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# The Impact of Transit-Oriented Development on Social Capital

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# The Impact of Transit-Oriented Development on Social Capital



MNTRC Report 12-67



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REPORT 12-67

# **THE IMPACT OF TRANSIT-ORIENTED DEVELOPMENT ON SOCIAL CAPITAL**

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## TABLE OF CONTENTS

<b>Executive Summary</b>	<b>1</b>
<b>I. Introduction</b>	<b>3</b>
<b>II. TOD and Social Capital</b>	<b>4</b>
<b>III. Survey and Data</b>	<b>7</b>
<b>IV. Results</b>	<b>12</b>
<b>V. Discussion and Conclusions</b>	<b>27</b>
<b>Appendix: Tabulations of Social Capital Measures by Train Station Area</b>	<b>29</b>
<b>Acronyms and Abbreviations</b>	<b>31</b>
<b>Endnotes</b>	<b>32</b>
<b>Bibliography</b>	<b>35</b>
<b>About the Authors</b>	<b>37</b>
<b>Peer Review</b>	<b>39</b>



## **LIST OF FIGURES**

1. Location of Stations Surveyed and Commuter Rail Lines in New Jersey 9

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## LIST OF TABLES

1. Demographics by Municipality	8
2. Social Capital Survey Questions	9
3. Summary Statistics	11
4. Social Capital: Binary Logit Model, “Have you volunteered...?”	13
5. Summary Results of Agreement on Social Capital Questions	14
6. Binary Logit Models for Social Capital Measures (with average age)	17
7. Binary Logit Models for Social Capital Measures (with home tenure)	19
8. Summary of Social Capital Scale, Including for Each Area	22
9. Social Capital Ordered Logit Model	24
10. Coefficients that Violate Parallel Lines Assumption, Model with Housing Tenure	25
11. Coefficients that Violate Parallel Lines Assumption, Model with Average Age	26

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## EXECUTIVE SUMMARY

A variety of research has examined whether more compact, mixed-use areas foster greater social capital. That is, the research looks at whether residents become more engaged with their community in a variety of ways, whether through involvement in civic activities, or more connections with neighbors and others in their community. Ever since the publication of *Bowling Alone* by Robert Putnam in the 1990s, some have made the argument that sprawling communities result in social isolation.<sup>1</sup> In this research, the authors examine this hypothesis with a focus on Transit-Oriented Development (TOD) in New Jersey.

Previous work in New Jersey has examined travel behavior associated with TODs, finding a tendency to use more transit, walk more and drive less for those living near various commuter rail stations.<sup>2</sup> This work uses the same data collected for the prior study and uses a selection of attitudinal questions aimed at measuring social capital. A series of models is presented that examine six measures, plus a scaled combination measure. These include a binary measure of whether respondents engage in volunteer activities, and ordered measures (based on a Likert scale from 'strongly disagree' to 'strongly agree') as follows: "My neighborhood is a good place to live," "living in my neighborhood gives me a sense of community," "I know my neighbors," "most people in my neighborhood can be trusted," and "my neighborhood is a good place to raise children."

Modeling results were more robust when a scaled measure was used, mainly because the distribution of the ordered measures was correlated with the station location. That is, wealthier station areas (e.g. Cranford, Metuchen, and Morristown) tended to agree or strongly agree with most measures, while stations in lower-income areas (Plainsfield and Newark) tended to disagree more. Combining measures provided more robust results.

Only two of the social capital measures were associated with the proximity of the station to one's residence. Those living closer to a station tended to agree that "my neighborhood is a good place to live" and "living in my neighborhood gives me a sense of community." There was no effect associated with other measures. This effect disappears in the model with the combined social capital measure.

The most robust results were that areas with higher employment density tended to have lower social capital, and that people living in single-family housing (both detached and attached) had higher levels of social capital than those living in multi-family housing. Higher employment density is one of the goals of most TOD and these also tend to have multi-family housing, so both these TOD-related measures tend to work against greater social capital, at least in the authors' data. On the plus side, increased population density had no effect, either positive or negative. There were some positive associations in the authors' data with people conducting activities in station areas and for those who took transit more frequently, although these results were less robust.

The authors' conclusions are at best indeterminate. They find minor evidence of some positive association with being close to a TOD area and increased social capital on two of their measures, but none for their combined measure. Employment density appears to be a negative for increasing social capital, as do large multi-family developments. This

suggests perhaps a more nuanced approach to developing around train stations, perhaps increasing the availability of single-family homes and not having as much employment. The authors' analysis, however, also misses some of the subtler design details of TOD, such as walkability enhancements and structured civic activities that might occur with good planning. Further research should seek to examine these areas.

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## I. INTRODUCTION

Among the benefits of more compact and walkable communities are the opportunities for increased social interactions on the street between neighbors, providing opportunities for increased chance encounters. Transit-oriented development (TOD) and the use of transit as a commute mode may also increase these interactions and consequently build social capital and civic engagement within a community. In this research, the authors test how various neighborhood features associated with TOD and proximity to rail stations affects civic engagement and social capital.

The investigators used a 2012 survey of households in eight communities in New Jersey, all well served by transit. The survey included specific questions commonly employed in social capital studies as well as questions on active and public transit travel behavior, commute and non-commute travel patterns, use of local amenities, personal health, and demographic data on the household. The focus here is on the analysis of self-reported social capital variables. The survey design allowed collection of data from households both near the transit stations and up to about two miles distance from each station (based on the straight-line distance from the station).

The authors' objective is to examine the hypothesis that more compact and transit-friendly communities can lead to more social capital, as expressed by Putnam.<sup>3</sup> The authors' findings provide both positive and negative evidence for this hypothesis, within the limitations of the data. They find only limited evidence that proximity to a rail station can enhance social capital, and they find that other features of the built environment normally associated with TOD have a negative effect.

In the following sections the authors first outline some of the theoretical aspects of social capital and discuss some empirical results that have linked social capital to the built environment. This is followed by a description of the survey and data, analysis and a discussion of results. Conclusions note the limitations of the analysis and provide suggestions for further research in this area.

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## II. TOD AND SOCIAL CAPITAL

Transit-oriented development (TOD) is compact, mixed-use, pedestrian-friendly, and integrated with walkable access to transit stations or stops. Previous research has documented many of the benefits associated with both TODs and more compact neighborhoods, and evidence suggests that TOD residents drive less than those living in areas that are less accessible to transit. Transit accessible locations have greater population and employment densities than traditional sprawling suburbs. They also have a fine-grained mix of land uses and allow residents, workers, and visitors to fulfill their daily needs without driving.<sup>4</sup> A previous analysis of the New Jersey data used here also finds this to be true.<sup>5</sup>

It is hypothesized that TODs have the potential to improve the livability of the community in which they are located, both for those who already live in the community and those who come to it for the amenities offered by the new development. One potential way that a community may be affected is in how residents are engaged with their community; this is one element of what is commonly referred to as social capital. The definition of social capital has emerged as a concept that encompasses “social networks and the norms of reciprocity and trust to which those networks give rise.”<sup>6</sup> More specifically, Putnam explains that:

“[the] core idea of social capital theory is that social networks have value. Just as a screwdriver (physical capital) or a college education (human capital) can increase productivity (both individual and collective), so too social contacts affect the productivity of individuals and groups.”<sup>7</sup>

Putnam argues that “civic virtue” is strongest when individuals interact and are not isolated from one another. Social capital, therefore, is the interaction between individuals within a community and the formation of common bonds.<sup>8</sup> These social networks have value to individuals and society.<sup>9</sup> Putnam argued that there are public and private benefits to social capital.<sup>10</sup> In theory, social capital can produce private (individual) benefits if it produces a positive externality on the quality of life, and thus produces happier and healthier citizens. The theorized public benefits of social capital are its ability to improve neighborhood and community relationships as a whole.

The need for social capital has been described in stark terms: “no democracy, and indeed no society, can be healthy without at least a modicum of this resource (social capital).”<sup>11</sup> More concretely, social capital has been found to improve the health and happiness of citizens, reduce crime, improve governance, and improve economies.<sup>12</sup> Transit-oriented developments may provide greater opportunities for communities to build lasting networks and therefore increase social capital. A recent study analyzed data from the 2000 Social Capital Benchmark Survey and found that residents of cities that were more engaged in sustainability efforts tend to be more active in the participatory process.<sup>13</sup>

A question that researchers are starting to answer is what effect does the built environment have on neighborhood social capital and under what circumstances can the built environment increase or reduce social capital? Sander contends, in a history of the relationship between

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social capital and New Urbanism, that the built environment can affect social capital, and that New Urbanism ideals are especially promising for the improvement of social capital.<sup>14</sup> In his seminal work *Bowling Alone*, Putnam posits that suburban sprawl is a key driver in the decline of social capital in the United States.<sup>15</sup> Putnam attributes the outsize negative effect of suburban sprawl to increased time traveling in cars, its encouragement of social segregation, and a blurring of distinct geographic community boundaries.<sup>16</sup>

Research has operationalized social capital into eight domains: empowerment; participation; associational activity and common purpose; supporting networks and reciprocity; collective norms and values; trust; safety; and belonging.<sup>17</sup> These domains provide the framework for social capital analysis.

Putnam's claims have been tested with mixed results. An analysis of the 2001 National Household Travel Survey found that increased travel time is associated with lower social capital. Specifically, commute times of 20 minutes or more are associated with fewer socially oriented trips, with the effect being the strongest for individuals that have commutes longer than 90 minutes.<sup>18</sup> Exploring social ties within a community, Freeman found a strong negative correlation between the proportion of residents who drive to work and the existence of neighborhood social ties.<sup>19</sup> A one percent increase in the proportion of residents who drive to work led to a 73 percent decrease in the odds that a randomly selected individual would have a neighborhood social tie.<sup>20</sup>

Compact, mixed-use development can lead to an increased feeling of connection to one's community. A survey of residents in Galway, Ireland, compared those living in more traditional neighborhoods (consisting of mixed-use and pedestrian-oriented development) to those living in more modern, automobile-dependent neighborhoods and found the former felt more connected to their community, were more likely to know their neighbors, and were more likely to trust others.<sup>21</sup> However, an analysis of the 2000 Social Capital Benchmark Survey data examined the effect of population density on social capital and disputes Putnam's claim that suburban sprawl reduces social capital (*Brueckner & Largey, 2008*); the results of this study in fact conclude that increased population density, not sprawl, reduces social capital.<sup>22</sup> However, this study also conflates sprawl with density, and ignores the subtler urban design components of many denser environments.

Leyden (*Leyden, 2003*), as previously noted, found that people residing in walkable neighborhoods have comparatively more social capital than those residing in auto-oriented neighborhoods. Leyden assessed community walkability by using self-reported survey answers, and conducted a multivariate analysis using four social capital indexes: know neighbors, political participation, trust, and social index. He found residents of more walkable neighborhoods feel more connected to their neighborhood, know their neighbors more, and were more likely to contact local officials.<sup>23</sup>

A case study of New Hampshire towns with different built environments supports the idea that more walkable neighborhoods lead to more social capital.<sup>24</sup> Rogers et al. used comparison of means tests to evaluate residents who live in more and less walkable areas of two towns in New Hampshire, and found that those living in walkable neighborhoods reported having more social capital; they were more likely to report trust in neighbors, trust

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in people in general, participate in community activities, more likely to invite friends over, volunteer, and attend a club or meeting.<sup>25</sup>

A study of Atlanta metropolitan residents found that a “sense of community” was improved by having walkable retail locations.<sup>26</sup> Wood et al. analyzed data from the US Strategies for Metropolitan Atlanta’s Regional Transportation and Air Quality (SMARTRAQ) survey. Social capital was positively associated with commercial floor space to land area ratios (Floor Area Ratio or FAR) that were used as a proxy for neighborhood walkability. They theorize that larger FAR ratios “indicate less surface parking and places where shops and services are likely to be close to the sidewalk.”<sup>27</sup>

A study analyzing the Physical Activity and Community Place Survey (PLACE) in Adelaide, Australia, contends that the relationship between walking and social capital is more complex than previous research has suggested.<sup>28</sup> Du Toit et al. believe that future studies need to incorporate other characteristics including open space, natural features, and perceptions of the environment. Their study, despite lacking these data, found a modest association between social capital and walkability.<sup>29</sup>

A study of Brisbane, Australia examining the ability of TOD to increase social capital focused on the domains of “trust and reciprocity” and “connections with neighbors.”<sup>30</sup> Kamruzzaman et al. measured differences between people living in TODs, Transit-Adjacent Developments (TADs), and Suburbs. A key finding was that residents living in TODs had higher levels of social capital than residents in TADs.<sup>31</sup>

One issue that most studies do not address is the length of time that residents have lived in a community. As many TODs in New Jersey are relatively new, this is one component that the authors include; they expect that many people will build their social capital over time, and if TODs are more transient then this may work against this effect. The authors’ survey of New Jersey TODs and transit areas includes questions aimed at gaining insights into social capital and neighborhood engagement, but also include questions on travel behavior, activity in the station area, and various socioeconomic and demographic questions. The authors’ working hypothesis is that those living closer to the transit station area will report more social capital, other things being equal.



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### III. SURVEY AND DATA

New Jersey has a large commuter rail system primarily moving commuters to New York City and Newark, but also serving many intermediate employment destinations. Many of these are historical communities built around their transit station; some are primarily residential, while others have a broad mix of land uses and would be considered natural transit-oriented communities. The New Jersey Department of Transportation (NJDOT) administers the Transit Village Initiative, which supports community redevelopment and revitalization around transit facilities. The initiative provides enhanced planning and technical assistance, as well as some funding, and as of July 2015, 30 municipalities have been designated as “Transit Villages.”

Eight transit station locations were surveyed for this research, which was part of a larger project.<sup>32</sup> The stations were selected in consultation with staff at New Jersey (NJ) Transit, based on their professional judgement and those of the research team. An effort was made to select a diverse set of communities. A list of the station areas surveyed is in Table 1 with the associated demographics of each municipality. Data was collected in summer 2012 using a combined online/printed survey of households residing within two miles of each station location (based on a straight-line distance). The authors’ target was to sample 1000 households within a two-mile radius of each station. This sample was stratified to include up to 200 households in new or substantially renovated structures within a half-mile radius, an additional 400 households within a half-mile, and 400 households in the remainder of the two-mile radius. For Metuchen, Cranford, and Plainfield stations, there were fewer than 200 addresses for new housing. Metuchen had no new housing, Cranford had 66 residences, and Plainfield had 75. The balance of the sample for these communities was reallocated to the half-mile radius from the station. Most of the communities are situated on commuter rail lines. Newark Broad St., however, is served both by commuter rail and the Newark subway (a light rail line), and Essex St. in Jersey City is served by the Hudson-Bergen Light Rail line. Details on each municipality (not just the sampled area) are listed in Table 1. A map of the location of each site and the commuter rail lines in New Jersey is shown in Figure 1.

Full details on the authors’ survey protocol are available in Noland et al.<sup>33</sup> The overall response rate was 23.5%, ranging from a low of 15% in Newark and Plainfield (both lower-income communities) to a high of 35.2% in Metuchen (a high-income community). In total, 8000 households were sampled, and the authors received 1629 responses. Some 74.1% were completed on-line and the remainder via mail.

The authors’ survey included a small subset of social capital questions adapted from other surveys. These are shown in Table 2. The question on volunteering was a binary yes/no question, while the others were measured on a 5-point Likert scale from “strongly agree” to “strongly disagree.” The authors were limited to just these questions, and a broader set of questions may have captured more dimensions of social capital.

**Table 1. Demographics by Municipality**

Municipality	County	Station	Line	Mean daily station ridership (FY11)	Mean daily ridership on line	% of line ridership	Approximate peak headway	Total population	Municipal population density (pop/sq mi)	Municipal median HH income
Newark	Essex	Newark Broad St	M&E/NLRT	2,316	27,372	8.5%	10 min	274,674	11,356	\$35,659
Jersey City	Hudson	Essex St	HBLR	1,152	41,000	2.8%	5-8 min	243,257	16,447	\$54,280
Metuchen	Middlesex	Metuchen	NEC	3,791	49,867	7.6%	20-30 min	13,431	4,859	\$94,410
New Brunswick	Middlesex	New Brunswick	NEC	4,866	49,867	9.8%	20-30 min	53,933	10,312	\$44,543
Morristown	Morris	Morristown	M&E	1,845	27,372	6.7%	15-30 min	18,457	6,299	\$64,279
Cranford	Union	Cranford	RV	1,189	11,673	10.2%	20 min	22,414	4,641	\$107,052
Plainfield	Union	Plainfield	RV	897	11,673	7.7%	20 min	49,043	8,147	\$52,056
Rahway	Union	Rahway	NEC/NJCL	3,060	49,867	6.1%	20-30 min	26,968	6,915	\$58,551

M&E - Morris and Essex

HBLR - Hudson Bergen Light Rail

NEC - Northeast Corridor

RV - Raritan Valley

NJCL - North Jersey Coast

NLRT - Newark Subway

Sources: NJ Transit, 2006-2010 ACS, 2010 Census.

**Table 2. Social Capital Survey Questions**

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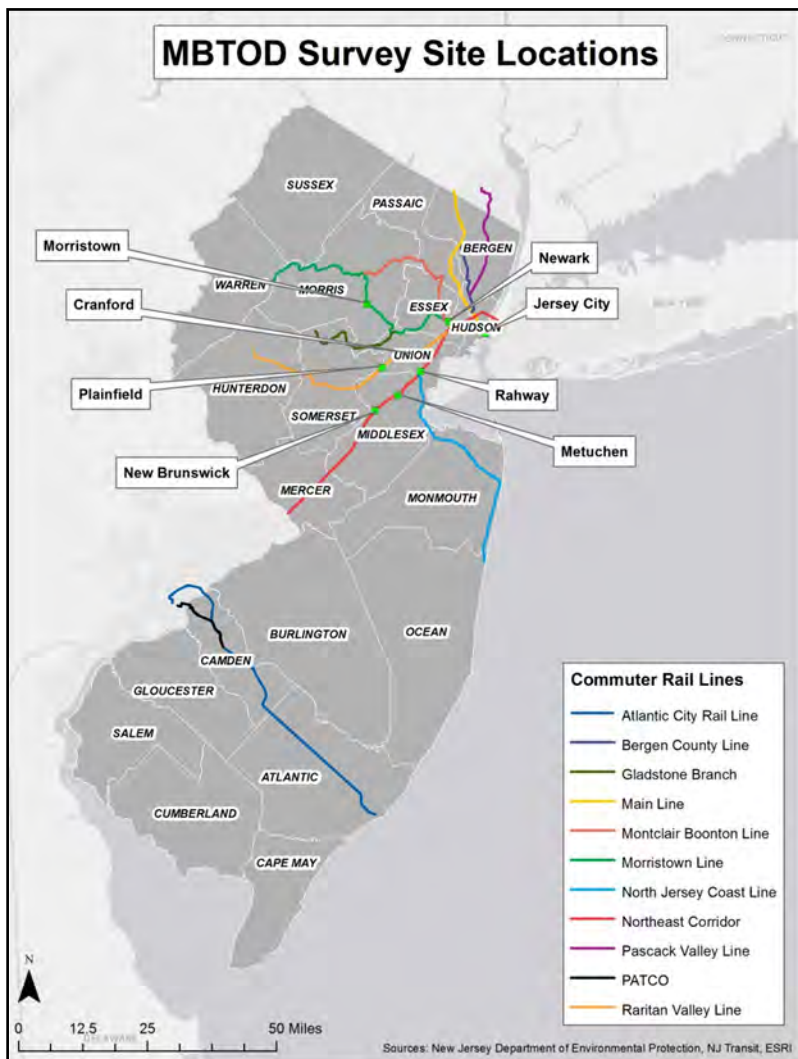
Have you volunteered your time for a neighborhood project or organization? (Yes/No)

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Please tell us how much you agree or disagree with the following statements. [Measured on a Likert scale from strongly agree to strongly disagree]

- My neighborhood is a good place to live
- Living in my neighborhood gives me a sense of community
- I know my neighbors
- Most people in my neighborhood can be trusted

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**Figure 1. Location of Stations Surveyed and Commuter Rail Lines in New Jersey**

Volunteering is a proxy for “participation,” “associational activity and common purpose,” “supporting networks and reciprocity,” and “collective norms values,” all of which are domains of social capital.<sup>34</sup> The authors further test the relationship between social capital and TOD by creating a “social capital index” using four additional questions from the survey shown in Table 2. These questions inquire about respondents’ perceptions of their neighborhood as a place to live, sense of community, knowing their neighbors, and trust. The authors feel that this index acts as a proxy for the “trust,” “safety,” “collective norms

and values,” and “belonging” domains of social capital.<sup>35</sup> The authors also analyze these variables individually.

Additional data were collected for each station area at the Census block group level. These include population density from the American Community Survey 2006-2010 averages, employment density at place of work from the 2010 Longitudinal Employer-Household Dynamics (LEHD) data, and network distance to the station from the household’s residence location, calculated using ArcGIS.

Other variables included various demographic and socioeconomic questions for each household, including household income. Age data was collected for the household, but not specifically linked to the survey respondent. Thus the authors estimated an average adult age (over 18 years old) for each household; sixty-two percent of households had all adults in a single age category, which meant estimates were straightforward. However, about 16 percent of the households required an averaging of ages to obtain a household estimate. Information on housing type was also asked in the survey (single-family versus detached versus multiple-family residence) as was how many vehicles were available to the household. In addition, respondents reported what length of time they had lived in their current residence.

Survey respondents rated their usage of various modes by frequency. The categories of response were: “Every workday,” “Few times a week,” “Once a week,” “Once a month,” “Few times a year,” and “Never.” The authors reclassified the modes to three categories: motorized, non-motorized, and transit, and separated into frequent use (few times a week or greater), infrequent use (once a week or less), and never (the reference category). Another series of questions focused on the use of personal and household services conducted in the station area. Three questions on shopping, dining out, and personal business activities in the station area were combined into a single measure of “TOD use.” Frequency categories were set as frequent, infrequent, and never and were used to derive three dummy variables representing the frequency of engaging in activities near the TOD.

The authors estimate a binary logit model and ordered logits models, first based on each social capital question and then for the ordered model based on a social capital index, derived from the same questions. Robust standard errors are estimated to correct for heteroskedasticity that was found in the model after conducting a Breusch-Pagan test. The authors’ models include dummy variables for each station to control for unmeasured effects associated with the station area. Proportional odds models are also estimated, as the authors’ ordered logit models violate the parallel lines assumption for some parameters.<sup>36</sup> The authors first tabulate the responses for each station area, as these provide useful information for their modeling strategy.

Summary statistics for all variables are shown in Table 3.

**Table 3. Summary Statistics**

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Min</b>	<b>Max</b>
Social Capital Scale	1569	3.891	0.779	1	5
Distance to nearest study station (feet)	1629	0.963	0.747	0.0171	4.717
Income less than 25,000	1466	0.078	0.268	0	1
Income 25,000 to 49,999	1466	0.140	0.347	0	1
Income 50,000 to 74,999	1466	0.132	0.339	0	1
Income 75,000 to 99,999	1466	0.129	0.335	0	1
Income 100,000 to 149,999	1466	0.111	0.314	0	1
Income 150,000 to 200,000	1466	0.137	0.344	0	1
Income more than 200,000	1466	0.078	0.268	0	1
Income over 150,000	1466	0.248	0.432	0	1
Race: Hispanic (Black or White)	1509	0.129	0.335	0	1
Race: White (Hispanic or non-Hispanic)	1509	0.712	0.453	0	1
Race: Black (Hispanic or non-Hispanic)	1509	0.116	0.320	0	1
Race: Asian	1509	0.099	0.299	0	1
Race: Multi-race or other	1509	.0072	0.258	0	1
LN Population density (Block Group, ACS)	1629	8.926	0.861	5.989	11.724
LN Employment density (Block Group, LEHD)	1629	7.713	1.983	2.072	12.048
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	1532	0.320	0.467	0	1
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1532	0.535	0.499	0	1
Q20: Car, truck, van, or motorcycle few times a week or more	1554	0.801	0.400	0	1
Q20: Car, truck, van, or motorcycle once a week or less	1554	0.133	0.339	0	1
Q20: Bicycle or walk few times a week or more	1495	0.5571	0.496	0	1
Q30: Walk once a month or less	1549	0.136	0.343	0	1
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1578	0.421	0.494	0	1
Q19: Shop, eat, or conduct business at TOD once a week or less	1578	0.452	0.498	0	1
Q3: Detached single-family house	1623	0.453	0.498	0	1
Q3: Attached single-family house	1623	0.061	0.239	0	1
Q3: Apartment building with 2 or more apartments	1623	0.434	0.496	0	1
Average age of reported adults	1496	47.474	14.665	21	80
Length of time in home, years	1607	12.978	13.99	0	83
Vehicles available per household adult	1464	0.849	0.473	0	5

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## IV. RESULTS

Social capital has been shown to be an important factor that affects volunteering propensity.<sup>37</sup> Volunteerism rates vary greatly by state in the US, and range from 17.8% (Louisiana) to 44.6% (Utah).<sup>38</sup> In New Jersey the volunteer rate, on average across the state, is 22.4%, and the respondents in the sample reported volunteer rates ranging between 26.6% (Jersey City) and 44.7% (Metuchen). Therefore, people living in the selected TODs reported higher levels of volunteering than the state as a whole.

The authors' first model is based on the survey question "Have you volunteered your time for a neighborhood project or organization?" As this is a binary yes/no response, a logit model is estimated. The authors hypothesize that people living in TODs or closer to the station will be more likely to volunteer than those who do not. As previously discussed, the primary TOD variable is distance to the station, and under the hypothesis, the authors would expect to see the likelihood of having volunteered decline the farther one gets from the station.

Model results are shown in Table 4. The authors estimate two versions of the model, one with average household age and the other with the length of time that the respondent has lived in the household. These variables were correlated ( $R=0.59$ ), and the authors found that inclusion of both variables in the same model suppressed the result for housing tenure. Both the average age of the household and the length of time respondents have lived in the household are positively associated with an increased probability of volunteering, but with a very small effect.

The authors find that distance to station has no effect on the likelihood to volunteer when all other variables are controlled for. Most demographic and socioeconomic variables have no significant associations, the one exception being that Asians tend to volunteer less than other ethnic groups. Population density and employment density (measured at the block group level for each household) also have no effect on the probability of volunteering. These elements of a compact area, therefore, are not associated with a social capital effect.

Those who use transit more frequently also seem to volunteer more, although this is also true of those using motorized vehicles, and in both cases, those who use transit or drive the most frequently volunteer slightly less. Those that walk infrequently do not tend to volunteer more, but those who engage in more activities in the TOD do tend to volunteer more. It is possible that those who engage in more transportation activities simply have less time to volunteer. Those who own more vehicles also have a greater probability of volunteering.

One result that is in conflict with the hypothesis that more dispersed development reduces social capital is the result on housing type. Those living in single-family detached housing have a greater probability of volunteering than those living in either attached single-family housing or multi-family housing.

**Table 4. Social Capital: Binary Logit Model, “Have you volunteered...?”**

Logit (volunteered)	With Housing Tenure	With Average Age	Odds Ratio	z-stat
	Odds Ratio	z-stat		
Distance to nearest study station (miles)	0.99	-0.06	0.96	-0.35
Station: Cranford	0.98	-0.09	0.97	-0.12
Station: Jersey City, Essex St	1.01	0.04	1.09	0.27
Station: Metuchen	1.40	1.41	1.32	1.17
Station: Morristown	1.47	1.44	1.49	1.51
Station: New Brunswick	1.03	0.11	1.01	0.05
Station: Newark Broad St	1.39	0.98	1.46	1.15
Station: Plainfield	1.54	1.49	1.50	1.40
Income: \$25k to \$49k	0.87	-0.56	0.84	-0.71
Income: \$50k to \$74k	1.30	1.02	1.27	0.96
Income: \$75k to \$99k	0.94	-0.25	0.89	-0.46
Income: \$100k to \$149k	1.24	0.92	1.16	0.66
Income: \$150k to \$199k	1.44	1.38	1.35	1.18
Income: \$200k or more	1.07	0.26	1.00	0.00
Race: Hispanic (Black or White)	1.04	0.22	1.09	0.46
Race: White (Hispanic or non-Hispanic)	1.08	0.3	1.14	0.54
Race: Black (Hispanic or non-Hispanic)	0.76	-0.88	0.77	-0.82
Race: Asian	0.45	-2.37	0.50	-2.1
Log of Population density (Block Group, ACS)	1.11	0.93	1.10	0.93
Log of Employment density (Block Group, LEHD)	0.98	-0.55	0.97	-0.68
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	2.34	3.25	2.12	2.99
Q20: Ride bus, LR, subway, train, or ferry once a week or less	2.46	4.17	2.34	4.08
Q20: Car, truck, van, or motorcycle few times a week or more	2.03	2.34	1.99	2.3
Q20: Car, truck, van, or motorcycle once a week or less	2.55	2.79	2.49	2.76
Q30: Walk less than once a month	1.30	1.45	1.26	1.28
Vehicles available per household adult	1.32	1.96	1.29	1.81
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.95	2.91	1.97	2.98
Q19: Shop, eat, or conduct business at TOD once a week or less	1.22	0.87	1.21	0.87
Q3: Detached single-family house	1.77	3.13	2.11	4.31
Q3: Attached single-family house	1.12	0.42	1.25	0.84
Length of time in home, years	1.02	3.21	-	-
Average age of reported adults		-	1.01	2.92
Constant	-4.062	-3.36	-4.389	-3.54
Log pseudo-likelihood	-762.758		-771.918	
Pseudo R <sup>2</sup>	0.087		0.084	
Number of obs	1252		1262	

*Note:* Reference categories for dummy variables: Station = Rahway; Income = Less than \$25k; Hispanic = No; Race: Multi-racial or other; Q20 = Never; Q19 = Never shop, eat, or conduct business; Q3 = Multi-family home. All models estimated with robust standard errors.

**Table 5. Summary Results of Agreement on Social Capital Questions**

Variable	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	N
"My neighborhood is a good place to live."	50.0%	38.8%	6.9%	3.3%	9.9%	1609
"Living in my neighborhood gives me a sense of community."	27.3%	36.4%	23.2%	11.0%	2.1%	1593
"I know my neighbors."	23.4%	44.7%	13.8%	14.8%	3.3%	1599
"Most people in my neighborhood can be trusted."	22.8%	42.8%	26.0%	5.5%	3.0%	1595
"My neighborhood is a good place to raise children."	30.0%	34.3%	21.5%	9.4%	4.8%	1593

The other social capital questions are first examined individually (see Table 5). These questions asked the survey respondent to evaluate characteristics of his/her neighborhood and state agreement or disagreement with each statement. As can be seen, most were in agreement that their neighborhood had the positive social capital characteristics associated with each statement. These measures varied substantially in each station area surveyed. Tabulations by station area are shown in the Appendix. Those communities that are wealthier (Cranford, Metuchen, Morristown) tend to have the strongest levels of social capital (based on respondents agreeing and strongly agreeing with almost all the measures). In these areas, most respondents did not indicate any strong disagreement on some measures. For example, none of the three communities mentioned had respondents stating that they strongly disagree with the statement that "My neighborhood is a good place to live."

The lack of answers on some of these measures makes it problematic to estimate ordered logit models for each individual factor. Instead, the authors estimate a binary logit model for agreeing and strongly agreeing with the statement, versus undecided, disagreeing, and strongly disagreeing. Separate models are again estimated with and without both the housing tenure and average household age variables. These are shown in Table 6 and Table 7.

As with our previous model for volunteerism, straight-line distance from the station is a proxy for TOD. Of the five social capital factors measured, living close to the station is only statistically significant for those agreeing that their "neighborhood is a good place to live" and those agreeing that their "neighborhood gives a sense of community," although weakly so in the model with home tenure. For these two factors, people living closer to their station tend to rate their neighborhood more positively. The authors discuss each model result in turn.

### **Neighborhood is a Good Place to Live**

The analysis suggests that people generally like the place where they live. However, Newark (Broad St.) stands out by being the only location that is statistically associated with respondents feeling that it is not a good place to live. Plainfield also has a negative coefficient, but it is not statistically significant. The coefficient on Metuchen is very large, as over 98% of the sample from Metuchen agrees or strongly agrees that their neighborhood



is a good place to live. Most control variables, including race, TOD usage, and number of vehicles per capita, have no statistically significant impact. A higher average age of the household has a positive and statistically significant association with agreement that the neighborhood is a good place to live; home tenure, however, has no effect. Those with higher incomes also tend to have positive associations. Higher employment density is negatively associated with feelings of a neighborhood as a good place to live (weak association in the model with average age). Living in a detached home is also weakly associated with better feelings about a neighborhood as a place to live (again, in the model with average age). Those who drive vehicles more frequently have a negative association with agreeing that their neighborhood is a good place to live. In fact, this result is one of the stronger effects in the model, but only at a 90% level of confidence. Thus, most of the associations are very weak in these models.

### **Living in My Neighborhood Gives Me a Sense of Community**

Those agreeing that their neighborhood gives them a good sense of community tend to live closer to the TOD train station. Income does not show much association, with those earning \$150K to \$199K having a negative association. In this case minority groups tend to have positive associations. Employment density is negatively associated with a sense of community. Households living in a detached home, older household residents, and those who have lived in their home for a longer time are positively associated with a greater agreement of having a sense of community in the neighborhood. Those more likely to take public transit and those who conduct activities in the TOD area also have more agreement that their neighborhood gives them a sense of community. In this model distance to station has an association with the perceived neighborhood quality of a TOD area, and some other TOD features seem to also have positive associations. On the other hand, the type of home residents live in (i.e., single-family homes not typically considered for TOD areas) has a mitigating impact.

### **I Know My Neighbors**

Living in or near a TOD has no effect on whether a person knows their neighbors or not. Hispanic respondents are more likely to report knowing their neighbors, while there is no difference among other ethnic groups. Of the key TOD-related variables, neither population nor employment density have a statistically significant impact. Engaging in activities near the train station and walking more frequently have a positive effect. Surprisingly, those with more vehicles per household member tend to know their neighbors more, maybe because they are more mobile; those using their cars more frequently also have a positive association. As with our other models, those in detached single-family homes tend to know their neighbors (and in this case, attached single-family homes also) and those in multi-family housing do not. Older average household age also leads to knowing one's neighbors more, although home tenure does not have a statistically significant association.

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## **Most People in My Neighborhood can be Trusted**

Another social capital measure is whether people believe that those in their neighborhood can be trusted. Distance from station has no effect on trust, but employment and population density are negatively associated with trust. Wealthier areas tend to report higher levels of trust. Also, people living in detached or attached housing (as opposed to multi-family housing) and older average households report higher levels of trust. As for race, Asians are more likely to report trust in neighbors, while Blacks have a strong negative association. Those conducting activities in the TOD area and those using public transit also agree that they trust their neighbors. Thus, while TOD features have some positive associations, these are again mitigated when living in single-family housing, which has the strongest association.

## **My Neighborhood is a Good Place to Raise Children**

Distance from a station has no effect on whether people view their area as a good place to raise children. Respondents in wealthier neighborhoods are more likely to agree that their neighborhood is a better place to raise children. For example, Metuchen has a large odds ratio, and Newark has a negative association. The TOD-related variable of employment density (at the block group level) is negatively associated with a neighborhood as a place to raise children, although population density is not statistically significant. Unsurprisingly, living in a detached single family home is positively associated with raising children. The negative association with employment density suggests that TODs have to overcome this barrier if they want to attract families with children, although the authors also note that those with more cars in their household do not agree that their neighborhoods are a good place to raise children.

**Table 6. Binary Logit Models for Social Capital Measures (with average age)**

	My neighborhood is a good place to live	Living in my neighborhood gives me a sense of community	I know my neighbors	Most people in my neighborhood can be trusted	My neighborhood is a good place to raise children						
	Model 1	Model 2	Model 3	Model 4	Model 5						
	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	
Distance to nearest study station (miles)	0.73	-1.65	0.80	-2.05	0.97	-0.25	0.94	-0.53	0.96	-0.33	
Station: Cranford	8.75	3.84	4.22	5.48	1.92	2.27	3.82	4.97	7.40	6.77	
Station: Jersey City, Essex St	5.15	2.95	3.85	3.99	1.23	0.59	2.46	2.64	3.36	3.32	
Station: Metuchen	41.34	3.59	3.44	5.00	1.49	1.44	2.76	3.92	11.92	7.48	
Station: Morristown	5.32	3.32	2.16	2.87	0.83	-0.64	2.00	2.51	3.18	4.08	
Station: New Brunswick	1.49	1.08	1.22	0.74	0.77	-0.91	1.35	1.12	1.05	0.18	
Station: Newark Broad St	0.33	-3.02	1.27	0.73	1.25	0.67	0.82	-0.59	0.29	-3.11	
Station: Plainfield	0.73	-0.89	1.37	1.05	1.29	0.77	1.37	1.10	0.87	-0.44	
Income: \$25k to \$49k	1.27	0.76	0.71	-1.41	1.02	0.09	1.56	1.70	1.41	1.16	
Income: \$50k to \$74k	2.24	2.25	1.06	0.21	0.76	-1.00	1.53	1.61	1.47	1.30	
Income: \$75k to \$99k	3.51	3.09	1.07	0.27	0.76	-0.99	1.70	2.03	1.00	-0.01	
Income: \$100k to \$149k	3.25	3.14	0.95	-0.19	0.89	-0.47	1.89	2.49	1.09	0.29	
Income: \$150k to \$199k	1.31	0.68	0.60	-1.92	0.79	-0.84	1.72	1.84	0.92	-0.27	
Income: \$200k or more	3.76	2.35	0.87	-0.51	1.13	0.41	1.98	2.36	1.39	1.04	
Race: Hispanic (Black or White)	1.08	0.23	1.21	0.94	1.45	1.70	0.96	-0.21	1.20	0.77	
Race: White (Hispanic or non-Hispanic)	1.14	0.35	1.55	1.70	1.00	0.02	1.40	1.37	0.96	-0.14	
Race: Black (Hispanic or non-Hispanic)	1.15	0.34	2.14	2.39	1.08	0.25	0.52	-2.16	1.23	0.60	
Race: Asian	0.98	-0.04	2.05	2.14	1.22	0.58	2.13	2.31	2.17	2.19	
LN Population density (Block Group, ACS)	0.79	-1.13	0.86	-1.37	1.12	0.89	0.83	-1.60	0.84	-1.39	
LN Employment density (Block Group, LEHD)	0.90	-1.67	0.91	-2.04	0.95	-1.17	0.91	-1.99	0.83	-3.79	
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	1.15	0.36	1.34	1.16	1.06	0.21	1.53	1.63	0.96	-0.14	
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.14	0.42	1.40	1.58	1.03	0.13	1.55	2.08	0.99	-0.05	
Q20: Car, truck, van, or motorcycle few times a week or more	0.42	-1.73	0.95	-0.20	2.13	2.54	0.87	-0.44	1.64	1.64	

	My neighborhood is a good place to live		Living in my neighborhood gives me a sense of community		I know my neighbors		Most people in my neighborhood can be trusted		My neighborhood is a good place to raise children	
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat
Q20: Car, truck, van, or motorcycle once a week or less	0.52	-1.25	0.91	-0.30	1.35	0.95	0.95	-0.16	1.53	1.28
Q30: Walk less than once a month	1.39	1.06	1.03	0.16	0.69	-1.86	0.77	-1.30	0.90	-0.49
Vehicles available per household adult	1.05	0.22	1.28	1.57	1.41	1.77	1.11	0.54	0.61	-3.00
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.07	0.20	1.77	2.36	2.21	3.00	1.66	2.04	1.21	0.67
Q19: Shop, eat, or conduct business at TOD once a week or less	0.81	-0.63	1.00	-0.02	1.46	1.48	1.16	0.62	0.97	-0.12
Q3: Detached single-family house	1.71	1.68	2.83	5.85	5.05	8.26	2.52	4.97	4.79	7.67
Q3: Attached single-family house	2.72	1.68	1.78	2.07	2.51	2.94	1.97	2.18	1.79	1.73
Average age of reported adults	1.02	2.31	1.02	3.55	1.03	4.94	1.02	4.61	1.01	1.28
Constant	32.01	1.67	0.77	-0.21	0.04	-2.37	0.74	-0.23	4.91	1.14
Log pseudo-likelihood	-318.39		-708.42		-645.74		-664.10		-578.37	
Pseudo R <sup>2</sup>	0.28		0.15		0.18		0.19		0.30	
Number of obs	1261		1256		1258		1260		1255	

Note: Reference categories for dummy variables: Station = Rahway; Income = Less than \$25k; Hispanic = No; Race: Multi-racial or other; Q20 = Never; Q19 = Never shop, eat, or conduct business; Q3 = Multi-family home. All models estimated with robust standard errors.

**Table 7. Binary Logit Models for Social Capital Measures (with home tenure)**

	My neighborhood is a good place to live	Living in my neighborhood gives me a sense of community	I know my neighbors	Most people in my neighborhood can be trusted	My neighborhood is a good place to raise children						
	Model 6	Model 7	Model 8	Model 9	Model 10						
	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	
Distance to nearest study station (miles)	0.76	-1.43	0.82	-1.85	1.00	-0.02	0.98	-0.15	0.94	-0.44	
Station: Cranford	9.01	3.88	4.31	5.60	2.04	2.51	3.98	5.11	7.06	6.59	
Station: Jersey City, Essex St	4.76	2.81	3.62	3.83	1.18	0.48	2.33	2.46	3.24	3.21	
Station: Metuchen	42.99	3.63	3.70	5.32	1.59	1.70	2.90	4.12	11.97	7.45	
Station: Morristown	5.07	3.18	2.12	2.83	0.83	-0.63	1.89	2.30	3.14	4.04	
Station: New Brunswick	1.41	0.97	1.20	0.69	0.75	-1.03	1.25	0.85	1.08	0.27	
Station: Newark Broad St	0.33	-2.99	1.25	0.68	1.34	0.86	0.77	-0.74	0.25	-3.30	
Station: Plainfield	0.80	-0.62	1.39	1.13	1.34	0.90	1.46	1.31	0.87	-0.43	
Income: \$25k to \$49k	1.27	0.76	0.67	-1.62	0.96	-0.14	1.56	1.68	1.46	1.23	
Income: \$50k to \$74k	2.12	2.12	0.98	-0.07	0.71	-1.25	1.45	1.43	1.55	1.47	
Income: \$75k to \$99k	3.34	2.97	0.99	-0.05	0.67	-1.44	1.58	1.74	1.05	0.16	
Income: \$100k to \$149k	2.92	2.89	0.86	-0.62	0.76	-1.10	1.71	2.11	1.18	0.57	
Income: \$150k to \$199k	1.25	0.54	0.55	-2.22	0.67	-1.39	1.55	1.49	1.01	0.02	
Income: \$200k or more	3.67	2.30	0.85	-0.56	1.05	0.15	1.96	2.29	1.58	1.41	
Race: Hispanic (Black or White)	0.98	-0.06	1.20	0.89	1.34	1.33	0.91	-0.44	1.23	0.91	
Race: White (Hispanic or non-Hispanic)	1.16	0.41	1.48	1.53	1.05	0.17	1.45	1.51	0.93	-0.25	
Race: Black (Hispanic or non-Hispanic)	1.12	0.27	2.06	2.28	1.16	0.47	0.51	-2.15	1.15	0.40	
Race: Asian	0.86	-0.32	1.75	1.68	1.07	0.19	1.92	2.00	2.15	2.14	
LN Population density (Block Group, ACS)	0.77	-1.23	0.86	-1.36	1.08	0.62	0.83	-1.50	0.83	-1.40	
LN Employment density (Block Group, LEHD)	0.91	-1.44	0.92	-1.93	0.96	-0.94	0.93	-1.68	0.82	-3.83	
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	1.25	0.57	1.38	1.25	1.05	0.19	1.54	1.66	1.06	0.19	
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.20	0.57	1.44	1.70	1.04	0.17	1.65	2.37	1.06	0.23	
Q20: Car, truck, van, or motorcycle few times a week or more	0.40	-1.82	0.86	-0.56	1.81	2.02	0.85	-0.54	1.59	1.53	

	My neighborhood is a good place to live	Living in my neighborhood gives me a sense of community	I know my neighbors	Most people in my neighborhood can be trusted	My neighborhood is a good place to raise children						
	Model 6	Model 7	Model 8	Model 9	Model 10						
	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	Odds Ratio	z-stat	
Q20: Car, truck, van, or motorcycle once a week or less	0.52	-1.20	0.85	-0.55	1.22	0.64	0.93	-0.22	1.50	1.20	
Q30: Walk less than once a month	1.51	1.30	1.08	0.36	0.73	-1.54	0.81	-1.01	0.94	-0.28	
Vehicles available per household adult	1.09	0.39	1.31	1.72	1.43	1.88	1.12	0.61	0.61	-3.02	
Q19: Shop, eat, or conduct business at TOD a few times a week or more	0.99	-0.04	1.68	2.13	1.90	2.44	1.49	1.63	1.24	0.75	
Q19: Shop, eat, or conduct business at TOD once a week or less	0.75	-0.85	0.95	-0.23	1.27	0.93	1.05	0.19	0.99	-0.03	
Q3: Detached single-family house	1.63	1.43	2.58	5.07	4.93	7.82	2.43	4.47	3.90	6.36	
Q3: Attached single-family house	2.40	1.52	1.68	1.87	2.51	2.99	2.00	2.20	1.58	1.38	
Length of time in home, years	1.01	0.75	1.01	2.01	1.01	1.40	1.01	1.44	1.02	2.61	
Constant	82.61	2.09	1.80	0.47	0.20	-1.21	1.78	0.45	5.90	1.28	
Log pseudo-likelihood	-317.52		-706.24		-652.54		-667.16		-570.92		
Pseudo R <sup>2</sup>	0.27		0.14		0.17		0.18		0.30		
Number of obs	1251		1247		1249		1251		1246		

Note: Reference categories for dummy variables: Station = Rahway; Income = Less than \$25k; Hispanic = No; Race: Multi-racial or other; Q20 = Never; Q19 = Never shop, eat, or conduct business; Q3 = Multi-family home. All models estimated with robust standard errors.

Moving beyond the individual logit models, the authors estimate a more comprehensive model that takes into account the variability found in the previous models, with an aim to providing more robust results. The previous dependent variables were combined into an additive index that produces a continuous scale between 1 and 5, where respondents with a “5” report having the largest amount of social capital, and respondents with a “1” report having the smallest level of social capital. The validity of the scale was measured using a simple factor analysis and calculating a Cronbach’s Alpha for the scale. The factor analysis showed that the factors that made up the scale had factor scores ranging between 0.62 and 0.78, which suggests that each variable is relevant in defining the scale. The authors also tested internal consistency of the scale with Cronbach’s Alpha, and confirmed that there is a high level of internal consistency. The Cronbach’s Alpha test in Stata allows for the generation of a standardized scale, and the authors used this standardized social capital scale. Table 8 provides a summary of the distribution of the scale. For this social capital scale, the authors removed the question about a neighborhood being a good place to raise a child, because of the high level of correlation with the other social capital questions.

**Table 8. Summary of Social Capital Scale, Including for Each Area**

<b>Scale</b>	<b>Total</b>	<b>Metuchen</b>	<b>Cranford</b>	<b>Jersey City</b>	<b>Morris-town</b>	<b>New Brunswick</b>	<b>Newark</b>	<b>Plainfield</b>	<b>Rahway</b>
Very Low Social Capital	24.41%	8.97%	6.06%	32.97%	19.52%	41.98%	54.95%	29.51%	35.47%
Low Social Capital	20.97%	15.06%	12.12%	28.11%	23.33%	19.75%	20.72%	31.97%	27.09%
Medium Social Capital	14.98%	16.03%	17.42%	12.43%	15.24%	16.67%	9.01%	13.11%	15.27%
High Social Capital	27.02%	38.14%	38.64%	21.62%	30.48%	17.28%	13.51%	18.85%	16.26%
Very High Social Capital	12.62%	21.79%	25.76%	4.86%	11.43%	4.32%	1.80%	6.56%	5.91%



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Given the more even distribution of the social capital index scale, in particular for each station area, the authors estimate an ordered logit model as opposed to a binary logit model. The key independent variable is again “distance to station” as a proxy for TOD development. The authors estimate two models, one with housing tenure and one with average household age, as the authors found multi-collinearity was affecting the results when both were included. The authors also simplified the income variable to one dummy variable for those households earning 200K or more. Results are in Table 10.

The key independent variable (distance from station) has the expected sign, although in both models it falls below the 95% confidence level (see Table 10). Population density is not associated with the social capital index, whereas (similar to other results) areas with higher employment density consistently have lower social capital in this model and the previous estimates.

People living in attached and detached housing have higher levels of social capital than people who live in multi-family housing; our individual binary logit models found a similar effect, but not in all cases for attached single-family housing. People who utilize TODs for shopping, eating, and other business are more likely to have higher levels of social capital, as are whites and Asians, and households with larger per capita vehicle ownership, all effects that were not consistent in the models in Table 6 and Table 7. Those using more public transit also are more likely to have higher social capital, although slightly more so for infrequent riders. There is no association with frequency of using a motor vehicle, and the frequency of walking has no effect.

Our model shows that households with older average ages are also associated with higher levels of social capital, and those who have lived in their home longer have a positive association at the 90% confidence level. Odds ratios in both cases are near one, however, suggesting a small effect size.

In summary, this model does not provide strong support for the hypothesis that more compact areas and those more proximate to transit to have higher social capital. The type of housing respondents lived in has a large association with social capital. That is, relative to multi-family housing (which is typically associated with TOD), those living in single-family housing (whether attached or detached) have a higher social capital index.

**Table 9. Social Capital Ordered Logit Model**

Social Capital Scale	With Housing Tenure	With Average Age	Odds Ratio	z-stat
	Odds Ratio	z-stat		
Distance to nearest study station (miles)	0.90	-1.14	0.87	-1.54
Station: Cranford	4.63	7.21	4.54	7.10
Station: Jersey City, Essex St	2.80	3.66	2.98	3.87
Station: Metuchen	3.81	6.42	3.59	6.11
Station: Morristown	2.05	3.01	2.09	3.08
Station: New Brunswick	0.99	-0.04	1.02	0.07
Station: Newark Broad St	0.66	-1.27	0.66	-1.32
Station: Plainfield	1.07	0.28	1.01	0.04
Income: \$200k or more	1.00	0.00	1.01	0.07
Race: Hispanic (Black or White)	1.16	0.82	1.18	0.94
Race: White (Hispanic or non-Hispanic)	1.51	1.99	1.55	2.10
Race: Black (Hispanic or non-Hispanic)	1.15	0.52	1.21	0.71
Race: Asian	1.77	2.13	2.12	2.76
LN Population density (Block Group, ACS)	0.94	-0.59	0.95	-0.57
LN Employment density (Block Group, LEHD)	0.90	-2.83	0.89	-3.18
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	1.46	1.70	1.47	1.77
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.53	2.38	1.52	2.38
Q20: Car, truck, van, or motorcycle few times a week or more	0.95	-0.21	1.03	0.15
Q20: Car, truck, van, or motorcycle once a week or less	0.93	-0.28	0.99	-0.02
Q30: Walk less than once a month	0.88	-0.87	0.83	-1.24
Vehicles available per household adult	1.55	3.05	1.51	2.89
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.54	2.10	1.71	2.59
Q19: Shop, eat, or conduct business at TOD once a week or less	0.84	-0.86	0.93	-0.39
Q3: Detached single-family house	3.14	7.05	3.32	7.75
Q3: Attached single-family house	1.59	2.01	1.63	2.17
Length of time in home, years	1.01	1.88		
Average age of reported adults			1.02	4.77
/cut1	-0.29		0.56	
/cut2	0.94		1.81	
/cut3	1.74		2.62	
/cut4	3.61		4.50	
Log pseudo-likelihood	-1702.52		-1705.85	
Pseudo R <sup>2</sup>	0.119		0.124	
Obs.	1231		1240	

Note: Reference categories for dummy variables: Station = Rahway; Income = Less than \$200k; Hispanic = No; Race: Multi-racial or other; Q20 = Never; Q19 = Never shop, eat, or conduct business; Q3 = Multi-family home. All models estimated with robust standard errors.

The authors tested whether any of the estimated coefficients violated the “parallel lines” assumption of an ordered model.<sup>39</sup> The authors estimated a proportional odds model; this model allows coefficients that violate the parallel lines assumption, and estimates their value for each of the ordered levels. Results (for just these coefficients) are shown in Table 10 (corresponding to the housing tenure model of Table 9) and Table 11 (corresponding to the model with average age). Estimates are relative to the highest level of social capital. Other variables in the model did not vary substantially from those in Table 9 and for brevity’s sake are not shown here.

Most of the odds ratios are not statistically significant in Table 10 and Table 11. One exception is the association with conducting activities frequently in a TOD area. In the previous models (Table 9) this association was statistically significant. However, as this variable violates the parallel lines assumption, the authors note that it is only statistically significant (and positive) for level 2 (and somewhat for level 3) in Table 11. This suggests that those who frequent the TOD area and shop, eat, or conduct business there have low to moderate levels of social capital. In Table 11, the authors also find that those who more frequently use public transit only have a statistically significant positive association with low to moderate social capital levels. (These variables did not violate the parallel lines assumption when estimated with housing tenure.) Thus, this analysis weakens some of the results shown in Table 9 on the associations with public transit and conducting activities in a TOD area.

**Table 10. Coefficients that Violate Parallel Lines Assumption, Model with Housing Tenure**

	Odds Ratio	z-stat
<b>Level 1</b>		
Newark	0.56	-1.83
Black	1.27	0.85
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.08	0.30
Q19: Shop, eat, or conduct business at TOD once a week or less	0.72	-1.30
<b>Level 2</b>		
Newark	0.82	-0.56
Black	0.85	-0.55
Q19: Shop, eat, or conduct business at TOD a few times a week or more	2.37	3.66
Q19: Shop, eat, or conduct business at TOD once a week or less	1.23	0.89
<b>Level 3</b>		
Newark	1.50	1.01
Black	1.33	0.86
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.70	2.05
Q19: Shop, eat, or conduct business at TOD once a week or less	0.79	-0.95
<b>Level 4</b>		
Newark	1.32	0.35
Black	1.38	0.63
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.29	0.78
Q19: Shop, eat, or conduct business at TOD once a week or less	0.67	-1.20

**Table 11. Coefficients that Violate Parallel Lines Assumption, Model with Average Age**

	Odds Ratio	z-stat
<b>Level 1</b>		
Hispanic	0.98	-0.11
White	1.40	1.44
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	0.95	-0.17
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.12	0.46
Q20: Car, truck, van, or motorcycle few times a week or more	0.64	-1.36
Q20: Car, truck, van, or motorcycle once a week or less	0.62	-1.42
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.38	1.24
Q19: Shop, eat, or conduct business at TOD once a week or less	0.88	-0.52
<b>Level 2</b>		
Hispanic	0.95	-0.29
White	1.92	2.83
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	2.14	2.98
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.87	2.89
Q20: Car, truck, van, or motorcycle few times a week or more	1.24	0.77
Q20: Car, truck, van, or motorcycle once a week or less	1.09	0.28
Q19: Shop, eat, or conduct business at TOD a few times a week or more	2.39	3.62
Q19: Shop, eat, or conduct business at TOD once a week or less	1.27	1.02
<b>Level 3</b>		
Hispanic	1.35	1.36
White	1.49	1.68
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	2.23	2.96
Q20: Ride bus, LR, subway, train, or ferry once a week or less	2.07	3.20
Q20: Car, truck, van, or motorcycle few times a week or more	1.68	1.67
Q20: Car, truck, van, or motorcycle once a week or less	1.84	1.76
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.63	1.85
Q19: Shop, eat, or conduct business at TOD once a week or less	0.77	-1.03
<b>Level 4</b>		
Hispanic	1.84	2.19
White	1.70	1.62
Q20: Ride bus, LR, subway, train, or ferry few times a week or more	0.91	-0.24
Q20: Ride bus, LR, subway, train, or ferry once a week or less	1.14	0.43
Q20: Car, truck, van, or motorcycle few times a week or more	0.83	-0.46
Q20: Car, truck, van, or motorcycle once a week or less	0.73	-0.64
Q19: Shop, eat, or conduct business at TOD a few times a week or more	1.57	1.32
Q19: Shop, eat, or conduct business at TOD once a week or less	0.80	-0.67

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## V. DISCUSSION AND CONCLUSIONS

Overall, the authors' models show mixed evidence of improved social capital for people living closer to train stations (i.e., in TOD areas). The strongest result is that being in a station area leads to agreement that that their community is a good place to live and that there is a greater sense of community; however, some other TOD related variables are not associated with greater social capital in the authors' models.

The results suggest that from a social capital perspective, TODs have additional impediments based on the details of how they are developed. Key features of TOD areas are dense mixed-use development connected to a transit facility (of any kind). A consistent finding throughout the authors' models, however, is that higher levels of employment density are associated with lower levels of social capital; higher population density, however, has no positive or negative association with levels of social capital. Furthermore, detached single-family housing, which is a housing form less frequently employed in TOD areas, is associated with higher levels of social capital. For planning professionals this suggests that housing density in TODs should be increased by deploying small lots, z-lots (i.e., lots set at an angle to the street), small houses, and accessory units as ways to increase population density but retain a "detached" housing feel for a neighborhood.

More specifically, the authors' model is clear that employment density is negatively associated with a community being perceived as a good place to raise children. This suggests, therefore, that when designing TODs, planners need to consider what the optimal level of population and employment are such that social capital is enhanced, while still providing good access to transit. Alternatively, they should reconsider how employment locations are traditionally integrated into TODs. A possible future study could consider the types of physical separations between employment and housing within TODs, and whether different configurations mitigate the negative social capital effect.

A limitation of this analysis is the diversity of areas that were surveyed. While the intent was to include lower and higher income areas, this may have had led to some difficulty in estimating effects. While dummy variables were included for each station area surveyed, some of the wealthier communities clearly had larger social capital than those that are poorer (e.g. Newark and Plainfield). The distribution of the social capital variables led to very small levels of "disagreement" with some of the measures in the wealthier areas, and this created some issues with model estimation. The authors' strongest results, however, are relatively robust across models, in particular for employment density and housing type.

The models the authors present do not include explicit variables that represent road network design features, such as four-legged intersection density. The authors examined some of these variables during the course of this research, but these had insufficient variation and did not lead to statistically significant results; some, such as four-legged intersections, are highly correlated with population density. A more detailed analysis of how road design affects social capital would be a useful study for the future.

While Putnam critiqued sprawling suburbs as an impediment to social capital, others have disputed this using empirical data.<sup>40</sup> The present study likewise suggests that urban form

and land use patterns may not be positive elements. There is evidence in the authors' analysis that providing access to good alternative travel options can enhance social capital, although this is not strictly linked to transit station proximity. It might be that the ability to commute without a car, perhaps avoiding the stress and uncertainty of congested travel, is what is most beneficial to providing people with the opportunity to build social capital in their communities.

In future studies, the authors would like to further test the relationship of TODs and social capital by being able to more thoroughly test the social capital domains from Forrest and Kearns: empowerment; participation; associational activity and common purpose; supporting networks and reciprocity; collective norms and values; trust; safety; and belonging<sup>41</sup> The survey administered for this study, due to its comprehensive nature, was very limited in the amount of social capital factors that could be tested. Furthermore, most of the social capital literature that intersects with transportation has been limited to geographic case studies. Given the greatly divergent quality and availability of public transportation around the United States the authors think it will be necessary to collect nationally representative data.

There are additional limitations to this work that point towards additional research opportunities. First, a more focused study that collects additional social capital questions could provide a richer view of these issues. Additional data is always helpful, and there would be benefit from including more survey respondents and not just those proximate (within two miles) of transit stations. Connections could be made to much of the research in urban design and travel behavior that attempts to measure how local conditions affect travel, and this in itself may affect residents' perceptions of their neighborhoods. An analysis of how the presence of children in the household may lead to greater connections within the community would also provide useful insights.

From a planning perspective, this paper's finding of no relationship between train station proximity and social capital is disappointing for those who advocate for more compact development. Sander and Putnam put the need for social capital in the stark terms that "no democracy, and indeed no society, can be healthy without at least a modicum of this resource (social capital)."<sup>42</sup> More concretely, social capital has been found to improve the health and happiness of citizens, reduce crime, improve governance, and improve economies.<sup>43</sup> Therefore, planners should continue to test and research different ways of fostering social capital.

## APPENDIX: TABULATIONS OF SOCIAL CAPITAL MEASURES BY TRAIN STATION AREA

<b>Cranford</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	0.00%	0.37%	1.11%	25.56%	72.96%
"Living in my neighborhood gives me a sense of community."	1.13%	2.26%	13.16%	38.72%	44.74%
"I know my neighbors."	0.74%	5.58%	10.04%	45.72%	37.92%
"Most people in my neighborhood can be trusted."	0.37%	0.74%	12.64%	43.87%	42.38%
"My neighborhood is a good place to raise children."	1.12%	1.87%	8.61%	32.21%	56.18%

<b>Jersey City</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	0.53%	3.21%	4.28%	35.29%	56.68%
"Living in my neighborhood gives me a sense of community."	2.14%	18.18%	27.27%	34.22%	18.18%
"I know my neighbors."	3.74%	29.95%	18.72%	35.83%	11.76%
"Most people in my neighborhood can be trusted."	2.16%	3.78%	36.22%	49.73%	8.11%
"My neighborhood is a good place to raise children."	5.41%	10.81%	36.76%	36.76%	10.27%

<b>Metuchen</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	0.00%	0.62%	0.93%	31.99%	66.46%
"Living in my neighborhood gives me a sense of community."	0.31%	5.02%	15.67%	35.11%	43.89%
"I know my neighbors."	1.90%	7.62%	8.57%	47.94%	33.97%
"Most people in my neighborhood can be trusted."	0.31%	0.31%	15.67%	47.02%	36.68%
"My neighborhood is a good place to raise children."	0.31%	0.94%	6.88%	37.81%	54.06%

<b>Morristown</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	0.00%	0.00%	3.72%	35.81%	60.47%
"Living in my neighborhood gives me a sense of community."	0.93%	7.91%	23.72%	38.60%	28.84%
"I know my neighbors."	4.69%	14.55%	18.31%	37.56%	24.88%
"Most people in my neighborhood can be trusted."	1.42%	2.84%	24.64%	47.87%	23.22%
"My neighborhood is a good place to raise children."	1.43%	7.62%	23.33%	40.48%	27.14%

<b>New Brunswick</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	1.78%	4.73%	10.06%	50.30%	33.14%
"Living in my neighborhood gives me a sense of community."	3.03%	23.64%	26.67%	31.52%	15.15%
"I know my neighbors."	6.63%	21.69%	18.07%	39.16%	14.46%
"Most people in my neighborhood can be trusted."	3.59%	11.38%	32.34%	40.72%	11.98%
"My neighborhood is a good place to raise children."	10.71%	17.86%	31.55%	22.02%	17.86%

<b>Newark</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	6.90%	17.24%	23.28%	38.79%	13.79%
"Living in my neighborhood gives me a sense of community."	7.08%	13.27%	31.86%	35.40%	12.39%
"I know my neighbors."	2.59%	21.55%	14.66%	47.41%	13.79%
"Most people in my neighborhood can be trusted."	17.09%	19.66%	34.19%	23.08%	5.98%
"My neighborhood is a good place to raise children."	20.51%	23.93%	31.62%	20.51%	3.42%

<b>Plainfield</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	2.42%	6.45%	12.90%	52.42%	25.81%
"Living in my neighborhood gives me a sense of community."	3.97%	13.49%	24.60%	44.44%	13.49%
"I know my neighbors."	4.76%	11.11%	11.90%	53.97%	18.25%
"Most people in my neighborhood can be trusted."	7.20%	8.80%	33.60%	38.40%	12.00%
"My neighborhood is a good place to raise children."	11.29%	12.90%	22.58%	40.32%	12.90%

<b>Rahway</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Undecided</b>	<b>Agree</b>	<b>Strongly Agree</b>
"My neighborhood is a good place to live."	0.48%	3.81%	13.81%	55.24%	26.67%
"Living in my neighborhood gives me a sense of community."	2.91%	15.53%	34.95%	33.98%	12.62%
"I know my neighbors."	3.83%	17.22%	14.83%	51.20%	12.92%
"Most people in my neighborhood can be trusted."	1.94%	9.22%	37.86%	38.35%	12.62%
"My neighborhood is a good place to raise children."	1.95%	15.61%	31.22%	36.59%	14.63%



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## ACRONYMS AND ABBREVIATIONS

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FAR	Floor Area Ratio
HBLR	Hudson Bergen Light Rail
LEHD	Longitudinal Employer-Household Dynamics
M&E	Morris and Essex
NED	Northeast Corridor
NJ	New Jersey
NJCL	New Jersey Coast
NJDOT	New Jersey Department of Transportation
NLRT	Newark Subway
PLACE	Physical Activity and Community Place Survey
RV	Raritan Valley
SMARTRAQ	Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality
TAD	Transit-Adjacent Development
TOD	Transit-Oriented Development

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## ENDNOTES

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