Assessing the Impact of Transit Stations on Urban Socio-economic and Spatial Patterns in Kuala Lumpur

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ABSTRACT

In order to reduce auto-dependency and environmental imprint for a sustainable development, the urban transit facility should be well distributed for all socio-economic groups. To achieve this, perhaps one of the most effective approaches is adopting the transit-oriented development (TOD) principles. However, in an unplanned urban transit development there is a major concern that the distribution of transit facilities is not following an equal urban socio-economic and spatial pattern. Since this issue has been little discussed in the literature, the current study looks at the influence of transit station on socio-economic, land use, and housing type distribution in Kuala Lumpur, Malaysia. A spatial analysis framework was developed for analyzing the pattern of household characteristics (i.e., size, education, age), land use (i.e., commercial, residential, entertainment, institutional), and housing type (i.e., low-cost, medium-cost, high-cost). The attributes of variables have been retrieved from various data sources for two distance areas of one quarter mile (approx. 400 meters) and half a mile (approx. 800 meters) radius around Putra Light Rail Train (LRT) transit stations. The preliminary findings indicate that, high profile socio-economic households and high and medium-cost housing types are significantly clustered in areas at one quarter mile radius around transit stations. The land use types also are more economical in this distance. The findings imply that low income households are residing in further distances from transit stations and there is a spatial mismatch between urban transit facilities and low income households, as well as low-cost housing types. These findings enhance our understanding on planning for social and spatial equity. So that, if the development is inclined with TOD principles there would be less spatial mismatch in achievement of sustainability.

Keywords: TOD, Spatial equity, Sustainable development, Spatial analysis, Kuala Lumpur
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Outline

• TOD and Urban Transformation
• What the literature says about TOD?
• Equitable TOD Principles
• TOD in KL
• Concluding Remarks
TOD and Urban Transformation

• TOD is often defined as higher-density mixed-use development within walking distance of transit stations.
What the literature says about TOD?

TOD Benefits

• Variety and choice in housing types, retail destinations, and office locations;

• Catalyst and framework for revitalization and redevelopment of central urban areas into vibrant communities;

• A highly activity level of transit station areas, increasing pedestrian safety through numbers;

Source: Cullingworth and Caves, 2009
TOD Benefits

• Enhanced transit ridership, walking, and cycling, and reduced automobile dependence;

• Contribution to reduced levels of congestion and improved air quality;

• Efficient use of infrastructure due to the greater intensity of development, both in existing and new areas.

Source: Cullingworth and Caves, 2009
TOD and Urban Transformation

• Many TOD projects are not fundamentally different from traditional residential suburban developments.

• They are not well-integrated with the station or the surrounding community, and they are neither mixed-use nor mixed-income.
  – Land Value effects
  – Housing Price and Rental
  – Socio-economic mismatch
Equitable TOD Principles

**Land use:**
- Density: Diversity of land use
- Land use type
- Competitions among the potential land uses in the station areas and along the transit routes:
  - Leisure facilities, retail facilities, education facilities
- Land use can affect on station and mix land

**Network line of TOD:**
- Features of the road network:
  - Linking catchment area, transport network, supporting transfer between modes of transport, facilitating commercial use of real estate...
- Travel time:
  - Walking times to reach bus stops, typical waiting times at bus stops, travel times on the bus network, transfer times between routes...
- Passenger safety

**Equitable TOD**

**Station:**
- Well distributed stations. To improve the access to the railway station.
- Walking facilities:
  - Sidewalk widths, pedestrian walking space, street furniture, lighting facility, safe walking facilities, shaded corridors, busy and interesting...
- Characteristics in station:
  - Social, economic and demographic characteristics, level of service, toilet, main entrances, ensure personal security, providing public space...

**Housing and related infrastructure**
- Housing data:
  - Housing prices, dwelling type, degree of finishing condition, green area ratio, and floor area ratio site and district locations, Distance to Transit Station, Distance to the City Center
- Local access to public services or amenities:
  - Expressways, health centers, public parks, and sports facilities
- Regional geography:
  - Area of urbanization, population, population density, and regional location
Age: 20 - 39

Given the z-score of 10.27, there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance.
High-Low Clustering Report

Age: 40 - 54

Observed General G: 0.000167
z-score: 2.906447
p-value: 0.003656

Significance Level (p-value)
0.01  < -2.58
0.05  -2.58 - -1.96
0.10  -1.96 - -1.65
0.15  -1.65 - -1.50
0.20  -1.50 - -1.25
0.25  -1.25 - -1.00
0.30  -1.00 - -0.75
0.40  -0.75 - -0.50
0.50  -0.50 - -0.25
0.60  -0.25 -  0.00
0.70  0.00 -  0.25
0.80  0.25 -  0.50
0.90  0.50 -  0.75
0.95  0.75 -  1.00
1.00  1.00 -  1.50

Critical Value (z-score)
> 2.58

(Random)

Given the z-score of 2.91, there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance.
Age: 55 and above

Given the z-score of 0.02, the pattern does not appear to be significantly different than random.
Land use Spatial Pattern in 1 mile buffer from transit Line and Stations

High-Low Clustering Report

- **Observed General G:** 0.000557
- **z-score:** 93.515502
- **p-value:** 0.000000

- **Significance Level (p-value):**
  - 0.01: < -2.58
  - 0.05: -2.58 - -1.96
  - 0.10: -1.96 - -1.65
  - 0.20: -1.65 - -1.5
  - 0.30: -1.5 - -1
  - 0.40: -1 - -0.8
  - 0.50: -0.8 - -0.5
  - 0.60: -0.5 - -0.3
  - 0.70: -0.3 - -0.2
  - 0.80: -0.2 - -0.1
  - 0.90: -0.1 - 0.1
  - 0.95: 0.1 - 0.5
  - 0.99: 0.5 - 2.58

- **Critical Value (z-score):**
  - > 2.58

**Given the z-score of 93.52, there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance.**
Land use Spatial Pattern in 1/4 mile buffer from transit Line and Stations

High-Low Clustering Report

Observed General G: 0.000788
z-score: 55.212813
p-value: 0.000000

Significance Level (p-value)
- 0.01
- 0.05
- 0.10
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- 0.10
- 0.05
- 0.01

Critical Value (z-score)
- < -2.58
- -2.58 - -1.96
- -1.96 - -1.65
- -1.65 - 1.65
- 1.65 - 1.96
- 1.96 - 2.58
- > 2.58

(Random)

Given the z-score of 55.21, there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance.
Results

• Transit Development in KL has a statistically significant relation to the **Socio-economic pattern**.
  - The transit development is serving the young residents more than elderly.
  - The Higher the Socio-economic profile the closer to transit stations.

• Transit Development in KL has also a strong relation with the **land use** pattern.
  - High cluster of commercial land uses in proximity to the LRT line and Stations.
Concluding Remarks

- Study on the *Transit Development* in KL shows a *mismatch* with the socio-economic profile.
Concluding Remarks

• It is evident that public transit and land use planning in KL are not well-coordinated, which causes acceleration in land price increase and gentrification effects.
Concluding Remarks

- Assessing the impact of TOD using GIScience helps to enhance transport planning as well as land use and social planning.