# APPENDIX

**Table A.** Relationship between Accessibility and TOD-nesses

| Source | TOD-ness [level, e.g., MSA and MSAC] (Dependent variable) | Predictors of TOD-ness (Independent variables) | | Relationship between TOD-ness and its predictors |
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| | | Accessibility | Others | |
| Calthorpe, 1993 | **Density:** Development density [MSA]. **Diversity:** Intensity of different land uses [MSA]. | **ABT:** Proximity to major transit networks or feeder lines [MSA]. | Existing land-use condition; market demand | Each TOD site's density and diversity attributes should be a function of its distance to transit facilities, its location in the transit network, market demand, and surrounding land use. <br><br> Across station areas, a high level of ABT should see a higher level of both density and diversity. |
| Cervero and Landis, 1997 | **Diversity:** Whether land-use changes; Percentage of changes in residential and non-residential building floor space [MSA]. | **ATT:** Straight-line distance from a cell within a station area to the nearest station [MSA]. | Existing land-use condition; Location of a station, such as whether it locates in the city center; Policy | Compared to non-station areas, ATT, in general, seems to have a modest impact on the change of land-use patterns within station areas. However, the positive influences from ATT can be seen in the change of land-use patterns within station areas in inner-city. |
| Bertolini, 1999 | **Density:** Number of residents [MSA]. **Diversity:** Number of workers of different workplaces; Degree of the functional mix [MSA] | **ABT:** Distance to the closest motorway; Frequency and directions of bus services; Number of stations within 45 minutes from a station [MSA]. <br><br> **ATT:** Number of bicycle paths [MSA]. | Morphology of the transportation network; Parking capacity for cars and bikes; Frequency and directions of a train services | Accessibility cannot be separated from its urban surroundings. The accessibility hierarchy of a station (area) in the transit system, measured by both ATT and ABT, points to the potential of enhancing TOD-nesses, which consider both density and diversity. <br><br> Stations with too high or too low values on TOD-ness or accessibility (both ATT and ABT) are regarded as outliers. |

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| Bertolini and le Clercq, 2003 | **Density & Diversity:** Number and the diversity of places or activities that can be reached at a given location [MSA]. | **ABT:** Speed, capacity, and flexibility of a transport mode at a given location [MSA]. | Policy. | The quality of ABT should match the number and diversity of activities there. Public transport with high ABT, such as speed, capacity, and flexibility, can see numerous and diverse activities around. |
| Schlossberg and Brown, 2004 | **Design:** Connectivity of the walking environment to transit stops [MSA]. | **ATT:** Intersection intensity; Length of different types of paths, dead ends road, and walkable zones [MSA]. | | ATT should be considered as part of the pedestrian environment. Better walking environment can improve ATT. |
| Geurs et al., 2006 | **Density:** Density of commercial and non-commercial services around new stations; Density of jobs [MSA]. | **ABT:** Opportunities in all other zones in the way that the more distant the opportunity, the smaller the influence; The generalized cost to all opportunities [MSA]. | | A concentration of activities around public transit contributes to ABT.<br><br>A less heavy concentration is preferred since a very heavy concentration of activities causes spatial imbalances in the labor market, which decreases marginal benefits for public transit users. |
| Pitot et al., 2006 | **Density:** Population density [MSA] | **ABT:** Distance to transit by walk and travel time via transit to different destinations within a city [MSA] | | A high population density should be accompanied by good ABT, which can be measured by walking distance and transit travel time to different destinations. |
| Atkinson-Palombo and Kuby, 2011 | **Density:** Development potential, such as the percentage of advanced TOD, the percentage of area with TOD planning, and the construction value [MSA]. **Diversity:** Land-use patterns in future TOD development [MSA]. | **ABT:** Numbers of population and jobs within a station area [MSA]. | Existing land uses condition; Socioeconomic characteristics, such as education level and income of residents; Type of a station, such as a terminal station; Parking facility. | Station areas with more population and jobs within walking distance, i.e., better MSA-level ABT, saw more TOD projects and implementation. Those station areas also attract mixed land-use development. |
| Chorus and Bertolini, 2011 | **Density:** Number of residents and employees [MSA]; **Diversity:** Functional mix [MSA]. | **ABT:** Number of bus lines; Types of trains a transit station connected to, such as rapid express; | Local traffic condition; Policy. | Density and ABT are highly correlated; diversity sees a subtle connection with ABT. Among different ABT indicators, the distance to city center coupled with the |

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| | | Distance to city center; Number of stations that a station connects to [MSA]. | | number of train connections see the largest impacts on the density of residents and employees. |
| Knowles, 2012 | **Density：** The number of employees living around stations [City]; **Diversity:** Expanded catchment areas; Relocation of retails, housing, and amenities development [City]. | **ABT:** Whether a station is in operation; Connection to essential locales, such as CBD or other cities [City]. | | The introduction of new public transit services increases accessibility from a site to other cities. The better ABT helps improve TOD-ness in terms of increasing diversity and density, e.g., the areas of catchment areas, number of employees, jobs, and development projects in or around station areas. |
| Calvo et al., 2013 | **Density:** Number of the population [MSA]. | **ATT:** Distance to a transit station [MSA]. <br><br> **ABT:** Whether a new station is introduced into a site [MSA]. | Location of a station, such as whether it locates at the city center or outer area; Type of a station, such as a station area mainly for residents. | Both ABT and ATT can improve TOD-ness in terms of density. The introduction of new stations increases the population density around, compared with non-station area and areas around old stations — the closer to the station, the higher the population. <br><br> Besides accessibility, the location and type of a station influence TOD-nesses. |
| Chatman, 2013 | **Density:** Population density around a household within a station area [MSA]; **Design:** Parking facilities provision; Number of bus stops around a household within a station area [MSA]. | **ATT:** Distance to a transit station from a household within a station area [MSA]. | Difference between the existing development and new development | A higher level of ATT can see the better design, such as lower off-street parking availability and more bus stops, and a higher population density around a household. <br><br> New development is more sensitive to accessibility than existing development. |
| Lee et al., 2013 | **Density:** Ratio of the total building floor area to the ground area [MSA]; **Diversity:** Mixed-use index calculating by different building floor area [MSA]; **Design:** Number of bus lines [MSA]. | **ABT:** Number of the population within a station area weighting by travel time to the station plus population weighting by travel time to all other stations via subway network [MSA]. | | Station areas are classified into 3 or 4 clusters based on ABT to understand their ridership pattern better. <br><br> Clusters with higher ABT saw higher values of density, diversity, and design. |

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| Papa et al., 2013 | **Density:**<br>Number of residents [MSA]. | **ABT:**<br>How centrally a station is located in the network [MSA]. | | A station's degree of centrality in the transit network should match its TOD-ness, e.g., the number of residents at the MSA level.<br><br>Mismatches can mean potential for TOD. |
| Ratner and Goetz, 2013 | **Density:**<br>Density of development and population [MSA];<br>**Diversity:**<br>Number/percentage of land-use development, such as residential and office buildings [MSA]; | **ABT:**<br>The hierarchy of transit stations in terms of their importance as a transit hub and destinations in the region [MSA]. | Location of a station, such as whether it locates at the city center; Years since the operation. | Different stations situate in a unique spot and are equipped with different ABT, which impact local land use, urban form, and population density.<br><br>Stations (especially downtown ones) with better ABT see more developments and higher population density. Different station areas in the local transit accessibility hierarchy see different types of land uses. |
| Cervero and Dai, 2014 | **Density:**<br>Building densities; Changes in building area footprint [City].<br>**Diversity:**<br>Land-use pattern [City]. | **ATT:**<br>Access and physical connection system from BRT stations to feeder systems and surrounding land parcels [City];<br><br>**ABT:**<br>Number of population and workers within one or two blocks of BRT [City]. | Local real estate markets; Type of a station, such as terminal station; Policy and strategic planning at multiple scales; Parking facility | Better ATT and ABT see higher effectiveness in BRT implementation, such as more changes of land use and higher building densities. |
| Shen et al., 2014 | **Diversity:**<br>Changes in land use [MSA]. | **ABT:**<br>Travel time from one cell to all other cells within the high-speed serves station area by metro and road network; Travel time from a cell within the high-speed serves station area to all municipalities out of the study area by rail transit and road network, weighted by the population at the destination [MSA]. | Socioeconomic attributes; Impacts from surrounding cells; The introduction of a station connecting to regional destinations. | The land-use development is closely associated with ABT at the city and regional levels.<br><br>The better the ABT of a station area, the more changes in land use.<br><br>Having a station connecting to regional destinations and improving the ease of access to this station can result in more land-use changes in the city.<br><br>Population and land use of neighborhoods significantly predict the changes in land use. |

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| Papa and Bertolini, 2015 | **Density:** Density of inhabitants and jobs of each cell [MSA]. **Distance to transit:** Average distance from a cell to all other cells in a city, corresponding to the closeness centrality index [City]; **"TOD degree":** To what extent density matches the distance based on the Node-Place model [City]. | **ABT:** Average number of inhabitants and jobs reachable in 30 mins' travel time by rail, metro, and tram from each cell of a city [City]. | | TOD urban structures are positively associated with ABT. TOD degree indicates how urban development clusters along rail corridors and stations. TOD degree can well predict accessibility to jobs and inhabitants in metropolitan areas. Distance is highly correlated to ABT whereas density is not. |
| Chorus and Bertolini, 2016 | **Density:** Floor area ratio [MSA]. **Diversity:** Number of residents and employees at different workplaces [MSA]. | **ABT:** Number of train services; Type of train services (rapid & local); Distance and time to the nearest sub-center; Distance to the city center [MSA] | | For each station along a corridor, TOD-ness is significantly correlated to the ABT. High-density developments and mixed land-uses often accompany with satisfactory transport/transit conditions in station areas. |
| Farber and Marino, 2017 | **Density:** Percentage of developable land [MSA]. | **ABT:** Number of people and jobs reachable by public transit within 50 mins at 8 am from a metro station [MSA]. | Socioeconomic characteristics, such as income, immigrants, etc. | Station areas can be categorized into different clusters according to their respective ABT, density (availability of developable land), and socioeconomic characteristics. Station areas with higher ABT and more developable land improve transit-related social equity if they were exploited to serve people with low(er) socioeconomic statuses. |
| Singh et al., 2017 | **Density:** Density of population; Number of commercial and business establishments [MSA]; **Diversity:** Land use entropy; Mixedness; Number of jobs [MSA]; **Design:** Length of walkable/cyclable paths; Intersection density; Pedestrian catchment area; Frequency; Number of directions; Parking provision [MSA]. | **ABT:** Centrality in the transit network [MSA]. | Location of a station, such as whether it locates in the city center; Passenger load during peak and non-peak hour; Safety, such as 'eyes' in a space; Availability and quality of transit service. | TOD-nesses are positively correlated to ABT. A station with better ABT should be exploited to serve more people, activities, and developments. |

| Deboosere et al., 2018 | **Density:**<br>Density of jobs and population [MSA; census tract];<br>**Diversity:**<br>Percentage of open areas (areas not used for residential, commercial, industrial, governmental, or park) [MSA; census tract]; | **ABT:**<br>Numbers of jobs and workers reachable in 30 mins by car and 45 mins by public transit [MSA]. | Individual attitude toward public transit. | ABT is associated with TOD-ness, such as density and diversity.<br><br>A site with better ABT can enjoy more land developments.<br><br>ABT has mixed impacts on population density. Increasing ABT (measured by workers reachable by public transit) can increase job density in a city. |
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| Lyu et al., 2019 | **Density:**<br>Average number of residents and employees of all stations within a cluster [Cluster level];<br>**Diversity:**<br>Average number of employees at different workplaces; Functional mix of all stations within a cluster [MSAC];<br>**Distance to transit:**<br>Connections to bus and other stations within a cluster; Average time/distance to all other stations within the same cluster [MSAC];<br>**Design:**<br>Urban design within a station area, such as intersections, block size, and walk scores [MSA]. | **ABT:**<br>Jobs and inhabitants reachable in 60 mins by public transport (rail, metro, and tram) in the morning peak hours from a metro station [MSA & MSAC]. | Level of transit services at a station, such as a train frequency | TOD-nesses such as distance to transit and design are positively associated with accessibility.<br><br>For density, a high job density but a low residence density can see a high level of ABT. For diversity, different job densities in different sectors are required to achieve a high level of ABT. Moreover, a lower level of the functional mix can enjoy a high level of ABT. |

**Table B.** Formulation of TOD-ness indicators

| TODness Indicators | | Source of Data |
|---|---|---|
| *Density* | Population density | Statistical Year books by the government |
| | Employment density | Points of Interest listed as businesses, establishments or governmental entities |
| | Compactness | |
| *Diversity* | Land use mix | |
| | Number of bus lines | Baidu Map |
| | Ground-floor retail density | Gaode Map |
| *Design* | Street network density | Open Street Maps (OSM) |
| | Number of metro station entrance | Tecent Map |
| | Number of parking facilities | Gaode Map |
| | Expressway density | OSM |
| *TODness* | The summary of 3Ds with different weights. Density:0.5 Diverisity:0.4 Design:0.5 | N/A |