shortline	• National/Regional Network
Passenger Rail	• Amtrak • Alaska Railroad • High Speed Rail	• National Intercity Connectivity
Commuter Rail	• Legacy • New Start	• Greater Metropolitan Commuter Shed
Urban Rail Transit	• Light Rail (Street Cars) • Heavy Rail (Subway or Metro)	• Intra-Urban • Downtown

Note: Commuter Rail and Urban Rail Transit are the focus of this chapter.
Source: Adapted from Brock and Souleyrette (2013)

rail, and urban rail transit. The focus of this chapter is on commuter rail and urban rail transit, what will be referred to throughout the chapter as rail transit.

Commuter rail encompasses both regional and suburban rail systems. These systems connect the downtown of a major city to the surrounding suburban communities. Operating on a frequent and regular schedule, they tend to run most often at traditional peak commuting hours. Commuter rail systems operate on shared track corridors with freight rail carriers and Amtrak passenger rail. These shared commuter corridors usually range between 30 and 200 miles of track, although the very largest systems in the country have up to several hundred miles of track. Commuter rail systems serve the metropolitan areas of many of the nation's largest cities including New York City, Chicago, Philadelphia, and Washington, D.C. (Brock & Souleyrette, 2014). With their wide service areas, commuter rail systems tend to serve affluent professionals and managers who live in the low-density, outer suburbs and commute to work in the central city. Their service quality is high, and in the wake of the post-war suburban expansion, many of the old commuter rail lines have been upgraded and extended into new and up-scale communities.

Urban rail transit systems are defined as electric-powered, fixed guide way rail systems that transport passengers within the city center and inner suburbs. One type of urban rail transit (also sometimes referred to as rail rapid transit) is heavy rail (subway or metro), which operates on a separated right-of-way and moves large numbers of passengers at once. With more cars coupled together, these heavy rail systems can move large volumes of passengers. Another type is light rail transit, also called streetcars. These transit systems operate on separated right-of-way, reserved corridors along highway medians or at-grade with street traffic. Although both are on city streets, 'light rail' commonly refers to a separated right-of-way, while 'streetcar' usually refers to at-grade vehicles that mix with traffic. Many of the larger and older cities built their heavy transit systems in the early years of the 20th century, such as New York, Boston, and Chicago. Some new systems have come on-line more recently, for instance, in the Washington, D.C. and San Francisco Bay areas.

Transportation and Population Movement: An Overview

Heavy and light rail systems were built in the early decades of the 20th century with rail ridership exceeding bus ridership through 1945. Altshuler and Luberoff (2004) reported that in the post-war era rail ridership, especially for light rail or streetcars, took a nosedive, falling from 9,246 million passengers in 1945 to 3,904 million in 1950. Consequently, many urban rail transits systems were discontinued, especially streetcars in midsize cities. Ridership on such systems reached its nadir in 1980 when ridership was only 122 million. Between 1945 and 1975, total ridership on

bus and rail dropped from 23,254 million passengers to 7,219 million passengers (Altshuler & Luberoff, 2004).

Americans had turned to the automobile for transportation. The number of automobiles on the roads rose sharply and cities experienced increases in congestion along with a shortage of available and low-cost parking. During the 1950s and continuing into later decades government at all levels invested heavily in new roadways, but the limits of building highways were soon recognized. Most large urban areas, especially those on the coasts, had a limited amount of land suitable for the construction of highways and parking facilities. The rapid rise in the population in urbanized areas gave rise to a search for another approach to congestion.

By the 1970s, many community leaders, politicians, and downtown business owners were calling for investment in rail infrastructure. They were joined by environmentalists, rail manufacturers, and rail operators (Altshuler & Luberoff, 2004). Proponents of rail advanced a number or arguments for investing in rail. These included arguments that rail systems reduce the need for new highway construction, help contain suburban sprawl, carry more passengers at lower labor costs than buses, reduce air pollution, stimulate higher density development and redevelopment around rail stations and stops, and attract the affluent middle-class back to the cities (Altshuler & Luberoff, 2004; Ehrenhalt, 2012).

Decision-makers at all levels of government accepted the need for transit and investment in transit rose considerably. By 1999, capital expenditures (in 2002 dollars) for transit had increased from $1.4 billion to $9.2 billion (Altshuler & Luberoff, 2004), and increased investment in rail infrastructure have continued (Ganning, Beaudoin, Brewer, Kim, & Park, 2016). A substantial portion of these expenditures was devoted to heavy rail, light rail, and commuter rail. Between 1975 and 1999, ridership on heavy rail rose by 51%, on light rail by 133%, and on commuter rail by 44% (Altshuler & Luberoff, 2004).

As the rail ridership growth suggests, many of the 51 largest urban areas have devoted resources to the development or expansion of one or more of the three types of urban rail transit systems. Remarkably, 31 of these systems were either built or expanded since 1984. By 2012, 27 U.S. cities operated light rail or streetcar/trolley systems. Twenty-two of these light rail systems were built or expanded since 1980. Since 2012, several more have begun service or are under construction. The contribution of these urban transit systems to the growth of public transportation in the U.S. is clear. The American Public Transportation Association reports that "[F]rom 1995-2013, public transportation ridership grew 37.2 percent, almost double the amount of population growth at 20.3 percent" (American Public Transportation Association, nd).

A Return to the Center

Urban economic development policies have a mixed track record. Some, such as investment in building convention centers, have failed to generate the promised middle-class jobs and residents (Farmer, 2018). But investment in rail may have the desired effects as the number of young college-educated residents living near the city center of the largest 51 American metropolitan areas has grown significantly over recent years (Cortright, 2014; Kolko, 2016) and many private sector companies are moving downtown (Kneebone, 2013). Moreover, the emerging preference for residing close to the central business district is not regional, as 49 of the 51 largest metropolitan areas in the U.S. have experienced rising numbers of college-educated young adults (Cortright, 2014). Another indicator of the strength of this movement towards the city center is the finding that among the 27 cities with declining populations, 25 witnessed an increase in the number of college-educated residents, ages 25 to 34 years, residing within 3 miles of the central business district (Cortright, 2014). Kolko (2016) notes similar urban trends using public use micro-data samples from the 2000 Census and 2014 American Community Survey. Within the 25 to 49 year old age group, those with college education are not only 5% more likely to live in urban neighborhoods in 2014 compared to 2000, but also, 17% more likely to live in higher-density urban core neighborhoods.

In all likelihood, the growth in transit ridership and the percentage of the young college educated moving to the center has multiple sources. Clearly, immigration is producing demographic changes likely to increase demand for transit services, as immigrants are more likely to live in large cities, less likely to own automobiles, and more likely to rely on transit (Glaeser, 2011). This suggests that immigrants are attracted to the cities offering rail services.

The rise of college-educated residents moving close-in to the city center suggests another trend that can increase ridership, especially on rail, and spur reinvestment in the central city. Using data from the American Community Survey, Cortright (2014) found that increasingly large numbers of college-educated young people are moving into close-in neighborhoods in the nation's 51 largest metropolitan areas where in 2012 more than 170 million Americans lived.

A close-in neighborhood is defined as a neighborhood located within three miles of a metropolitan area's central business district. Cortright (2014) reported that, "In 2000, young adults with a four-year degree were 77 percent more likely to live in close-in neighborhoods than other metro residents. Now, these well-educated young adults are about 126 percent more likely to live in these close-in urban neighborhoods" (p. 2). Overall, the number of college-educated residents, ages 25 to 34, living in close-in neighborhoods rose 37.3 percent between 2000 and 2012—an increase

almost twice the 19 percent rise of similar young people across the 51 metropolitan areas on the whole (Cortright, 2014). Kolko (2016) finds that the college-educated residents who live in dense urban neighborhoods are more likely to be young, white, affluent, and childless. Population growth in Washington, D.C. reflects the trend. The New York Times reports that approximately all of the District's population growth between 2000 and 2010 was in the 20 to 34 year old demographic group (Morello, Keating, & Hendrix, 2011; Weiland, 2017).

Not only are the young moving toward the city center, they are driving less. From 1995 to 2009, urban drivers, ages 25 to 34, reduced their vehicle miles of travel per day from 30.1 miles to 24.5 miles, while urban drivers, ages 35 to 44, reduced their daily mileage by a negligible amount from 30.3 to 30.1 miles (Santos, McGuckin, Nakamoto, Gray, & Liss, 2011). This suggests that the young, college-educated residents may be more willing to rely on transit for some or even all of their travel needs, in which case, they might be more likely to move to cities with transit options. Additionally, research has found that the more affluent residents of large cities are more likely than the average American to ride transit (Rashidi, Mohammadian, & Zhang, 2010).

No doubt many of the more educated will move to the suburbs when they have children. However, the rising age of first births for mothers, especially those who hold college degrees, suggests that the life course for many of the well-educated in their 20s and 30s will include a lengthy stay near the city center (Glaeser, 2011). Currently, those who move to suburbs are replaced each year by a new contingent of college graduates, an annual event that is expected to continue into the foreseeable future.

The Appeal of Rail

Commuter rail and urban rail transit connects suburbs and residential neighborhoods in the city to the central business district. However, as Kotkin (2010) notes, many commuters prefer traveling on urban rail transit to riding on city buses. Rail transit tends to be much faster than buses because buses share the street with automobiles and make more stops than rail, and in general, rail trips tend to be smoother and more comfortable. Middle-class Americans are more likely to ride heavy or light rail than buses, (Kotkin, 2010) and cities with these systems tend to have more affluent transit users.

Many of these urban rail transit systems are relatively new or newly expanded (Garrett & Taylor, 1999). The new and expanded rail transit systems may attract new ridership when they promote transit-oriented residential and commercial development around rail transit stops. By design, many of these developments are a quick ride

from the downtown area, as developers appear to assume college-educated people find neighborhoods with access to rail transit to be desirable ("Transit Oriented Denver: Transit Oriented development Strategic Plan," 2014).

While this chapter's focus is on rail transit broadly, for analysis, it is useful to distinguish commuter rail from urban rail transit (light rail and heavy rail). Commuter rail systems bring suburban residents living far from the city center into the city. They tend to have fewer stops in the city. Urban rail transit systems, in contrast, are more likely to serve city residents with more stops, especially those living close-in.

Hypothesis One: Cities with light and/or heavy rail systems experienced a larger increase in the percent of young college graduates residing in close-in neighborhoods than cities with only commuter rail or bus service.

As shown in Table 1, there are two categories of commuter rail: legacy systems developed before 1975 and new start systems developed since 1975. Fourteen of the 20 commuter rail systems in the 51 largest metropolitan areas in the U.S. are new start systems and only six are legacy systems. New commuter rail systems are more likely to be built with redevelopment of the inner city and transit development in mind. The presence of these new start commuter rail systems could be associated with more college-educated residents living in close-in neighborhoods.

Hypothesis Two: Cities with recently built (new start) commuter rail systems experienced a larger increase in the percent of young college graduates moving close-in than cities with old (legacy) commuter rail systems.

DATA AND METHODS

This chapter's analysis uses a sample of the 51 largest metropolitan areas in the U.S in 2012 (see Table 2 for the list of metropolitan areas). The data include information from the Federal Transit Agency on the types of transit services available in each metropolitan area, including whether or not they are new start or legacy systems. Of the light rail systems operating across the U.S., all but three are operating in the 51 largest metropolitan areas used in this chapter.

In terms of population change, the data include the percentage change, between 2000 and 2012 in college-educated, 25 to 34 year olds, living within three miles of the city center, as reported by Cortright (2014) from American Community Survey data. Data on city population and demographics from the U.S. Census Bureau are also included. Note that the population of the central city is used rather than that of

Table 2. List of the 51 metropolitan areas (in 2012) in the study sample

Atlanta-Sandy Springs-Roswell	Minneapolis – St. Paul – Bloomington
Austin – Round Rock	Nashville – Davidson – Murfreesboro – Franklin
Baltimore – Columbia - Towson	New Orleans – Metairie
Birmingham – Hoover	New York – Newark – Jersey City
Boston – Cambridge – Newton	Oklahoma City
Buffalo – Cheektowaga – Niagara Falls	Orlando – Kissimmee – Sanford
Charlotte – Concord – Gastonia	Philadelphia – Camden – Wilmington
Chicago – Naperville – Elgin	Phoenix – Mesa – Scottsdale
Cincinnati	Pittsburgh
Cleveland – Elyria	Portland – Vancouver – Hillsboro
Columbus	Providence – Warwick
Washington – Arlington – Alexandria	Raleigh – Cary
Dallas – Fort Worth – Arlington	Richmond
Denver – Aurora – Lakewood	Riverside – San Bernardino – Ontario
Detroit – Warren –Dearborn	Rochester
Hartford – West Hartford – East Hartford	Sacramento – Roseville – Arden – Arcade
Houston – The Woodlands – Sugar Land	Salt Lake City
Indianapolis – Carmel – Anderson	San Antonio – New Braunfels
Jacksonville	San Diego – Carlsbad
Kansas City	San Francisco – Oakland – Hayward
Las Vegas – Henderson – Paradise	San Jose – Sunnyvale – Santa Clara
Los Angeles – Long Beach – Anaheim	Seattle – Tacoma – Bellevue
Louisville/Jefferson County	St. Louis
Memphis	Tampa – St. Petersburg – Clearwater
Miami – Fort Lauderdale – West Palm Beach	Virginia Beach – Norfolk – Newport News
Milwaukee – Waukesha – West Allis	

the metropolitan area, as transit is more heavily used by central city residents and used far more for commuting to work because of the high cost of downtown parking.

Some key characteristics of the sample are provided in Table 3, which shows the descriptive statistics. All the cities at the center of the 51 largest metropolitan areas operate a bus system with 18 cities (35.3%) offering only bus service. Thus, 33 cities (64.7%) provide some type of rail service. Twenty cities (39.2%) have commuter rail, 11 cities (21.2%) have heavy rail, and 26 cities (51%) have light rail.

Table 3. Descriptive statistics (N = 51)

	Mean	Std. Deviation	Minimum	Maximum
City Population	864,883.59	1,232,776.38	124,775	8,175,133
% Change in Young College Graduates Living Close-in (2000-2012)	46.73	29.85	-16.00	138.00
% White	71.27	9.66	47.90	87.50
% Black	16.15	10.84	1.60	54.00
% Hispanic	15.83	13.19	1.40	54.40
Light Rail	.51	.50	.00	1.00
Heavy Rail	.22	.42	.00	1.00
Light Rail or Heavy Rail	.59	.50	.00	1.00
Light Rail and Heavy Rail	.14	.35	.00	1.00
Commuter Rail	.40	.49	.00	1.00
Legacy Commuter Rail	.12	.33	.00	1.00
New Start Commuter Rail	.28	.45	.00	1.00
Buses Only	.35	.48	.00	1.00

Six central cities (11.8%) have legacy commuter rail systems, and 14 cities (27.5%) have new start commuter rail systems.

City size and racial composition vary greatly across the sample. Population size ranges from 124,775 to 8.2 million with a mean of 864,883 residents. The average city's population is 71.3% white, 16.2% black, and 15.8% Hispanic. Resident diversity by racial category also varies with the central cities having between 1.6% and 54.0% black residents and between 1.4% and 54.4% Hispanic residents.

In terms of the population, variable of interest – the percent change in young, college educated 25 to 34 year olds living within three miles of the central business district – there is also variation. The mean percent change was 47%, and the median was 40%. Two cities saw a movement of this group away from the central business district. Birmingham (AL) and Detroit (MI) experienced a -16% and -6% change in the population of young graduates living close-in, respectively. In contrast, St. Louis (MO) and Miami (FL) saw growth of 138% and 118%, respectively.

Building on the descriptive statistics, the analysis identifies and examines different transit system configurations and analyzes association patterns in terms of the different transit systems. Comparisons of means are used to analyze how the change in the percentage of young college graduates residing close-in differ across the transit system configurations featuring light and heavy rail, and new start and legacy commuter rail. Finally, correlation analysis is conducted to assess the two

hypotheses and specifically, to determine how characteristics of commuter rail and urban rail transit systems covary with the movement of the young college educated into the inner city.

RESULTS

Transit System Configurations

All 51 metropolitan areas in the sample have transit systems that include bus routes, and 18 cities (35.3%) offered bus service to their citizens but no rail service. A total of 33 central cities in the sample complemented their bus service with some combination of the three possible types of rail service—light, heavy, and commuter. As shown in Table 4, urban transit systems can have seven possible configurations of bus and rail services. Combined with bus service, 11 cities (21.6%) offer only light rail. None of the cities offer the combination of only heavy rail and bus, but two cities (3.9%) provide a combination of light rail, heavy rail, and bus; while four cities (7.8%) offer the combination of commuter rail, heavy rail, and bus. Three central cities (5.9%) provide commuter rail and bus; eight cities (15.7%) offer light rail, commuter rail, and bus; and five cities (9.8%) offer all three types of rail service along with bus service.

As noted earlier, 20 cities (39.2%) have commuter rail, and of these 6 were legacy rail systems and 14 were new start commuter rail systems. 11 cities (21.2%) have heavy rail; and 26 cities (51%) have light rail. Thirty central cities (58.8%) have

Table 4. Distribution of transit system configuration in 51 largest cities in 2012

Transit System Configuration	Percent
Bus only	35.3%
Bus + Light Rail	21.6%
Bus + Commuter Rail	5.9%
Bus + Light Rail + Heavy Rail	3.9%
Bus + Commuter Rail + Light Rail	15.7%
Bus + Commuter Rail + Heavy Rail	7.8%
Bus + Commuter Rail + Light Rail + Heavy Rail	9.8%

Note: There is one additional possible combination of bus and heavy rail, but no city in the sample had this combination.

either heavy or light rail, and seven (13.7%) have both light and heavy rail. Table 5 shows the correlations between the commuter rail and urban rail transit variables.

Table 5 shows the correlations between the different commuter and urban rail transit systems. Commuter rail, which largely serves the suburbs, is also positively correlated with the presence of heavy rail transit systems. The correlations between commuter rail and any combination involving heavy rail transit were positive, ranging from a low of 0.306 (between legacy commuter rail and having either light rail or heavy rail) and a high of 0.574 (between new start commuter rail and heavy rail transit). The presence of a light rail transit system was not related to heavy rail transit or commuter rail (new start or legacy).

Assessment of Hypotheses

Table 6 summarizes the average percent change in college-educated, 25 to 34 year olds, living within three miles of the city center between 2000 and 2010 across the different transit system configurations. As a group, central cities with a combination of bus, commuter rail, and heavy rail had the highest increase in the percent of young college graduates living close-in. Cities with transit systems comprised of bus and light and heavy rail had, on average, a 60.5% increase in this demographic group. Cities with bus and light rail transit service experienced an average 57.1% increase. At the lower end of the growth spectrum, cities with only bus service saw a smaller increase in 25 to 34 year old college graduates living close-in of 35.3%, and cities with bus and commuter rail had an increase of 35.7%.

Table 5. Correlations between commuter rail and urban rail transit variables

	Light Rail	Heavy Rail	Light Rail or Heavy Rail	Light Rail and Heavy Rail	New Start Commuter Rail
Heavy Rail	0.133				
Light Rail or Heavy Rail	0.853	0.439*			
Light Rail and Heavy Rail	0.391**	0.761***	0.334*		
New Start Commuter Rail	0.211	0.574***	0.441***	0.363***	
Legacy Commuter Rail	0.115	0.548*	0.306*	0.385***	0.781***

Note: **** p<.0001 *** p<.001 ** p<.01 * p<.05

Table 6. Transit system configurations and average change in percent of young college graduates living within three miles of the city center

		Commuter Rail	Light Rail	Heavy Rail
Bus only	35.3%			
Bus +		35.7%	*57.1%*	
Bus + Commuter Rail +			*48.8%*	*65.8%*
Bus + Light Rail +				*60.5%*
Bus + Commuter Rail + Light Rail +				*37.3%*

Note: Boxes shaded in gray indicate transit configurations that include urban rail transit (light rail or heavy rail)

The results shown in Table 6 provide support for Hypothesis 1, as cities with some transit combination that included light and/or heavy rail systems (italics in Table 6) have experienced greater increases, on average, in the percent of young college graduates residing in close-in neighborhoods than cities with only bus service, only commuter rail, and bus service and commuter rail. The 18 cities offering only bus service saw an increase of 35.3%, while the three cities with only commuter rail and bus but neither light nor heavy rail had an increase of 35.7%. In contrast, the 30 cities with either light or heavy rail or both systems experienced an average increase in the percent of young college graduates living close-in of 54.1%. The differences between the two groups (bus only or bus and commuter rail vs. transit combinations that include urban rail transit) was statistically significant ($t = 2.012$, $p < .05$).

Hypothesis 2 expects that cities with new start commuter rail systems attracted more of the college-educated young to the city center than cities with legacy commuter rail systems. In a simple comparison of means, cities with new start commuter rail systems saw a larger increase in this demographic category than cities with legacy commuter rail systems (58.6% to 41.2%). However, the difference between the two groups, while in the expected direction, was not statistically significant.

In addition to the comparisons of the growth in the percent of young college graduates living close-in across the different groups (light and/or heavy rail vs. bus only or bus and commuter rail, and new start commuter rail vs. legacy commuter rail), the chapter also analyzed the correlation between the percent change in young college graduates living close-in, the presence of urban rail transit (light rail and heavy rail), and the presence of new start or legacy commuter rail systems. The correlation matrix is presented in Table 7.

The correlation analysis supports Hypothesis 1. The change in the percent of young college graduates living close-in was positively correlated with having light rail

Table 7. Correlations between population variables and commuter rail and urban rail transit

	% Change in Young College Graduates Living Close-in	Population	Population Density	% White	% Black
Light Rail	0.308*	-0.035	0.011	-0.154	-0.129
Heavy Rail	0.287*	0.412***	0.684****	-0.404*	0.126
Light Rail or Heavy Rail	0.416**	0.239	0.345*	-0.286*	-0.070
Light Rail and Heavy Rail	0.197	0.100	0.340*	-0.297*	0.064
New Start Commuter Rail	0.095	0.038	0.043	-0.032	-0.299*
Legacy Commuter Rail	-0.069	0.408***	0.645****	-0.258	-0.062

Note: **** p<.0001 *** p<.001 ** p<.01 * p<.05

(r=0.308, p=0.028) and heavy rail (r=0.287, p=0.041) transit systems. The change in the percent of college graduates ages 25 to 34 living in close-in neighborhoods are also positively correlated (r=0.416, p=0.002) with having either a light rail or heavy rail transit system. However, this population change was not correlated (r=0.197, p=0.167) with a central city having both light and heavy rail. The findings support that cities with light or heavy rail systems have experienced a larger increase in the percent of young college graduates residing in the urban center

The correlation between the percent of young college graduates living close-in and the presence of new start commuter rail was not statistically significant (r=0.095, p=0.506). The correlation with legacy commuter rail was similarly not statistically significant (r= –0.069, p=0.632). The correlation analysis does not provide support for Hypothesis 2.

Other population variables are related to some dimensions of transit. Population size is positively correlated with having a heavy rail transit system (r=0.412, p=0.003) and a legacy commuter rail system (r=0.408, p=0.003). Population density is similarly correlated with having a heavy rail system (r=0.684 p<.0001), either a heavy or light rail system (r=0.345, p=0.013) or both heavy and light rail systems (r=0.340, p=0.015). Population density is also positively correlated with having a legacy commuter system (r=0.645, p<.0001). These relationships suggest that more populated and denser central cities are more likely to have transit systems that include heavy rail and legacy commuter rail. Racial composition of the central city also covaries with urban rail transit. Cities with a larger percentage of its population

that is white is also less likely to have a heavy rail system (r= –0.404, p=0.033) or a combination of light and heavy rail. Percent black is negatively correlated with having a new start commuter rail (r= –0.299, p=0.033).

DISCUSSION AND CONCLUSION

The hypothesis regarding the relationship between the presence of urban rail transit (light or heavy rail) and an increase in the percent of the young college-educated living close-in (within three miles of the urban center) was supported. The second hypothesis regarding new start and legacy commuter rail, however, was not supported. Cities with recently built (new start) commuter rail systems experienced a larger increase in the percent of young college graduates moving close-in than cities with old (legacy) commuter rail systems, but the differences were not statistically significant. Furthermore, the correlations between the percent of young college graduates living close-in and the presence of either new start commuter rail or legacy commuter rail were not statistically significant.

The results are consistent with the widely held belief of urban planners that urban rail transit systems will lure more affluent individuals such as college graduates into the inner city (Lucy & Phillips, 2006). This, of course, is one of the traditional goals of economic development near the city center. Affluent residents can afford to pay higher rents. Their landlords can afford to pay for basic residential maintenance or improvements. The presence of college-educated residents in a neighborhood draws commercial and residential investment, which is more profitable due to the increased spending power of the young newcomers. Over time, the cities with growing numbers of the affluent are likely to see property tax revenues go up significantly.

A caveat is called for—while the results suggest that the presence of rail transit can draw the young, college-educated to the city center, they do not establish a clear causal relationship for several reasons. This demographic group generally seeks professional work. No doubt the job structure of the city is a primary factor explaining its appeal (Polese, 2013). Moreover, these young, college-educated residents tend to have political influence (O'Connell, 2009), and they could be strongly represented in the city prior to the development of a new rail system. Their proportion of the population could then expand, leading to even more demand for rail and transit-oriented development. This scenario would constitute a reinforcing cycle of development.

Policy Implications

This chapter's findings suggest that it may be the case that government investment in rail connected to the downtown—heavy rail as well as light rail—can spur a virtuous cycle of inner-city development, including new residential multi-unit dwellings. Clearly, seeking to promote and shape the cityscape, government officials may have good reason to turn to investment in rail systems as a central part of a broader set of policies designed to enhance the economic, physical, and environmental sustainability of their cities.

Denver, Colorado, for instance, has been at the forefront of light rail expansion, increasing its mileage of rail transit from 5.3 miles in 1994 to 81 miles in 2016. The city views rail as vital to its growth and central to its strategy to promote the wellbeing of all its residents, wealthy and poor alike. In its plan for Transit Oriented Development (TOD), Denver actively encourages TOD in existing or planned communities near rail transit stations in order to create walkable, vibrant, mixed-use environments ("Transit Oriented Denver: Transit Oriented development Strategic Plan," 2014).

The overarching goal of Denver's plan is to provide an alternative to the automobile for everyday transportation. Residents living in TOD areas will use rail for the majority of their commutes as well as for some longer journeys to other neighborhoods and walking for trips to stores, restaurants, and most routine needs. Thus, dense walkable neighborhoods close to transit centers is the key to generating urban sustainability. The combination of less driving and more walking along with living in dense, often multi-story buildings, will reduce Denver's carbon footprint, the lane miles of new roadway it will need, the level of air pollution, and improve public health ("Transit Oriented Denver: Transit Oriented development Strategic Plan," 2014). Denver has had much success. Thousands of housing units have been built in walkable areas served by light rail, including Downtown, Union Station, and Lower Highlands. The city reports some indicators of positive results, as miles driven per capita have declined and the number of residents commuting by bike or on foot to work has gone up.

However, movement of the more affluent toward the city center during the early stages of their careers can also lead to increasing rents and the loss of housing for the low-income, but it might also provide the tax dollars needed for investment in low-income housing. It can also lead to new, high density housing around rail stations.

Could the popularity of light rail come to an end? Some argue that it is possible the future adoption of autonomous vehicles could undercut the appeal of rail transit (Anderson et al., 2014), and over time, the effect on transit ridership could be dramatic, as autonomous vehicles may have the capacity to drop people at their destinations

and then move the vehicle to a remote parking facility or even pick up new riders who sequentially share use of the vehicle. This scenario, however, seems unlikely in the near term, as traffic congestion and an absence of inexpensive parking in dense urban centers will continue to deter automobile use and encourage rail transit.

This chapter looked at the 51 largest metropolitan areas. Clearly, more studies are needed, as research suggests that rail impacts location choices and related developments under some conditions but not others (Chatman, 2013). But the future conditions are favorable. People marry at a later age, crime is down, and many couples do not have children. Light rail makes it easier to move about without driving, cities are building walkable and bikeable facilities, and skilled as well as unskilled immigrants head to cities to find work and live in ethnic neighborhoods.

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KEY TERMS AND DEFINITIONS

Central Business District: The main business and commercial area of a town or city. In larger city, the central business district is often synonymous with the city's financial district. May also coincide with the city center or downtown, but this is not necessarily always the case.

Close-In Neighborhoods: A neighborhood located within three miles of a metropolitan area's central business district.

Commuter Rail: Passenger rail transport service that primarily connects the city center of a major city to the surrounding suburban communities or commuter towns. Also called regional or suburban rail.

Heavy Rail: A form of high-capacity urban rail transit that operates on a separated right-of-way, separate grade or on elevated railways. Also known as rapid transit or mass rapid transit.

Legacy Transit Systems: Transit systems built before 1975. Generally located in densely populated, older metropolitan areas. These systems generally face substantial issues in terms of overcrowding, aging infrastructure, and underfunding.

Light Rail Transit: A form of urban rail transit that operates tramcars or similar rolling stock on separated right-of-way, reserved corridors along highway medians or at-grade with street traffic.

New Start Transit Systems: Transit systems built after 1975. Generally built with redevelopment of the inner city and transit development in mind.

Urban Rail Transit: Encompasses various types of rail systems, including heavy rail (rapid transit) and light rail transit, that provide passenger service within and around urban or suburban areas.