NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Bulletin of Geography. Socio-economic Series, No. 55 (2022): 7–15
http://doi.org/10.12775/bgss-2022-0001

ISSN 1732–4254 quarterly

BULLETIN OF GEOGRAPHY. SOCIO–ECONOMIC SERIES

journal homepages:
https://apcz.umk.pl/BGSS/index
https://www.bulletinofgeography.umk.pl/

Socio-spatial transformation of neighbourhoods around rail transit stations: an experience from Tehran, Iran

Amir Forouhar [1, CDFMR], Bahador Zamani [2, CFR], Mojtaba Rafieian [3, CFR]

[1,2]*Art University of Isfahan*, Faculty of Architecture and Urban Planning, Iran, [1]e-mail: a.forouhar@aui.ac.ir, phone: +989359519993; [2]e-mail: b.zamani@aui.ac.ir (*corresponding author*), phone: +989132808550 Postal Address: Hakimnezami St., Isfahan, Iran; [3]*Tarbiat Modares University,* Faculty of Art and Architecture, Teheran, Iran

How to cite:
Forouhar, A., Zamani, B., & Rafieian M. (2022). Socio-spatial transformation of neighbourhoods around rail transit stations: an experience from Tehran, Iran. *Bulletin of Geography. Socio-economic Series*, 55(55): 7-15. DOI: http://doi.org/10.12775/bgss-2022-0001

Abstract. While increasing evidence suggests that rail infrastructure plays a structuring role in shaping and transforming cities and regions over time, empirical studies on the simultaneous development of rail infrastructure and socio-spatial transformation of surrounding neighbourhoods, especially at a local scale, are scarce. The main aim of the article is to evaluate the transformation of neighbourhoods around rail transit stations, as well as provide a possible explanation of how neighbourhoods can be differently affected by the presence of rail stations. Based on a longitudinal dataset (2006–16) and using a Difference-in-Differences (DID) model and Multivariate Analysis of Variance (MANOVA), a comparative analysis of the Tehran Metro Rail System (TMRS) is conducted between high-income neighbourhoods and low-income neighbourhoods of the city. The results yield that the northern, high-income neighbourhoods and the southern, low-income neighbourhoods of Tehran have been transformed heterogeneously in terms of socio-demographic factors, land-use conditions and renewal processes. The findings also indicate that the mixed estimated transformation of neighbourhoods around TMRS's stations could be explained by the contextual factors of the northern and southern study settings in Tehran, including land-use characteristics and socio-economic factors.

Article details:
Received: 2 August 2021
Revised: 29 September 2021
Accepted: 22 November 2021

Key words:
urban rail transit,
socio-spatial transformation,
Transit-Oriented Development,
Difference-in-Differences Model,
Tehran

Contents:

1. Introduction

It is widely argued that major new transport infrastructure, especially urban rail infrastructure, has a structuring role in shaping and transforming cities and regions over time (Banister, 1995; Cervero & Seskin, 1995; Higgins et al., 2014). Although the introduction of urban rail transit has been generally associated with tangible objectives such as lower levels of air pollution, noise, traffic and road congestion (Anderson, 2014; Baum-Snow et al., 2005; Yang et al., 2014), one of the highly regarded expectations of built or rejuvenated rail transit systems is that investment in rail infrastructure can spur urban transformation, revitalise declining areas and promote more transit-oriented development (TOD) by increasing land rents and promoting higher density development over time within the urban system (Bhattacharjee, 2013; Guiliano & Agarwal, 2010; Higgins et al., 2014; Knight & Trygg, 1977). The logic is based on changes in regional accessibility, mobility options and transportation costs being likely to give one area a new competitive advantage over other areas, which in turn results in greater opportunity for further urban development and attracting the flow of socio-economic resources (Banister, 1995; Cohen-Blankshtain & Feitelson, 2011).

The relationship between rail infrastructure and urban transformation has been investigated from a variety of perspectives (Banister, 1995; Burmeister, 1998; Nijkamp & Blass, 1994). Much of the macro-level empirical research in this area dates back to the late 1980s, when federal governments of the United States supported studies on the relationship between urban form and rail infrastructure development (For example, see Cervero & Seskin, 1995; Donnelly & Price, 1982; Lawless & Gore, 1999; Meyer & Gomez-Ibanez, 1981; Smith, 1984; Webber, 1976). Early studies on this topic found that, consistent with location theory, regional rail systems were a force toward decentralisation of both population and employment, and at the same time had some clustering effects (decentralised concentration), leading to a more polycentric urban spatial structure (Banister, 1995; Cervero, 1984; Cervero & Seskin, 1995; Higgins et al., 2014).

At the local scale, many studies focus on the impact of rail transit on physical transformations and activity pattern variations around rail lines and stations (For example, see Cervero & Landis, 1997; Giuliano, 2004; Higgins et al., 2014; Huang, 1996; Knight & Trygg, 1977). In this respect, changes in land use as the spatial embodiment of human activities have been widely studied with different approaches. However, a growing body of scholarly research challenges the generative land-use effects of rapid transit, arguing that rail transit systems can have a substantial redistributive impact and influence where and how growth in a region affects activities (Babalik-Sutcliffe, 2002; Cervero & Landis, 1997; Cervero & Seskin, 1995; Hass-Klau & Crampton, 2002; Knight & Trygg, 1977). Another part of the literature is dedicated to micro-economic impacts, such as variations in property and rent values for different uses (For example, see Debrezion et al., 2007; Higgins & Kanaroglou, 2016; Mohammad et al. 2013). Although the verall picture has been mixed, providing that there is a strategic policy package, the literature offers evidence that rail transit has generally had a positive effect on land values within walking distance of a rail access point, though results differ among modes and contexts and across analysis types (Cervero et al., 2004; Debrezion et al., 2007; Diaz & Mclean, 1999; Higgins & Kanaroglou, 2016).

Although rail transport has a well-accepted influence on socio-spatial structures of cities at the macro level, at a more detailed level (local scale) both the methodologies for analysis and the empirical evidence are limited (Banister, 1995; Higgins & Kanaroglou, 2016). In this respect, urban researchers have rarely analysed the relationship between the presence and introduction of (new) rail transit stations and socio-spatial transformation of surrounding neighbourhoods through a comprehensive model. In this study, thus, we argue that rail transit projects rarely occur in isolation from other changes in urban systems. The neighbourhoods surrounding rail transit stations are often part of a larger effort by a city to encourage transformation around the stations, as well as being the main point of connection and interaction of rail systems with the urban environment (Bertolini, 1999; Bertolini, 2008; Billings, 2011; Papa et al., 2008). Therefore, estimating the possible effects of rail transit on urban systems without sufficient attention to the local scale and the overall transformation in the surrounding neighbourhoods is an unrealistic and insufficient way to identify the dynamic process around rail stations and its potential underlying factors. In this respect, the introduction of the Tehran Metro Rail System (TMRS) provides an interesting opportunity to evaluate the socio-spatial transformation of neighbourhoods around rail stations in different urban contexts, as the neighbourhoods served by TMRS to the north and south of the line are considerably different in respect of socio-economic level and physical circumstances. Applying a Difference-in-Differences (DID) model, this article contributes to the body of literature by evaluating the transformation of socio-spatial attributes of neighbourhoods around rail transit stations through different urban contexts at the local scale. This context-sensitive approach not only captures any possible changes in the socio-spatial characteristics of neighbourhoods after the opening of a rail station but also reveals the contextual factors which are likely to affect the magnitude and direction of the impact.

2. Data nad methods

The present article employs a Difference-in-Differences (DID) model to evaluate the socio-spatial transformation of residential neighbourhoods around rail transit stations. The DID is a statistical technique that can be used to calculate the effect of a "treatment" (i.e., a new rail service) on an outcome variable (i.e., neighbourhood change) by comparing the average change for the treatment and control groups over a relatively long period, with at least one time period before the treatment (pre-treatment) and at least one time period after the treatment (post-treatment) (Abadie, 2005; Conley & Taber, 2011; Lechner, 2011). To systematically produce an aggregated DID model for all socio-spatial variables, this article used Multivariate Analysis of Variance (MANOVA) to investigate the effect of interaction between independent variables (interaction between the Time dummy and the Treatment group dummy) on multiple dependent variables (socio-spatial contextual factors of neighbourhoods). The present study defines treated neighbourhoods as those located within a given distance of a station, while control neighbourhoods are those located at a greater distance. In this study, the catchment zone for treated neighbourhoods includes urban blocks that are located at a distance equal to or less than 400 metres from the central point of the new rail stations. In addition, the control zones used in this article are selected through the use of the common trend and bias stability assumption of the DID model (Lechner, 2011; Ransom, 2018; Wing et al., 2018). To satisfy this assumption, we compared the trend of socio-spatial changes between the catchment areas and the control zones before the introduction of the rail stations. In addition, the present article attempts to select the threshold of the control neighbourhoods according to the similarities in land use and population characteristics between the catchment areas and the control zones. Therefore, control neighbourhoods located in different contexts (such as non-urbanised areas) are excluded from the dataset. Then, the maximum possible distance from the stations with the aforementioned conditions is selected as the control zone, which covers an area between 1600 and 2000 metres from the rail stations (Fig. 1). Based on the criteria, Qeitarieh Metro Station (opening date: 2009) was selected from the high-income neighbourhoods in the north, and Zamzam Metro Station (opening date: 2013) was

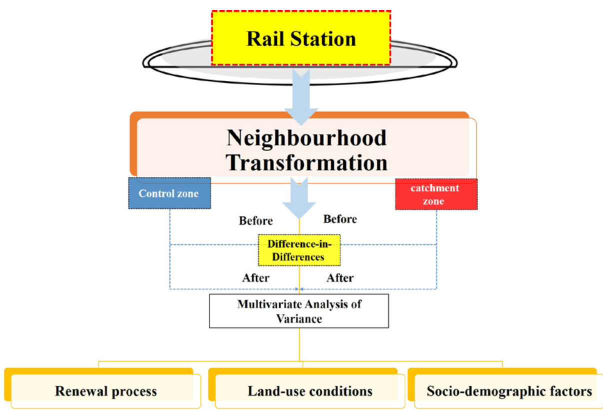

Fig. 1. Research methodology
Source: Elaborated by the authors

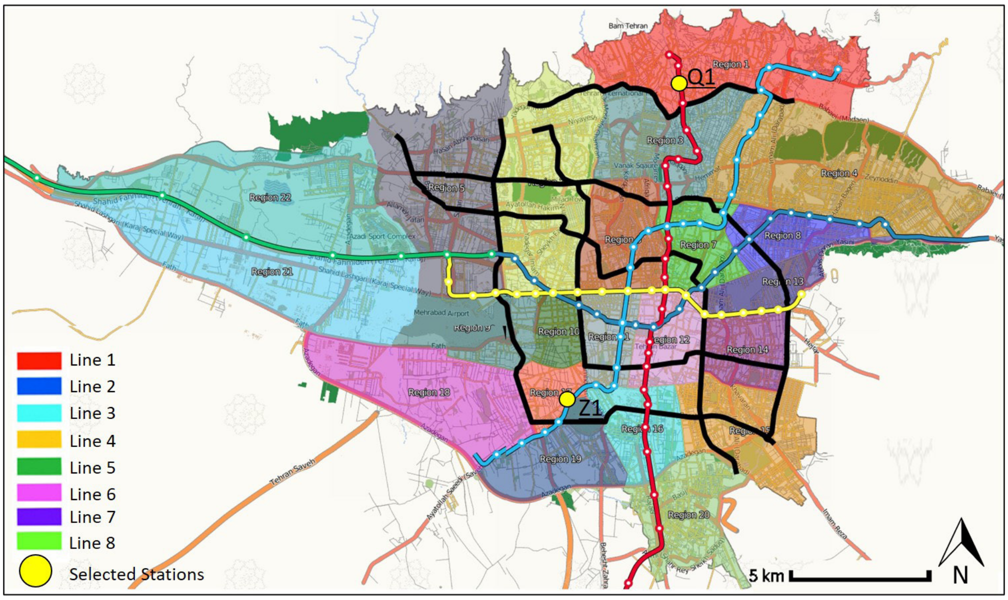

Fig. 2. Tehran Metro Rail System and the selected stations
Source: Elaborated by the authors

examined from the lower-income neighbourhoods in the southern districts of Tehran (Fig. 2).

In this article, the socio-spatial transformation of neighbourhoods around TMRS's stations is investigated through the use of a rich dataset provided by the Statistical Centre of Iran (SCI). The Population and Housing Census of Iran (PHCI) by SCI is one of the most reliable and comprehensive statistical data sources in Iran, and provides comprehensive information on social, demographic, economic and physical characteristics of urban areas at a census block. The ultimate dataset contains 1158 and 1136 valid census blocks, respectively, for Qeitarieh and Zamzam metro stations. The dataset includes information related to changes in socio-demographic factors, land-use conditions and renewal processes, which are further described in Table 1.

Table 1. Descriptive statistics of socio-spatial variables

Category	Variable name	Unit	Mean	Sd	Variance	Source
Socio-demographic factors	Population density	/hectare	503.995	315.289	99,407.303	PHCI
	Number of households	/hectare	91.394	85.234	7,264.868	PHCI
	Household size	/household	3.279	.508	.259	PHCI
	Immigrant population	/hectare	25.788	39.475	1,558.314	PHCI
	Employment rate	%	.352	.062	.004	PHCI
	Student population	/hectare	58.601	58.328	3,402.191	PHCI
Land-use conditions	Number of business/ commercial units	/hectare	19.290	30.034	902.051	PHCI
	Number of floors	-	2.214	.4924	.242	PHCI
	Surface area	m^2	73.502	20.636	425.844	PHCI
	Number of residential units	/hectare	89.183	83.500	6,972.406	PHCI
	Residential built-up area	% of total	.404	.063	.004	PHCI
Renewal process	Number of run-down housing units	/hectare	18.176	21.787	474.679	PHCI
	Number of housing units with dilapidated structure	/hectare	65.580	61.493	3,781.456	PHCI

Source: authors 'own elaboration

3. Results

The results obtained from the DID models are reported in Table 2 for the selected stations and the catchment zones. The present study essentially attempts to evaluate whether the changes in socio-spatial variables differ statistically between the treatment and control neighbourhoods. In this respect, Pillai's Trace as the most robust multivariate test in MANOVA confirms that the socio-spatial variables differ along the dimensions of time, treatment and specifically their interaction (time*treatment). Thus, with a 99% confidence level, it can be generally concluded that the opening of the selected stations – as an independent variable – contributed to the changes in socio-spatial variables – as dependent variables – of adjacent neighbourhoods, compared to the control neighbourhoods. In addition, The DID models for treated neighbourhoods explain 0.626 and 0.742 percent of the variation in socio-spatial variables, respectively, for Qeitarieh and Zamzam metro stations.

The results yield that the socio-demographic factors of neighbourhoods located near the selected stations experienced a considerable transformation after the opening of the rail stations, as compared to the control neighbourhoods. In the northern neighbourhoods, the population density decreased at a distance equal to or less than 400 metres from the rail stations. Following the opening of the northern rail station, the growth in total population in the area surrounding the stations was estimated to be less than in the control neighbourhoods, as the population density decreased by 19.421 people per hectare within a 400-metre radius of Qeitarieh station. Accordingly, the number of households living close to the northern station also shows a significant decrease of 8.2% compared to the control neighbourhoods. The opposite is true for the southern station in low-income neighbourhoods, where the population density and the number of households are positively correlated with the opening of the rail station. The models demonstrate 19.3% increases in the population density for Zamzam station. In addition, over the period considered by the present study, the results show that the age structure has also transformed to a younger population compared to the control neighbourhoods, since the ratio of the young population close to the stations increased by 10.122 (11.1%) and 21.010 (23.2%) people per hectare, respectively, for Qeitarieh and Zamzam metro stations. However, only for that station in the northern high-income neighbourhoods, the decrease in the elderly population is estimated to be significant. In fact, following the opening of Qeitarieh station in high-income neighbourhoods, the living conditions around the station transformed into an undesirable environment for the elderly population. The results also yield that households of lesser size are more inclined to live in the area close to the metro stations compared to the control neighbourhoods. Immigration flow is also estimated to have a strong relationship with the opening of the selected metro stations in both northern and southern neighbourhoods of Tehran. The DID models demonstrate that the number of immigrants increased significantly around the selected stations. More specifically, higher percentages for the immigrant population are captured for the Qeitarieh station in high-income neighbourhoods, where the immigrant population increased by 12.4%. Regarding the changes in employment and activity, the results show that the opening of the selected stations had a significant effect on the number of employed people living around the stations, as compared to the control neighbourhoods. During 2006–2016, the employment rate rose by 12.2% and 21.2%, respectively, for Qeitarieh and Zamzam stations relative to the neighbourhoods outside the impact range of the stations. However, the significance level of the models shows that the student population did not experience statistically significant changes around the southern station, but in the case of high-income neighbourhoods, the student population increased within a 400-metre radius of Qeitarieh station. The findings also indicate that residential properties closest to the selected rail stations tended to become denser after the opening of the rail stations in both low-income and high-income neighbourhoods of Tehran, since the average surface area of the residential properties decreased and the number of floors significantly increased around the selected stations, as compared to the control properties. The DID models demonstrate a paradoxical land-use change close to the selected rail stations in high-income and low-income neighbourhoods of Tehran. In the case of northern neighbourhoods, the number of business/commercial units increased considerably by 10.142 (19.2%) per hectare, and at the same time, the number of residential units fell by 11.1% within a 400-metre radius of Qeitarieh station. Conversely, in the southern, low-income neighbourhoods, the number of residential units increased significantly following the opening of Zamzam station.

Regarding the effect that the opening of rail stations had on the renewal process, the results show that the low-income neighbourhoods in the southern part of Tehran experienced considerable renewal. In this regard, the number of run-down housing units decreased by 9.221 (10.3%) per hectare, and in the same way, the number of housing units with dilapidated structure dropped to 13.2% close to Zamzam station. The opposite is true

Table 2. Estimating socio-spatial transformation of neighborbourhoods around rail stations using difference-in-differences model

		Q1 Station	**S2 Station**
Category		Catchment Zone	Catchment Zone
	Pillai's Trace (Time*Treatment)	0.626 ***	0.742***
	Partial Eta Squared	0.786***	0.895***
	F-test	2.579***	9.205***
Socio-demographic factors	Population density	-19.421*** (-9.3%)	56.412*** (19.3%)
	Young population (18-25 years old)	10.122*** (11.1%)	21.010*** (23.2%)
	Adult population (25-60 years old)	8.221 (6.1%)	22.336** (28.1%)
	Elderly population (over 60 years old)	-13.221*** (-18.8%)	5.010 insig (2.1%)
	Number of households	-6.123*** (-8.2%)	12.621*** (21.2%)
	Household Size	-.232***	-.246***
	Immigrant population	9.258*** (12.4%)	5.355*** (8.7%)
	Employment rate	12.2%***	21.2%***
	Student population	11.109** (10.2%)	-2.236 insig (-0.1%)
Land-use conditions	Number of business/commercial units (/ha)	10.142*** (19.2%)	0.104 insig (0.7%)
	Number of floors	1.879**	1.220***
	Surface area (m2)	-24.508***	-14.028 ***
	Number of residential units (/ha)	-9.221 (-11.2%)	19.114** (21.2%)
	Residential built-up area (%)	-5.4%***	6.2%***
Renewal process	Number of run-down housing units (/ha)	7.225** (9.4%)	-9.221** (-10.3%)
	Number of housing units with dilapidated structure (/ha)	7.259 *** (6.3%)	-14.115*** (-13.2%)

Source: authors 'own elaboration

for the high-income neighbourhoods in northern parts of Tehran, which experienced increases in the run-down housing units with dilapidated structures in the vicinity of Qeitarieh station over the period considered by the present study.

4. Discussion and conclusion

This article aimed to assess the socio-spatial transformation of low-income and high-income neighbourhoods around rail transit stations, based on an experience from Tehran, Iran. The findings demonstrated that following the opening of TMRS stations, the northern, affluent neighbourhoods and the southern, low-income neighbourhoods of Tehran were transformed differently in terms of socio-demographic factors, land-use conditions and renewal processes. In the northern, affluent neighbourhoods of Tehran, the DID model indicated that the opening of the selected rail station was accompanied by a growth of business/commercial units within 400 metres of the station, while population density and residential built-up area significantly decreased compared to the control neighbourhoods. The opposite was captured for the southern rail station in low-income neighbourhoods, where the opening of the station showed a positive impact on population density as well as the residential built-up area close to the selected station compared to the neighbourhoods outside the impact range of the station. In addition, the results showed that the age structure also transformed to a younger population with lower-level family size, though living conditions around the northern station in high-income neighbourhoods transformed to an undesirable environment for the elderly population. Immigration flow and employment rate were also estimated to have a strong relationship with the opening of the selected rail stations in both northern and southern neighbourhoods of Tehran. Ultimately, the findings indicate that the residential properties closest to the selected rail stations tended to become denser after the opening of the rail stations in both low-income and high-income neighbourhoods of Tehran, but that only the southern station had a positive impact on the renewal process.

The results of this article suggest that the mixed estimated transformation of neighbourhoods around TMRS's stations could be explained by the contextual factors of the northern and southern study settings in Tehran, including land-use characteristics and socio-economic factors. Due to the dramatic socio-economic and physical differences between the northern and southern parts of Tehran, the low-income households of southern neighbourhoods tend to rely more on public transportation, as compared to the northern affluent neighbourhoods. Thus, in this context, living in the immediate station area is of high importance for low-income households and newcomers to access employment opportunities across regions, as considerable densification of population and residential land-uses was captured in southern neighbourhoods around the selected station. On the opposite side, haphazard and unplanned commercial gentrification and socio-cultural tensions around the northern station in the affluent neighbourhoods led to an unwillingness of wealthy former inhabitants or newcomers to live around the station. This manifested itself in considerable population loss, as well as an increased number of run-down housing units with dilapidated structures.

Although compact and mixed-use development around rail stations is aligned with TOD principles, the findings of this study imply that the success of densification and mixed-use transformation in residential areas relies on the capacity of the host neighbourhoods, as well as supporting demographics within those neighbourhoods, to adapt well to denser ways of living, working, traveling and socialising. If the host neighbourhood for a rail station does not have the capacity to receive a high degree of densification, then the result may be undesirable congestion, neighbourhood nuisance and socio-cultural tensions, similar to what the high-income neighbourhoods of Tehran experienced. This highlights the urgent need for context-sensitive land-use planning around the constructed rails stations that not only supports the positive effects of metro stations but can also minimise the nuisance effects through a multi-objective planning model that integrates transport and local specificities.

References

Abadie, A. (2005). Semiparametric difference-in-differences estimators. *The Review of Economic Studies*, 72(1): 1-19.

Anderson, M.L. (2014). Subways, strikes, and slowdowns: The impacts of public transit on traffic congestion. *American Economic Review*, 104(9): 2763-2796.

Babalik-Sutcliffe, E. (2002). Urban rail systems: Analysis of the factors behind success. *Transport Reviews*, 22(4): 415-447.

Banister, D. (1995). *Transport and Urban Development*. London: Routledge.

Baum-Snow, N., Kahn, M. E., & Voith, R. (2005). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000 (with comment). Brookings-Wharton papers on urban affairs, 147-206.

Bertolini, L. (1999). Spatial development patterns and public transport: the application of an analytical model in the Netherlands. *Planning Practice and Research*, 14(2): 199-210.

Bertolini, L. (2008). Station areas as nodes and places in urban networks: An analytical tool and alternative development strategies. In F. Bruinsma, E. Pels, P. Rietveld, H. Priemus, & B. van Wee (Eds.), *Railway Development*, 35-57, Physica-Verlag HD.

Bhattacharjee, S. (2013). Impact of rail transit on the Denver metro region: Transportation and land use. Dissertation.

Billings, S.B. (2011). Estimating the value of a new transit option. *Regional Science and Urban Economics*, 41(6): 525-536.

Cervero, R. (1984). Journal report: light rail transit and urban development. *Journal of the American planning association*, 50(2): 133-147.

Cervero, R., & Landis, J. (1997). Twenty years of the Bay Area Rapid Transit system: Land use and development impacts. *Transportation Research Part A: Policy and Practice*, 31(4): 309-333.

Cervero, R., & Seskin, S. (1995). An Evaluation of the Relationships Between Transit and Urban Form. Transit Cooperative Research Program.

Cohen-Blankshtain, G., & Feitelson, E. (2011). Light rail routing: Do goals matter? *Journal of Transportation*, 38: 343-361.

Conley, T.G., & Taber, C.R. (2011). Inference with "difference in differences" with a small number of policy changes. *The Review of Economics and Statistics*, 93(1): 113-125.

Debrezion, G., Pels, E., & Rietveld, P. (2007). The impact of railway stations on residential and commercial property value: a meta-analysis. *The Journal of Real Estate Finance and Economics*, 35(2): 161-180.

Diaz, R.B., & Mclean, V. (1999). Impacts of rail transit on property values. American Public Transit Association Rapid Transit Conference Proceedings,

Donnelly, P., & Price, W. (1982). Rail Transit Impact Studies: Atlanta, Washington, San Diego–Summary Report.

Giuliano, G. (2004). Land use impacts of transportation investments. *The geography of urban transportation*, 3: 237-273.

Guiliano, G., & Agarwal, A. (2010). Public transit as a metropolitan growth strategy. In N. Pindus, H. Wial, & H. Wolman (Eds.) *Urban and Regional Policy and Its Effects*, 3: 205-252, Washington DC: Brookings Institution.

Hass-Klau, C., & Crampton, G. (2002). Future of Urban Transport: Learning from Success and Weakness: Light Rail. Environmental and Transport Planning.

Higgins, C., Ferguson, M., & Kanaroglou, P. (2014). Light rail and land use change: Rail transit's role in reshaping and revitalizing cities. *Journal of Public Transportation*, 17(2): 5.

Higgins, C.D., Ferguson, M.R., & Kanaroglou, P.S. (2014). Light Rail and Land Use Change: Rail Transit's Role in Reshaping and Revitalizing Cities. *Journal of Public Transportation*, 17(2): 93-112.

Higgins, C.D., & Kanaroglou, P.S. (2016). Forty years of modelling rapid transit's land value uplift in North America: Moving beyond the tip of the iceberg. **Transport Reviews**, 36(5): 610-634.

Huang, H. (1996). The land-use impacts of urban rail transit systems. *Journal of Planning Literature*, 11(1): 17-30.

Knight, R.L., & Trygg, L.L. (1977). Land Use Impacts of Rapid Transit: Implications of Recent Experience.

Lawless, P., & Gore, T. (1999). Urban regeneration and transport investment: a case study of Sheffield 1992-96. *Urban Studies*, 36(3): 527-545.

Lechner, M. (2011). The estimation of causal effects by difference-in-difference methods. Foundations and Trends® in Econometrics, 4(3): 165-224.

Meyer, J.R., & Gomez-Ibanez, J.A. (1981). *Autos transit and cities*. US: Harvard University Press.

Mohammad, S.I., Graham, D.J., Melo, P.C. & Anderson, R.J. (2013). A meta-analysis of the impact of rail projects on land and property values. *Transportation Research Part A: Policy and Practice*, 50: 158-170.

Papa, E., Pagliara, F., & Bertolini, L. (2008). Rail system development and urban transformations: Towards a spatial decision support system. In *Railway Development*, 337-357, The Netherlands: Springer.

Ransom, M.R. (2018). The effect of light rail transit service on nearby property values. *Journal of Transport and Land Use*, 11(1): 387-404.

Smith, W.S. (1984). Mass transport for high-rise high-density living. *Journal of Transportation Engineering*, 110(6): 521-535.

Webber, M. (1976). The BART Experience—What Have We Learned?. Monograph No. 26, Institute of Urban and Regional Development and Institute of Transportation Studies. University of California, Berkeley.

Wing, C., Simon, K., & Bello-Gomez, R.A. (2018). Designing difference in difference studies: best practices for public health policy research. *Annual review of public health*, 39: 453-469.

Yang, Y., Zhang, P., & Ni, S. (2014). Assessment of the impacts of urban rail transit on metropolitan regions using system dynamics model. *Transportation Research Procedia*, 4: 521-534.