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The Transit-Jobs Nexus: Insights for Transit-Oriented Development

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THE TRANSIT-JOBS NEXUS: INSIGHTS FOR TRANSIT-ORIENTED DEVELOPMENT*

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INTRODUCTION

Transit has supported sustainability within, around, and connected to urban areas through job attraction, environmental and climate benefits, and other job-related benefits associated with proximity to transit. The extent to which jobs are attracted to transit varies by urban area, type of rail system, and employment sector.[1] The relationship between jobs and transit accessibility is an important component of sustainability.

Development around transit is typically referred to as transit-oriented development ("TOD"). The U.S. Environmental Protection Agency ("EPA") has defined the concept as a "compact development built around a transit station or within easy walking distance (typically a half-mile) of a station and containing a mix of land uses such as housing, offices, shops, restaurants, and entertainment."[2] The type of development varies. The concept of the TOD is an old one, and a review by Ian Carlton linked it directly to sustainability and identified its introduction initially with Peter Calthorpe and the expansion of the term by others.[3] Other reviews similarly support the relationship between rail transit and job density.[4]

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1. Arthur C. Nelson, *Transit-Oriented Developments Make a Difference in Job Location,* 44 FORDHAM URB. L.J. 1079 (2017). Other studies identified in this Article have also addressed this either directly or indirectly, such as Daniel G. Chatman & Robert B. Noland, *Do Public Transport Improvements Increase Agglomeration Economies? A Review of Literature and an Agenda for Research*, 31(6) TRANSPORT REVS. 725 (2011).

2. *Smart Growth and Transportation*, U.S. ENVTL. PROT. AGENCY (Nov. 4, 2016), https://www.epa.gov/smartgrowth/smart-growth-and-transportation [https://perma.cc/YY6M-4G86].

3. *See* PETER CALTHORPE, THE NEXT AMERICAN METROPOLIS: ECOLOGY, COMMUNITY, AND THE AMERICAN DREAM 41 (Princeton Architectural Press, 1993); IAN CARLTON, UNIV. OF CAL. BERKELEY INST. OF URB. & REGIONAL DEV., HISTORIES OF TRANSIT-ORIENTED DEVELOPMENT: PERSPECTIVES ON THE DEVELOPMENT OF THE TOD CONCEPT (2007), http://fltod.com/research/marketability/histories_of_transit_oriented_development_perspectives_on_the_development_of_the_tod_concept.pdf [https://perma.cc/48YQ-8PZ9]. Ian Carlton further identifies other works that build on Calthorpe's initial theme, namely, Tom Still, *Transit-Oriented Development: Reshaping America's Metropolitan Landscape*, SMART GROWTH (Winter 2002), https://www.nar.realtor/smart_growth.nsf/Pages/ocg_winter2002_transit_oriented_development [https://perma.cc/RT95-PR8B] and HANK DITMARR & GLORIA OHLAND eds., THE NEW TRANSIT TOWN: BEST PRACTICES IN TRANSIT-ORIENTED DEVELOPMENT (Island Press, 2004); Nelson, *supra* note 1, at 1084.

4. *See generally* Chatman & Noland, *supra* note 1. Job density in this Article signifies the number of jobs within an area circumscribed by radii of a given size or a geographic area (e.g., a Census block or tract). It is intended here to be synonymous

Transit systems are typically categorized as including light rail transit ("LRT"), bus rapid transit ("BRT"), street car transit ("SCT"), commuter rail ("CR"), and heavy rail ("HR").[5] In his article, Professor Nelson evaluates LRT, SCT, and BRT with respect to job attraction, transit accessibility, and characteristics of urban areas that support the job and transit relationship for groupings of certain economic sectors within defined alternative radii around transit.[6] Studies other than Nelson's have examined this relationship

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with job concentration. The actual density varies with the radii or the geographic area, which makes it difficult to use a single area as a reference. There are precedents for the use of the terms job or employment density and distance from transit stations in TOD studies. For example Daniel G. Chatman, Robert B. Noland & Nicholas J. Klein, *Firm Births, Access to Transit, and Agglomeration in Portland, Oregon, and Dallas, Texas,* 2598 TRANSP. RES. REC. 1, 3 (2016) use the concept of "firm births" within distances of transit stations; Robert Cervero & Erick Guerra, *Urban Densities and Transit: A Multi-dimensional Perspective* (Inst. of Transp. Stud., Univ. of Cal., Berkeley, Working Paper No. UCB-ITS-VWP-2011-6, Sept. 2011), http://www.its.berkeley.edu/sites/default/files/publications/UCB/2011/VWP/UCB-ITS-VWP-2011-6.pdf [https://perma.cc/F3T5-B64S], at 7, identify positive relationships between job density and transit, including heavy rail transit; Chatman & Noland, *supra* note 1, at 727, 736 refer specifically to employment density near transit stations.

5. In order to show the differences among the transit systems, the U.S. DOT National Transit Database ("NTD") distinguishes several different rail transit systems. The American Public Transportation Association ("APTA") provides definitions of types of transit. APTA, 2016 PUBLIC TRANSPORTATION FACT BOOK GLOSSARY, http://www.apta.com/resources/statistics/Pages/glossary.aspx [https://perma.cc/4W4R-FUHR]. The abbreviations that the NTD and APTA use are "LR" for light rail, "CR" for commuter rail, and "HR" for heavy rail. *See id.*; *see also* U.S. DEP'T OF TRANSP. FED. TRANSIT AUTH., NATIONAL TRANSIT DATABASE GLOSSARY (Jan. 9, 2017), https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary [https://perma.cc/Z7AP-B49B]. According to the APTA, "Heavy Rail is a mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration . . . ." In contrast, "Light Rail is a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car, trains) on fixed rails . . . typically driven electrically with power being drawn from an overhead electric line via a trolley or a pantograph." APTA, *supra* note 5. Commuter Rail is defined as "a mode of transit service (also called metropolitan rail, regional rail, or suburban rail) . . . [operating] on an electric or diesel propelled railway for urban passenger train service consisting of local short distance travel for the purpose of transporting passengers within urbanized areas, or between urbanized areas and outlying areas." *Id.* The APTA term excludes intercity rail except for that portion operated by or under contract with a public transit agency for predominantly commuter services. *Id.*

6. *See generally* Nelson, *supra* note 1. For abbreviations of types of transit, Nelson uses LRT for Light Rail and SCT for Streetcars. Therefore, this Article adopts Nelson's conventions for those two systems, and uses the U.S. DOT abbreviation convention for Heavy Rail ("HR").

using fewer nodes and geographic areas.[7] Nelson's study included eleven LRT, three SCT, and eight BRT systems.[8] These account for about half of the LRT systems, about a third of the SCT systems, and all of the BRT systems in the U.S.[9] The LRT, SCT, and BRT transit systems serve more decentralized populations relative to those served by HR; LRT, SCT, and BRT have been important drivers of TODs, as Nelson observes, and their growth rates support Nelson's focus on these systems.[10] LRT in particular has grown substantially in terms of the number of systems, passenger trips, and miles traveled, as indicated by the analyses of data from the American Public Transportation Association ("APTA") and the U.S. DOT National Transit Database ("NTD").[11]

While LRT, SCT, and BRT modes generally account for a lower share of transit ridership, they have been shown to have grown the fastest during many time periods according to the APTA and NTD.[12] This Article complements Nelson's emphasis on LRT, SCT, and BRT in highlighting how HR transit also supports job growth. Given the higher ridership that HR can and does support, it has the potential to attract jobs on a larger scale. Though, as Nelson points out, there may have been a disinvestment in HR,[13] HR transit still commands a very large share of urban transit, as discussed later in this Article.[14] A few studies have focused on the HR and employment relationship.[15]

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7. *See, e.g.*, Chatman, Noland & Klein, *supra* note 4.

8. Nelson, *supra* note 1, at 1088.

9. These proportions are based on system totals by mode by the APTA. APTA, 2015 PUBLIC TRANSPORTATION FACT BOOK 6 (Nov. 2015) [hereinafter APTA 2015 FACT BOOK], https://www.apta.com/resources/statistics/Documents/FactBook/2015-APTA-Fact-Book.pdf [https://perma.cc/Z4RL-DNP6].

10. Nelson, *supra* note 1, at 1082, 1090-91.

11. APTA, 2015 PUBLIC TRANSPORTATION FACT BOOK APPENDIX A: HISTORICAL TABLES (June 2015), https://www.apta.com/resources/statistics/Documents/FactBook/2015-APTA-Fact-Book-Appendix-A.pdf [https://perma.cc/U2UP-3KA9]; U.S. DEP'T OF TRANSP., OFF. OF BUDGET & POL'Y, 2015 NATIONAL TRANSIT SUMMARY & TRENDS 19 (Oct. 2016) [hereinafter DOT 2015 SUMMARY AND TRENDS], https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/2015%20NTST.pdf [https://perma.cc/NTC8-82R4]; U.S. DEP'T OF TRANSP., OFF. OF BUDGET & POL'Y, NATIONAL TRANSIT SUMMARY AND TRENDS: APPENDIX 2015 REPORT YEAR 25, 27, 39 (Oct. 2016) [hereinafter DOT 2015 SUMMARY AND TRENDS APPENDIX], https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/2015%20NTST%20Appendix.pdf [https://perma.cc/SB7P-X3RC].

12. *See* APTA 2015 FACT BOOK, *supra* note 9; DOT 2015 SUMMARY AND TRENDS, *supra* note 11.

13. Nelson, *supra* note 1, at 1079.

14. DOT 2015 SUMMARY AND TRENDS APPENDIX, *supra* note 11, at 25.

15. *See e.g.*, HIROYUKI ISEKI ET AL., ANALYSIS OF AGGLOMERATION EFFECTS IN THE PROXIMITY OF METRO RAIL STATIONS IN THE WASHINGTON, DC METROPOLITAN

This Article makes a case for HR as an attractor of jobs and an important complement to other modes of travel, while advocating for further research into other factors that contribute to job growth at transit stations. Part I of the Article provides context for the study of transit and jobs for sustainability, with an emphasis on HR. Part II provides an evaluation of HR systems with respect to the important role they play along with smaller services like LRT, SCT, and BRT in attracting jobs. Part III explores data from New York City ("NYC") that illustrates job attraction at HR stations. Part IV identifies the connectivity between HR and the other transit systems as a key factor in the success of rail and bus transit overall. Part V identifies factors other than jobs that potentially promote TOD growth around transit stations either directly or indirectly. Lastly, the Article concludes with observations about the TOD analysis.

I. ANALYZING TRANSIT AND JOBS FOR SUSTAINABILITY

The first part of the Article addresses the relationship between transit, jobs, and sustainability in three sections. First, it discusses the importance of transit and its proximity to jobs to society and sustainability. Second, it presents methodologies to evaluate transit and job relationships. Third, it provides general patterns and trends nationwide for selected bus and rail transit systems as context for the HR analysis in Part II that follows.

A. The Importance to Society and Sustainability of Transit and its Proximity to Jobs

Transit is a strong magnet for development in a number of different forms, and in particular for job growth. To the extent that workers use the transit that is nearby, concentrating jobs and residences around transit hubs has the potential for achieving sustainability goals by promoting less carbon intensive ways of traveling to work.[16] Accordingly, LRT, SCT, BRT, and HR play key roles in achieving sustainability goals. Rail systems, however, in

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AREA, presented at the Association of Collegiate Schools of Planning (ACSP) Conference, Portland, OR (Nov. 2016).

16. For worldwide figures of the contribution of rail to reducing greenhouse gas emissions ("GHGs") for both passenger and freight transport see INT'L ENERGY AGENCY, TRANSPORT, ENERGY AND CO2, MOVING TOWARD SUSTAINABILITY 52, 66 (2009), https://www.iea.org/publications/freepublications/publication/transport 2009.pdf [https://perma.cc/AX9U-MXBC] (2005 statistics are on page 52 and the projected statistics are on page 66).

different cities vary considerably in carbon loading, which affects their relative contributions to sustainability.[17]

Nelson's study period encompasses the recession in the mid- to late 2000s and the recovery period, from 2008 to 2011,[18] and identifies job attractiveness to transit by geographic location and sector. Since the post-recession period from about 2008 to 2011 experienced slower employment growth,[19] Nelson selects only those systems operating approximately around the time of the recession. Looking at job changes during that time period could represent conservative changes in jobs, given that one would expect negative impacts on jobs at that time. One explanation for how job changes respond to transit is that transit infrastructure (e.g., stations, systems, or tracks) may not have been as affected by the recession given the longer planning period for that infrastructure.

B. Methodologies for Transit and Job Relationships

A number of methodologies and databases are used to evaluate the relationship between the proximity of transit and job development. This Article relies on the U.S. Census Bureau Longitudinal Employer-Household Dynamics database ("LEHD"),[20] also used in a number of works[21] including Nelson's study.[22] This Article also uses the related U.S. Census product from *OnTheMap* for job density change.[23] Job density is one indicator of the prevalence and strength of TOD, as is job growth. Nelson also points out that other activities are attracted to transit, such as residential development, and are alternative TOD indicators.[24]

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17. STACY C. DAVIS ET AL., TRANSPORTATION ENERGY DATA BOOK 2-18 (31st ed., July 2012), http://large.stanford.edu/courses/2016/ph240/pourshafeie1/docs/Pub37730.pdf [https://perma.cc/M6XP-L5TC].

18. Nelson, *supra* note 1, at 1083, 1088.

19. Christopher J. Goodman & Steven M. Mance, *Employment Loss and the 2007–09 Recession: An Overview*, 143 MONTHLY LAB. REV. 3, 3-12 (Apr. 2011), https://www.bls.gov/mlr/2011/04/art1full.pdf [https://perma.cc/RW97-8BDR].

20. *Longitudinal Employer-Household Dynamics Database*, U.S. CENSUS BUREAU, https://lehd.ces.census.gov/ [https://perma.cc/Q2GG-NE3E].

21. *See e.g.*, ROBERT B. NOLAND ET AL., MEASURING BENEFITS OF TRANSIT ORIENTED DEVELOPMENT (Mineta Inst., Oct. 2014), http://transweb.sjsu.edu/PDFs/research/1142-measuring-TOD-benefits.pdf [https://perma.cc/HPN4-LRTU]; *see also* Daniel G. Chatman & Robert B. Noland, *Transit Service, Physical Agglomeration and Productivity in US Metropolitan Areas*, 51 URB. STUD. 917 (Aug. 2013).

22. Nelson, *supra* note 1, at 1091.

23. *OnTheMap*, U.S. CENSUS BUREAU, https://onthemap.ces.census.gov/ [https://perma.cc/SH42-E285].

24. Nelson, *supra* note 1, at 1091-92, 1094-95, 1101.

The EPA has assembled a series of factors in a database to measure accessibility to jobs via transit. These factors were initially issued as part of the EPA's Smart Location database, and underscore what is commonly identified, for example, in Litman's study as the transportation and land use connection, where increasingly spread out land uses result in greater dependency on automotive travel that produce more pollution.[25] The EPA uses LEHD data to identify the percentage of jobs available for each U.S. Census block. The EPA defines accessibility to work as being a commute time of forty-five minutes, including intermediate factors such as waiting, transferring among modes, and walking to and from the transit location.[26] To summarize, job density or concentration and job growth have emerged as commonly used indicators for development around transit stations,[27] with the caveat that factors other than transit proximity are possible attractors for development near transit stations as well,[28] which are often difficult to identify and isolate from transit effects.

C. General Patterns and Trends Nationwide for Selected Bus and Rail Transit Systems

Though Americans remain heavily reliant on vehicle (e.g., automobile) travel, transit has gained increasing popularity since the beginning of the twentieth century. In fact, as Nelson indicates in his article,[29] transit can compete with or at least complement car travel. Vehicle miles of travel ("VMT") increased dramatically in the first part of the twentieth century but then the rate slowed during the latter part of the first decade of the twenty-first century.[30]

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25. U.S. EPA, ACCESS TO JOBS AND WORKERS VIA TRANSIT-TECHNICAL DOCUMENTATION AND USER GUIDE (Mar. 2014) [hereinafter U.S. EPA ACCESS TO JOBS AND WORKERS VIA TRANSIT USER GUIDE], https://www.epa.gov/sites/production/files/2014-03/documents/sld_trans45_ug_0.pdf [https://perma.cc/VJ3S-D4EF] (the general database site is at https://www.epa.gov/smartgrowth/access-jobs-and-workers-transit-technical-documentation-and-user-guide [https://perma.cc/663Z-7E94]). *See also* TODD LITMAN, EVALUATING TRANSPORTATION LAND USE IMPACTS: CONSIDERING THE IMPACTS, BENEFITS AND COSTS OF DIFFERENT LAND USE DEVELOPMENT PATTERNS 2 (Nov. 25, 2016), http://www.vtpi.org/landuse.pdf [https://perma.cc/6CGE-KW59].

26. U.S. EPA ACCESS TO JOBS AND WORKERS VIA TRANSIT USER GUIDE, *supra* note 25, at 2.

27. *See e.g.*, Chatman & Noland, *supra* note 21, at 1-21; discussion, *supra* note 4.

28. Nelson, *supra* note 1, at 1101.

29. *Id.* at 1080-81.

30. *Public Road Mileage, Lane-Miles, and VMT, 1920–2015 Chart VMT-421C*, FED. HIGHWAY ADMIN., U.S. DEP'T OF TRANSP., HIGHWAY STATISTICS 2015 (2016), https://www.fhwa.dot.gov/policyinformation/statistics/2015/vmt421c.cfm [https://perma.cc/P9NT-JHKK]; *id.* at 4-5.

Non-HR "fixed guideway" or rail systems have become increasingly prominent travel modes. Indicators of this change, usually applied from the beginning of the twentieth century onward,[31] include length of track, rail mileage traveled, and ridership. TODs stand to benefit significantly by taking advantage of these systems, as Nelson points out in his article.[32]

LRT, in particular, is a rapidly growing transit sector compared to HR, and the NTD attributes the increase of 5.6% in fixed guideway systems between 2006-2015 partly to expansions in LRT and SCT.[33] Still, HR commands a very large share of both transit ridership and miles traveled. Moreover, HR had a robust rate of increase from 2000 through 2014 described in more detail in the next section, which is at most times comparable to LR, especially given the very large HR base.[34] Part II, addresses these patterns and trends in more detail.

II. HEAVY RAIL AND OTHER FIXED GUIDEWAY MODES

This Part introduces some general patterns and changes in U.S. transit systems and in HR and LRT in particular. The analysis supports a focus on HR and the attractiveness of jobs to that transit system.

A. Shares of Transit Modes Relative to Other Modes

Rail transit systems are categorized as fixed guideway systems ("FG"). HR, LRT, and SCT modes of transportation are in the FG rail system category.[35] The U.S. DOT provides a summary definition of FG as "a facility that uses separate right-of-way (ROW) or rail exclusively for public transportation. FG may be a fixed catenary system useable by multiple forms of public transit (e.g., trolleybus, light rail, etc.)."[36] The APTA provides similar definitions.[37]

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31. APTA, 2015 PUBLIC TRANSPORTATION FACT BOOK APPENDIX A: HISTORICAL TABLES, *supra* note 11, at 173-175, 39-40, 25-28.

32. Nelson, *supra* note 1, at 1085-86.

33. DOT 2015 SUMMARY AND TRENDS, *supra* note 11, at 19. HR is considered part of the Fixed Guideway System. *Id.*

34. APTA, 2016 PUBLIC TRANSPORTATION FACT BOOK APPENDIX A: HISTORICAL TABLES 414-15 (Apr. 2016), https://www.apta.com/resources/statistics/Documents/FactBook/2016-APTA-Fact-Book-Appendix-A.pdf [https://perma.cc/U96Y-RVVU].

35. The concept is defined in 49 U.S.C. § 5302: "fixed guideway means a public transportation facility (A) using and occupying a separate right-of-way or rail for the exclusive use of public transportation and other high occupancy vehicles; or (B) using a fixed catenary system and a right-of-way usable by other forms of transportation." 49 U.S.C. § 5302(A)-(B).

36. DOT 2015 SUMMARY AND TRENDS, *supra* note 11, at 18.

According to 2014 data from the APTA, HR dominates among FG modes in transit activity. The APTA uses two ways of measuring transit activity or ridership, as unlinked passenger trips and passenger miles of travel. The APTA defines

> unlinked passenger trips, also called boardings, as the number of times passengers board public transportation vehicles, no matter how many vehicles they use to travel from origin to destination, and regardless of whether they pay a fare, use a pass or transfer, ride for free, or pay in some other way.[38]

The APTA defines passenger miles as "the cumulative sum of the distances ridden by each passenger" within the transit system.[39] The APTA's 2014 data regarding the relative share of rail, as an FG mode, is the following:

- All FG modes accounted for 47.3% of all roadway and rail transit passenger *trips* combined (i.e., all modes), with HR accounting for 36.5% and LRT for 4.5% of all modes of travel (including roadways).[40]
- All FG modes accounted for 55.8% of the roadway and rail transit passenger *miles of travel* (i.e., all modes), with HR accounting for 30.7% and LRT for 4.2% of all modes of travel (including roadways).[41]

Thus, HR has a large share of ridership and a comparable growth rate to LRT.

Buses are another form of transit. Nationwide, in 2014, the shares of bus and FG rail trips were about equal, being 49.1% and 47.3%

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37. According to the APTA,

> Fixed-Guideway is a grouping of transit services that have physical fixed-guideway such as rails, concrete channels, or overhead cables or operates on a fixed-route waterway such as ferry boats. Fixed Guideway modes reported on the fixed-guideway tables of this report include aerial tramway, automated guideway transit, cable car, commuter rail, ferry boat, heavy rail, hybrid rail, inclined plane, light rail, monorail, and streetcar. Trolleybus and bus on exclusive or controlled-access rights-of-way are considered fixed-guideway in the National Transit Database for data that are used in some formulas which distribute federal financial assistance; they are include[d] with roadway modes on the tables in this report.

APTA, supra note 34, at 514.

According to the APTA's definition and categorization of modes into fixed guideways, the APTA puts buses and BRT into roadway mode whereas the NTD puts it in fixed guideway. *Id.*

38. APTA 2015 FACT BOOK, *supra* note 9, at 67.

39. *Id.*

40. APTA, 2016 PUBLIC TRANSPORTATION FACT BOOK APPENDIX A: HISTORICAL TABLES, *supra* note 34, at 36.

41. *Id.* at 44.

respectively,[42] but buses had a smaller share of passenger miles than fixed rail, with 37.7% bus miles versus 55.8% FG rail miles.[43]

B. U.S. Rates of Change in Heavy and Light Rail Transit

The following rates of change in HR and LRT systems in Table 1 were calculated using the APTA data for selected time periods from 2000 through 2014.[44] The 2008-2011 period corresponds to the period that Nelson used for job changes.

Table 1: U.S. HR and LRT Rates of Change, Selected Periods Between 2000 and 2014

	Total % Change		Annualized % Change	
	Trips	Miles	Trips	Miles
Heavy Rail				
2000-2010	34.9%	18.5%	3.0%	1.7%
2000-2014	49.2	32.5	2.9	2.0
2008-2011	2.8	2.8	0.9	0.9
Light Rail				
2000-2010	42.8	60.3	3.6	4.4
2000-2014	50.9	83.6	3.0	4.3
2008-2011	-4.0	5.3	-1.3	1.7

The NTD gives somewhat comparable data on change in the different modes, with different year ranges. For example, it reports that for HR, LRT, and BRT ("Bus"), the percentage changes for unlinked passenger trips from 2006 through 2015[45] was 31.9% for HR, 17.9% for LRT, and minus 3.1% for BRT. For vehicle revenue miles, the percentages were 6.6% for HR, 44.8% for LRT, and 2.4% for BRT.[46]

Table 1 shows that in terms of trips, HR's rate of increase was less than LRT's during the first decade of the twenty-first century, but HR had about the same rate of increase as LRT from 2000 to 2014. HR has a much larger base which tends to dwarf rates of change.

42. *Id.* at 32, 36.
43. *Id.* at 42, 44.
44. *Id.* at 27-28, 39-40.
45. DOT 2015 SUMMARY AND TRENDS APPENDIX, *supra* note 11, at 26. The percentage changes were higher for each mode in the 2014 report covering the period 2005-2014.
46. *Id.* "Vehicle revenue miles are the miles a transit vehicle travels while in revenue service." U.S. DEP'T OF TRANSP. FED. TRANSIT AUTH., *supra* note 5, at 28.

Meanwhile, while HR trips continued to increase during the recession years between 2008 and 2011, LRT trips declined. Thus, the prevalence and robustness of HR in the face of economic downturns indicates that it is likely to be a job attractor, and should be considered in TOD analyses as it relates to job attraction.

III. HR SYSTEMS AND JOB CHARACTERISTICS AROUND HR STATIONS IN NEW YORK CITY

In this Part, NYC is used to illustrate job attraction at HR stations in the NYC subway system.[47] With NYC as the geographic area of focus, this research looks at (1) changes in job density and (2) the absolute value of job density along HR transit routes, with a focus on transit stations. As indicated earlier in Note 4, job density is used synonymously here with job concentration. The NYC system is a very rich database given the size and extent of its rail transit system and its large and diverse job centers. The City of New York has identified job density patterns in NYC, but not in a way that superimposes them over transit stations, as the research presented in this Article does.[48]

The significance of NYC in terms of the job market is reflected in the magnitude of jobs in the region in which it is located. In 2016, U.S. Department of Labor ("DOL") data indicated that the New York-Newark-New Jersey metropolitan area ranked highest in employment of any metropolitan area in the U.S. with a civilian labor force of about 10.1 million; this exceeded the total labor force of many individual states, and was about 1.5 times greater than the second highest-ranking metropolitan area.[49] In addition, the DOL reported that the New York-Newark, Jersey City, NY-NJ-PA metropolitan area also had the largest "over-the-year" increase in non-farm employment from 2015 through 2016 based on November employment levels, compared to other comparable metropolitan areas in the U.S.[50]

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47. This Part does not take into account HR stations in NYC's commuter rail network (e.g., the Long Island and Metro North railroads). It only includes the subway system operated by NYC Transit.

48. CITY OF N.Y., ONE NEW YORK: THE PLAN FOR A STRONG AND JUST CITY 29 (2015), http://www.nyc.gov/html/onenyc/downloads/pdf/publications/OneNYC.pdf [https://perma.cc/Q2KU-DSVF].

49. U.S. Dep't of Labor, Bureau of Labor Statistics, *Economic News Release: Table 1. Civilian Labor Force and Unemployment by State and Metropolitan Area*, U.S. DEP'T OF LAB., https://www.bls.gov/news.release/metro.t01.htm [https://perma.cc/DQR9-FEW7] (last modified Apr. 5, 2017).

50. U.S. Dep't of Labor, Bureau of Labor Statistics, *Economic News Release: Metropolitan Area Employment and Unemployment Summary*, U.S. DEP'T OF LAB.,

A. Job Density Change

Substantial job increases have been identified in discrete locations throughout NYC using the U.S. Census Bureau *OnTheMap* application.[51] Though the data was aggregated by census tract from *OnTheMap* block level data, the block level data was retained and overwhelmingly indicates that many of such job increase areas are near HR subway stations. NYC currently does not have a LRT system, though one has been proposed to connect Brooklyn and Queens along the waterfront.[52]

Job density ranges are defined for census tracts by ID numbers ranging from one to five,[53] with corresponding job ranges for each category varying by time period and place. For NYC, changes in the job density ranges for 2008 (the period near or at the onset of the recession), 2013, and 2014 (the period when the recession was ending, however, effects may still have been felt)[54] were:

Job Density Ranges

ID	2008	2013	2014
1	5 - 23,856	5 - 26,268	5 - 26,866
2	23,857 - 95,411	26,269 - 105,057	26,867 - 107,452
3	95,412 - 214,669	105,058 - 236,373	107,453 - 241,760
4	214,670 - 381,630	236,374 - 420,215	241,761 - 429,793
5	381,631 - 596,295	420,216 - 656,584	429,794 - 671,549

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https://www.bls.gov/news.release/metro.nr0.htm [https://perma.cc/2J6J-ZJWE] (last modified Apr. 5 2017).

51. *OnTheMap*, *supra* note 23. The definition of geographic units for which *OnTheMap* data is collected is found at U.S. Census Bureau, Longitudinal Employer-Household Dynamics: OnTheMap Help and Documentation, U.S. CENSUS BUREAU, https://lehd.ces.census.gov/applications/help/onthemap.html#!geographic_data. [https://perma.cc/9TQQ-L78P].

52. *See About DOT*, NYC DOT (2017), http://www.nyc.gov/html/dot/html/about/redhookstreetcar.shtml [https://perma.cc/B7BH-72WE]. *See also* Miranda Katz, *Light Rail Could Connect Brookly-Queens Waterfront for $1.7 Billion*, GOTHAMIST (Jan. 6, 2016, 3:10 PM), http://gothamist.com/2016/01/06/brooklyn_queens_connector.php [https://perma.cc/J6TD-NDQW].

53. The U.S. Census has indicated it uses a "custom function" to generate the intervals, which are expressed in terms of employment. The function starts with minimum and maximum employment range and then fits a polynomial function to it that produces a best fit, i.e., "the most number of valid (i.e., monotonically increasing) breaks" to produce thermal maps. Response to Inquiry from Ces.onthemap.feedback@census.gov, Feb. 23, 2017 (on file with author). The data source is obtained using *OnTheMap, supra* note 23.

54. This Article lists the ranges for years 2008, 2013, and 2014 to correspond to the recession onset and conclusion.

Below, Table 2 shows the shifts in job density around NYC HR stations from 2008 to 2014 in terms of category shifts.

Table 2: Changes in Job Density by Category, 2008-2014, NYC HR Transit[55]

Number of Categories Shifted	Number of Stations Shifted	Percentage of Stations Shifted
-1	5	1.01%
0	458	92.90
1	25	5.07
2	5	1.01
Total	493	100.00

Two important trends are relevant to the analysis of HR and jobs: first, that twenty-five (five percent) of NYC transit stations increased by one job category, and second, that five (one percent) of the NYC transit stations increased by two job categories.

Areas with high and increasing job density from 2008 to 2014 are located near certain HR stations that are potentially job attractors. Four of the five stations that increased by two levels were in the Borough Hall area of Brooklyn,[56] where a number of stations converge; the fifth was South Ferry at the southern tip of Manhattan.

During this timeframe, there were nine stations outside Manhattan that increased by one level.[57] This change also implies that these areas are attracting jobs. They include Mosholu Parkway in the Bronx; Bergen Street, Fort Hamilton Parkway, High Street, Hoyt-Schermerhorn, and Lafayette Avenue in Brooklyn; and Main Street Flushing, Roosevelt Island, and 39th Avenue-Beebe Avenue in Queens.[58]

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55. These are computed by corresponding the station locations and the location of the job density change data from *OnTheMap*, *supra* note 23. Note that although the stations are shifting with respect to which job density category they are in, the values for the ranges are shifting also, usually just slightly.

56. These stations are in the Borough Hall Jay Street complex: Court Street, Lawrence Street, Jay Street, and Borough Hall. The Lawrence Street station was replaced by Jay Street-Metrotech in the early 2000s. *Forgotten Queens: Lawrence Street*, FORGOTTEN NEW YORK (last updated Oct. 18, 2015), http://forgotten-ny.com/2012/02/lawrence-street/ [https://perma.cc/LF2A-JQYX]. As discussed in the next Section, these areas also contained stations in the highest density category in 2014.

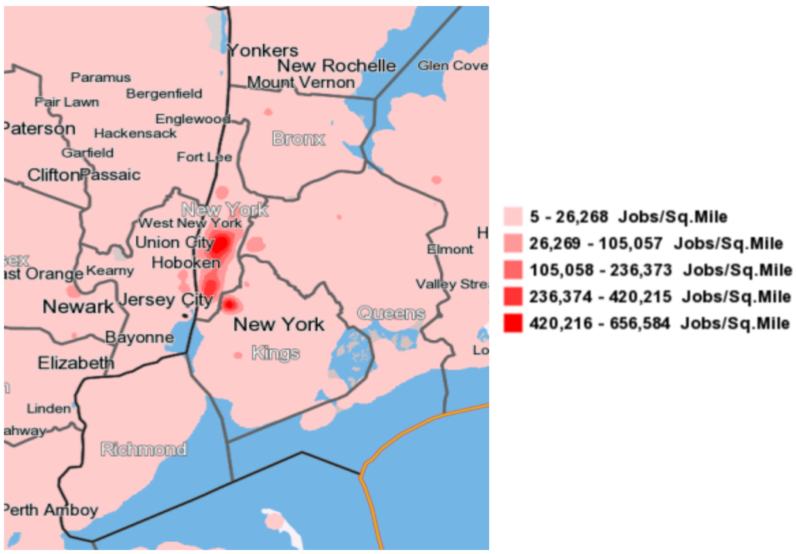
57. These were identified from the data used as the basis for this Article.

58. *Id.*

B. Job Density or Concentration

Figure 1 shows the job density or concentration, as opposed to the shifts in the ranges discussed in the previous Section, for the New York combined statistical area created from the U.S. Census data, which is important to this Section of the Article.[59]

Figure 1: *Job Density, New York Area (Combined Statistical Area), 2013*[60]



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59. The U.S. Office of Management and Budget defines Combined Statistical Area and other geographic areas. The U.S. Census defines Combined Statistical Areas ("CSAs") as consisting of two or more adjacent Core Based Statistical Area ("CBSAs") that have "substantial employment interchange." Meanwhile, CBSAs consist of

> the county or counties or equivalent entities associated with at least one core (urbanized area or urban cluster) of at least 10,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties with the counties associated with the core . . . .[the term] refers collectively to metropolitan statistical areas and micropolitan statistical areas.

Geographic Terms and Concepts-Core Based Statistical Areas Related Statistical Areas, U.S. CENSUS BUREAU (Dec. 6, 2012), https://www.census. gov/geo/reference/gtc/gtc_cbsa.html#csa [https://perma.cc/V2N7-KYSQ].

60. The map data was computed from data from U.S. Census Bureau. *OnTheMap*, *supra* note 23. *Longitudinal-Employer Household Dynamics (LEHD) Program*, U.S. CENSUS BUREAU (2016), https://lehd.ces.census.gov/ [https://perma.cc/T4A4-95VC]. The year the *OnTheMap* tool was used was 2016, applied to 2013 LEHD data.

The U.S. Census Bureau LEHD Origin-Destination Employment Statistics ("LODES") contains jobs as discrete values, unlike the ranges in the previous Section. As defined in this analysis, these discrete values represent the number of jobs around each HR transit station in NYC for different areas circumscribed by three different radii, 0.1, 0.25, and 0.5 miles, from the latitude and longitude identifier assigned to each station. Smaller radii were selected here, compared to those used in other studies, given the density of NYC.[61]

The range of jobs citywide for the areas circumscribed for each of the radii across all of the stations was as follows:[62]

0.10 miles: 121 to 272,952 jobs

0.25 miles: 434 to 455,728 jobs

0.50 miles: 434 to 847,559 jobs

The distribution of jobs is highly correlated for each of the distances (i.e., radii selected) based on correlations computed by the author. Each combination was close to 0.9, as indicated by the examples below.[63] A correlation coefficient ranges from 0 (no association) to 1 (complete association).

Radii (miles)	Correlation Coefficient
0.10 and 0.25	0.90
0.10 and 0.50	0.82
0.25 and 0.50	0.93

As in the case of job density changes in the previous Section, a few stations and clusters of stations emerge as having higher numbers of jobs within areas circumscribed by the different radii. In some cases, these correspond to the areas where jobs changed the most.

Within the 0.10 mile radius, the Borough Hall area exceeded 200,000 jobs. A Lower Manhattan area followed with second-highest job density within that radius. Within the 0.25 radius, concentrations exceeding 300,000 jobs shifted primarily to Lower Manhattan and Midtown Manhattan. Within the 0.50 radius, areas exceeding 400,000 jobs similarly were greatest in Lower Manhattan and Midtown Manhattan. While the Lower and Midtown Manhattan corridor is highest in job density, the Brooklyn Borough Hall complex leads in job density change (as described in the previous Section). This is not

61. The data used to aggregate by radii was again, the *Longitudinal-Employer Household Dynamics Program*. *Id.*

62. *Id.*

63. *Id.*

surprising given the rate of change in development that has occurred in that part of Brooklyn.

However, there are some anomalies in the job-transit access relationship. While stations with higher numbers of jobs tend to have more train lines stopping at the station, with at least two or more train lines, there are some exceptions. There are stations in some of the parts of Brooklyn, for example that are far from Manhattan and have a large number of train lines, as many as four,[64] but probably have an extremely low number of jobs. Looking forward, it will be important to watch whether, given the existing access reflecting the number of train lines, these areas will become hubs for job development in addition to the means for workers to access areas of higher employment from more outlying areas of the system.

IV. CONNECTIVITY AND SUPPORT AMONG TRANSIT SYSTEMS

Connections between buses and subways do and can continue to provide alternative transportation modes that make rail transit stations more attractive to development. This is because multiple modes enable riders to potentially shorten the length of their trip by transferring to other modes. Connectivity also supports flexibility during downtimes. Nationally, the Intermodal Passenger Connectivity Database ("IPCD") indicates that bus connectivity is highest with rail transit compared to other forms of mode connectivity, and this is particularly true in the New York area where "20 of the 22 intercity train stations and 337 out of 469 heavy rail transit stations are connected to bus transit."[65] A 2014 study of the connectivity between NYC subway stations and bus stops showed that buses stopping at subway stations can range from none to a couple of dozen.[66]

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64. Rae Zimmerman et al., *Promoting Transportation Flexibility in Extreme Events through Multi-Modal Connectivity*, UNIV. TRANS. RES. CTR. (June 2014), http://www.utrc2.org/sites/default/files/pubs/Final-NYU-Extreme-Events-Research-Report.pdf [https://perma.cc/RH5F-WU8X].

65. Rae Zimmerman et al., *MultiModal Transit Connectivity for Flexibility in Extreme Events*, 2532 TRANSP. RES. REC. 64-73 (2015); Zimmerman et al., *supra* note 64, at 20; *see also* RES. & INNOVATIVE TECH. ADMIN., U.S. DEP'T OF TRANSP., *Intermodal Passenger Database* (2013), http://www.transtats.bts.gov/IPCD_Facts.pdf; https://www.transtats.bts.gov/IPCD_Facts.pdf [https://perma.cc/J547-CZJQ] (for IPCD information). Note that the number of stations cited here differs from that shown in Table 2. The higher number in Table 2 reflects a count of the actual entrances and exits. The lower number reflects the places where ridership is counted. Stations were aggregated for counting ridership, since it is difficult to keep track of ridership at multiple points in a place where there are a number of entrances and exits.

66. Zimmerman et al., *supra* note 64, at 30-31.

Bus connectivity is in part related to the number of train tracks, i.e., number of train lines located at each station.[67] This reflects the attraction of bus systems to areas with greater ridership, generally typical of areas with more train lines. The significance of this is that bus connectivity to rail transit stations provides system users with more transit flexibility. Moreover, many of the stations or station conglomerates where numerous buses also stopped were also areas of high job density.

Equity in the distribution of transit access in terms of stations and buses connecting to them is an important consideration. Notably, the 2014 analysis revealed that certain station locations in poorer areas of NYC have relatively fewer buses stopping than areas with higher income levels.[68] Outside of NYC, in the U.S. as a whole, equity issues are arising in suburban areas in connection with access of poorer areas to rail transit. As illustrated by combining Brookings Institution data for metropolitan areas and rail data, areas that saw an increase in poorer populations also had a gap in the accessibility of HR transit. To examine this, about a dozen cities were identified where the ratio of populations in poverty in 2010 and those in poverty in 2000 exceeded twenty percent.[69] The percent share of the HR rail transit trips was computed for each of those cities with ratios above twenty percent from the NTD data cited earlier; this data showed the percent share that each HR system had of total U.S. HR trips. The results indicated that, of these areas, only one city, Chicago, exceeded a ten percent share for any rail type, and most of the cities, except for Chicago, accounted for less than five percent of the U.S. share of HR trips.[70]

V. FACTORS INFLUENCING THE TOD/JOB PHENOMENON

Many factors influence the relationship between transit proximity and job density, specifically whether jobs are attracted to transit, and if so, to what extent. This Article suggests eight important factors to keep in mind when interpreting these relationships.

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67. *Id.* at 42.

68. *Id.* at 34-39, 43.

69. Data provided by Elisabeth Kneebone, BROOKINGS INSTITUTION (on file with author).

70. RAE ZIMMERMAN, TRANSPORT, THE ENVIRONMENT AND SECURITY: MAKING THE CONNECTION, 16 (2012). Information on trips was compiled from the U.S. DOT National Transit Database. Population and population change data was compiled from data provided by Elisabeth Kneebone from the Brookings Institution (on file with author).

First, methodology is a key factor that can influence the relationship between transit proximity and job density. The method used to measure the areas around transit stations for defining job location can be critical. Issues include the shape of such areas, and the existence of physical barriers within them, such as coastlines, roadways, or buildings, that can interrupt data.[71]

One choice in determining methodology is deciding the measurements for transit station proximity. Nelson identifies three studies to support using four bands up to a one mile radius around a station to measure the job effect.[72] The one mile radius and others within it have been used by other studies of transit location and job density. This Article used several distances described above, namely 0.10, 0.25, and 0.50 miles which are smaller radii given the density of NYC and its HR system.

Another related methodological issue is the shape of the area surrounding the transit station. A circular configuration (e.g., one mile) around a station might be supplemented by a distance along a transit corridor, even though the corridor, or rail line, also includes stations located along the corridor. In a study by the Transportation Research Board ("TRB"), a transit corridor is defined as follows:

> A transit corridor consists of a transit alignment (the physical transit line at the center "axis" or "spine" of the corridor), a catchment or buffer area (the width or area of influence of the transit line that extends outward from the corridor alignment), and its length. Some corridors also contain a wide variety of land uses, activity patterns, and travel conditions (among other characteristics) that suggest it should be viewed as a collection of segments.[73]

This definition incorporates the station when defining the boundaries of a transit corridor and its catchment area, making stations clearly part of the corridor.[74] Thus, TOD may be a station oriented phenomenon, as Nelson and others define it, or a corridor phenomenon. While the station is where the transit service can be accessed, broader corridor areas might have a significant impact on jobs which may not be accounted for if not part of the measurement used for analysis.

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71. CHRISTOPHER E. FERRELL ET AL., LIVABLE TRANSIT CORRIDORS: METHODS, METRICS, AND STRATEGIES (2016), http://www.tcrponline.org/PDFDocuments/tcrp_rpt_187.pdf [https://perma.cc/S8QY-ZTWW].

72. *See* Nelson *supra* note 1, at 1088.

73. FERRELL ET AL., *supra* note 71, at 13.

74. *Id.* at 15.

Second, characteristics of the transit service itself could be a significant factor in attracting jobs. Chatman and Noland identified a number of these in their statistical analysis of job agglomerations around transit stations.[75] Ramsey and Bell in their methodology for exploring transit and job access identified a wide set of characteristics at the U.S. Census block group level that could be used in modeling, such as accessibility of both jobs and population to transit by wage level and travel time to jobs using transit.[76]

Third, other activities and attractions located near and around stations could bring jobs, even indirectly, rather than or in addition to transit. Examples of these include health services,[77] educational facilities, recreation, and shopping that could benefit from the density of the area near transit stations.

Fourth, there is the underlying temporal sequencing question, which is whether jobs attract transit or transit attracts jobs.

Fifth, accessibility to transit stations can influence the strength of the job and transit relationship. For example, it is important to note whether there is a road or bike lane along the corridor for easy access to the station. The availability and cost of a variety of alternative modes of travel, such as cars for hire, e.g., on-call or on-demand vehicular services, shared rides, and specialized services for certain sectors of the population, such as Access-A-Ride, can influence accessibility. Paratransit is also a critical concept related to some of these examples, defined as a "demand response" mode of travel not following fixed routes.[78] This involves understanding how transit riders access stations, and whether access is by motorized or non-motorized means of transportation, such as walking and biking.[79]

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75. Chatman & Noland, *supra* note 21, at 9.

76. KEVIN RAMSEY & ALEXANDER BELL, U.S. EPA, ACCESS TO JOBS AND WORKERS VIA TRANSIT 3-6 (2014), https://www.epa.gov/sites/production/files/2014-03/documents/sld_trans45_ug_0.pdf [https://perma.cc/B79M-F84H].

77. *See* Kelsey E. Thomas, *St. Louis to Deliver Healthcare at the Train Station*, NEXT CITY NEWSL. (Sept. 14, 2016), https://nextcity.org/daily/entry/us-dot-grant-healthcare-transit-station-st-louis [https://perma.cc/9PK8-YZDQ].

78. APTA 2015 FACT BOOK, *supra* note 9, at 66. The APTA defines paratransit as

> characterized by the use of passenger automobiles, vans, or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. The vehicles do not operate over a fixed route or on a fixed schedule.

Id.

79. Avisha Ceder & Chen S. Teh, *Comparing Public Transport Connectivity Measures of Major New Zealand Cities*, 2143 TRANSP. RES. REC. 24-33 (2010); Lily Gordon-Koven & Nolan Levenson, *Citi Bike Takes New York*, N.Y.U. RUDIN CTR.

Sixth, human behavior in transit route choice does not always lead to linear relationships; there are behavioral factors that influence whether or not people choose the shortest route. A good way to assess the attractiveness of a TOD site is to understand why people choose the transit routes they do. Factors in this decision-making may include reliability, relative cost, other trips needed in connection with the journey to work, and other travel alternatives.[80]

Seventh, gentrification and equity issues may arise where job attraction can dislocate existing uses. For example, this issue has been raised in connection with some subway station improvements in New York City, such as the Second Avenue Subway.[81] The effects of gentrification and potential equity issues on job-transit relationships are uncertain. They could increase either residential or business uses near transit stations, and the jobs they bring could drive out existing residential uses, such as low-income residents, especially renters.[82]

Eighth, a transit station's general resilience to changing climate and extreme climates may make it more attractive for jobs. One factor that can influence resiliency is a station's interdependencies and interconnections with other infrastructure such as electric power. There are a few other resiliency factors specific to what firms and workers may seriously consider. One is the opportunity of transit to provide pre-event evacuation, that is, to enable people to use transit to leave an area in an emergency.[83] A second is the flexibility of transit services to shift from one mode to another especially in

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FOR TRANSP. MGMT. & POL'Y (2014), http://wagner.nyu.edu/rudincenter/publication/citi-bike-takes-new-york-2/ [https://perma.cc/R7RA-BBAR].

80. Z. Guo & N. H.M. Wilson, *Assessing the Cost of Transfer Inconvenience in Public Transport Systems: A Case Study of the London Underground*, 45 TRANSP. RES. PART A: POL'Y & PRAC., 91-104 (2011); Zhan Guo, *Mind the Map! The Impact of Transit Maps on Path Choice in Public Transit*, 45 TRANSP. RES. PART A: POL'Y & PRAC., 625-39 (2011).

81. Emma G. Fitzsimmons, *Second Avenue Subway's Arrival Brings Fear That Rents Will Soar*, N.Y. TIMES (Dec. 30, 2016), https://www.nytimes.com/2016/12/30/nyregion/second-avenue-subway-rent-worries.html [https://perma.cc/WV53-FDZX].

82. Michael S. Barton & Joseph Gibbons, *A Stop Too Far: How Does Public Transportation Concentration Influence Neighbourhood Median Household Income?*, 54 URB. STUD., 538-54 (2017).

83. Rae Zimmerman et al., Public Transit and Mandatory Evacuations Prior to Extreme Weather Events in NYC (2015), ongoing research, New York University, Wagner Graduate School of Public Service. *See also* Rae Zimmerman et al., *Public Transit and Mandatory Evacuations Prior to Extreme Weather Events in NYC*, *UTC Spotlight Univ. Transp. Ctrs. Program No. 109*, *in* A NEW ROLE FOR RAIL TRANSIT: EVACUATION (Apr. 2017), https://www.transportation.gov/sites/dot.gov/files/docs/utc/April_2017_UTC_Spotlight.pdf [https://perma.cc/63PP-GT76].

emergencies.[84] A third is transit's vulnerability in wind-prone, flood-prone, and land-instability areas.

These factors can potentially affect the sharpness of the findings of any TOD analysis. Analysts should consider them carefully in designing and interpreting such studies.

CONCLUSION

In his article, Professor Nelson makes a strong case for the attraction of certain kinds of jobs to transit nationwide for different kinds of transit systems and industries.[85] The connection between transit and jobs has the potential to produce compelling sustainability and resilience benefits. Environmental and sustainability benefits can be achieved by increasing transit accessibility to those sectors of society with fewer resources to allocate to travel, since transit might have cost advantages over private vehicles, as well as environmental and other benefits to those users where gentrification is taken into account. These findings vary considerably by location, and are determined by the kind of urban area, type of industry, and mode of transit available.[86]

Nelson analyzed transit sectors that are now growing rapidly but have been relatively less studied.[87] Still, it is instructive to also look at the HR sector, given that some of the largest cities with the largest employment rely on HR transit. This Article offered NYC as an example, given the size of its workforce, population, and transit system, yet its approach and findings can be scaled to other areas. However, before other cities use these findings to plan for and tailor development and transit design to their needs and expectations, their implications need to be better understood.

Accordingly, there are some caveats and cautions involving methodological refinements that need to be addressed. This Article already touched upon some of the critical caveats, particularly with respect to the design of research to identify the transit and TOD associations and their impacts. To summarize, the first is the sequence of transit and job proximity, that is, whether transit or development came first at the sites evaluated. This has important practical effects for metropolitan planning, for example, in how one might zone land areas and the timing of those actions to accommodate or anticipate the co-location of transit and

84. Zimmerman et al., *supra* note 64.
85. *See generally* Nelson, *supra* note 1, at 1079.
86. *See generally* Chatman & Noland, *supra* note 21.
87. *See* Nelson, *supra* note 1, at 1079, 1084-85.

development. Another caveat is how to assess intervening variables. It will be important to discern whether other attractors are located within a defined radius of a station. Some of these attractors may be drawing people to transit stations, rather than transit itself. Health services, for example, are being promoted around transit stations to attract transit users to the health services and vice versa.[88]

Planning that incorporates transit and job relationships must do so with caution to balance the risk of negative environmental and economic impacts with the benefits. First, the TOD phenomenon, depending on how and where it is designed, could increase decentralization of development that poses other environmental ills similar to the effects of sprawl[89] that TODs could instead prevent. An extensive review of the compact development literature (not specifically focused on TODs) has argued that compact development will not produce congestion and the environmental effects that may accompany it.[90] Further, adverse equity issues identified above should be taken into consideration if TODs increase rents or property values.[91] Lastly, TODs can provide the density necessary to economically sustain LRT and other non-HR systems. If they do, then HR can be supported as well, though a higher density might be required, as well as a more complex analysis to evaluate this.[92] Various kinds of transit systems can support TODs, though the kinds of development associated with transit can vary over time, by type of transit, location, and other factors, and benefits of this association can vary with design. In conclusion, in addition to lower density transit and TOD relationships, higher density transit systems such as HR have the potential, depending on the conditions, for supporting such development and its benefits also.

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88. *See* Thomas, *supra* note 77.

89. LITMAN, *supra* note 25, at 19; *see generally* ROBERT BURCHELL, ANTHONY DOWNS, BARBARA MCCANN & SAHAN MUKHERJI, SPRAWL COSTS: ECONOMIC IMPACTS OF UNCHECKED DEVELOPMENT (2005).

90. LITMAN, *supra* note 25, at 20.

91. *See* Fitzsimmons, *supra* note 81.

92. Cervero & Guerra, *supra* note 4.