Exploring Equity Dimensions of Rail Transit Impact: A case study in a Chinese large city

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Abstract:
With both regeneration and development aims, public rail transit systems are continuing to be built or upgraded especially in those rapidly developing Asian cities with problems of congestion and decentralization. As it is widely acknowledged, the rail transit provides travel convenience (as its direct effects), and potentially also leads to land development, property price increase, economic and social changes (as its indirect effects).However, the regeneration effects of rail transit aggregate to exert different impacts on geographic locations and population groups. Disparities in social equity, in relation to public transport provision, arise because of different levels of accessibility. Moreover, value uplift of land and property price, change of physical and social environment, living cost and employment opportunity etc. also have diverse impacts on population groups. Transport provision can often fail to meet specific or even minimum needs in terms of social characteristics, ability, affordability, preference and attitudes. When distribution of impacts across spaces and groups has disproportionate benefits or burdens, the problem of inequity emerges. This research is applied in a newly emerging large city, Chongqing, in China. It aims to understand how the impact of rail transit on development and regeneration differs by location, assessing who gains and who loses from the value uplift associated with the transit investment, exploring the equity dimensions arising from the transit investment.

1. Introduction

With both regeneration and development aims, public rail transit systems are continuing to be built or upgraded especially in those rapidly developing Asian cities with problems of congestion and decentralization. There is a substantial body of evidence suggesting that rail transit system tends to benefit certain locations rather than others. Moreover, it is put forwards by plenty of research that regeneration effects of rail transit aggregate to exert different impacts not only on geographic locations, but also on population groups. Previous evidences have also made it clear that transit s effects on land and property value uplift, physical and social environment change and employment opportunity increase etc. have diverse impacts on certain groups. Disparity in social equity arises because different groups disproportionately benefit or are affected from the effects of transit system.

This research is applied in a newly emerging large city, Chongqing, in China. A brand new rail transit system is being built in recent years stretching from the core to the fringe of the city region, in order to stimulate growth in both mature and undeveloped areas. The research aims to understand how the rail transit effect on development and regeneration differs by locations and population groups, and to what extent groups are disproportionately benefited or adversely affected from the transit system. It then assesses who gains and who loses from the value uplift associated with the transit investment, exploring the equity dimensions arising from the transit investment.

The research is based on a comparison study among locations and population groups. Time serial census data was collected to explore the changes across time in different locations, and a questionnaire survey was carried out to explore transit impacts on different groups of people.

In contrast to the previous empirical studies, as a conclusion of this paper, there is no viable dichotomy of population groups such as the users and the affected by the transit impact. In fact the most frequent transit users are the lowest income people and at the same time receive most adverse impact from the regeneration caused by the transit. It makes the benefit and compensation issues complicated. Meanwhile, income level is a potential threshold of benefit distribution. The effect of rail transit tends to benefit a certain group of people most. The mid-low income group exhibits highest evaluation of transit impact on themselves.

The rest of the paper is organized as follows: Section 2 outlines the literature and highlights the critical social equity issues in transport investment. Section 3 describes the methodology, research framework and data resources of this paper. Section 4 presents the analysis results. Section 5 summaries the key finding and discusses the implications.

2. Literature review

In the local scale, the general regeneration effects of the rail transit consist of four widely recognized aspects. These are the direct aspect of travel convenience, and the indirect aspects of economic, urban, and social effects.(BANISTER and HICKMAN, 2003) In actuality, they are internally connected and all the other three aspects have their social effects.

In the society with great mobility, in order to figure out how transport disadvantages contribute to social inequity, it is necessary to extend the understanding of transport advantage to include the concept of motility, which consists of access, competence and appropriation. (Lucas, 2012, Cass et al., 2005, Kaufmann et al., 2004) It is proposed that transport disadvantage can be understood as an outcome of a lack of a series of criteria, such as access to basic resources, skills and abilities, and cognitive knowledge. (Lucas, 2012, Schwanen et al., 2015) It means that transport disadvantage among individuals will not result in social inequity only because of disparity of transport provision or spatial accessibility. What makes the situation significantly worse is when the disadvantage interact directly or indirectly with other dimensions relating to individual characteristics, such as a lack of opportunity, competence and appropriation.

Previous literature indicated that the benefit of the rail transit system in the city is distributed disproportionately in terms of geographic locations and population groups. (Feitelson, 2002) However, it has also been argued that research on the relevance of social impacts should not only focus on geographic inequity, but also address aspects of disproportionate distributed benefits and accumulated social impacts across population groups. This is because not all groups, as is suggested, for example differentiated by income, gender, race, ethnicity, age, geographical region, etc., will be affected by

specific transport policies or investments. (Geurs et al., 2009)

Therefore, it is necessary to disintegrate the process of how transport investment generate its social impacts and result in social inequity. Social impacts of transport are argued to exert both positive and negative influence either on individuals or collectively on population groups, social categories and society. Individual sensitivity to social effects from transport varies. When the effect exceeds their sensitivity level, it turns into social impact. People belonging to a certain social category tend to bear similar impacts. If the impacts are unacceptable according to the values and standards of society, it tends to bring about social injustice problems. (Geurs et al., 2009) It provides a reference for carrying out analysis exploring whether social inequity from transport investment exists.

3. Methodology:

As is introduced, this research adopted a comparison study among locations and population groups. Changes across time in transit station catchment areas are compared to those in reference and control areas. Data from both census data and questionnaire survey is analysed.

3.1 Context of case study areas:

As shown in *Figure 1,* three reference regions were selected according to the demographic census boundary. The reference regions are quite typical to reflect the trends of both regeneration in the built up regions and development in the rural or undeveloped lands. Within these reference regions, four station catchment areas and one non-station affected area were selected. A radius of around 500m catchment area was identified. Statistics gained from the community level is averaged according to its proportion within the radius boundary.

One of the reference region is in the old city region, just west of the old city centre, which is called Daping Sub-district (DPSD in short). The sub-district resides many old residents in a poor living condition, who are either redundant workers or once farmer years ago. It is also a popular destination of migrants to the city. Now it is experiencing massive urban regeneration with the refilling trend to the city centre. Within Daping Sub-district, the transit station catchment area Daping locates at the junction of two rail lines going across the reference region. It is called DP for short.

The other two reference regions are in the new developing region on the north bank of the river, which are called Longxi Sub-district (LXSD in short) and Longta Sub-district (LTSD in short). With the towards north developing trend in Chongqing, the once farm lands have become prosperous new city centre within just 20 years. Most of the residents are new well- offs moved from the old region or outside the main city area along with the urbanization trend in China. The two catchment areas in LXSD are called Jiahzhoulu (JZL) and Huahuiyuan (HHY). JZL located along Line 3 on the main transit corridor linking north and south of the city. Now it s a fast developin
a huge commercial centre being built just at the station. The catchment area in LTSD is Hongtudi (HTD). Both HHY and HTD are long Line 6 but off the main transit corridor. They are both mature

residential areas, which are developed respectively in the 1990s and within the last 10 years. The control area is also located in Longta reference area. It is a large residential area called Luneng (LN). Though off the transit corridor, it is a comparatively wealthy residential area.

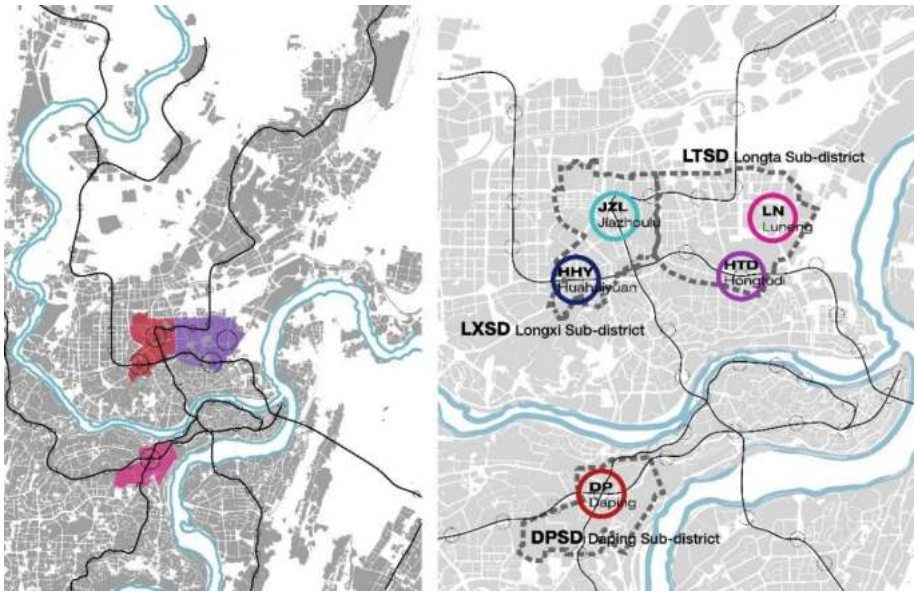

Figure 1: Reference regions, station catchment areas and control area

3.2 Survey research framework

In the questionnaire survey, 1100 questionnaires in total were sent out. About 30-40 questionnaires were sent to each community in the station catchment area. 1000 questionnaires were returned and 752 were reliable after checking. In the survey result, 50.1% of the respondents were women. When compared with the proportion of 49.38% in annual census data of Chongqing, the sample appears fairly representative of the population. People above 65 years old are slightly under sampled, with the percentage of 5.5% compared to 11.9% in the 2013 census data. Migrants from outside the City are slightly over-sampled, with 9.4% in the survey versus 4.83% in the 2013 census data. The survey sample of car ownership around station catchment areas is fairly representative when compared to the 2014 citywide travel survey.

People can be categorized into groups according to their social attributes. Potential vulnerable groups were identified as low income groups, migrants, elder people (age), and those who do not have access to private cars. This paper especially focus on the impact on different income groups, as it is the most straightforward criteria to distinguish population and relate to social impacts. As shown in *Table 1,* the respondents of the survey are divided into four groups according to their chosen income level in the questionnaire. People are divided into the lowest income, the middle low income, the mid high income and the highest income groups. Notice that the three kinds of name shown in the table below may appear in the whole paper from now.

Table 1: Income group identification

Group number	Group income level	Annual household income (RMB_yuan/year)
Group1	Lowest income group	Below 50,000
Group2	Mid low income group	50,000-100,000
Group3	Mid high income group	100,000-200,000
Group4	Highest income group	Above 200,000

In the questionnaire below in *Table 2*, questions can be categorized into well recognized dimensions of transit impact as economic, urban, social and travel. Respondents were asked a series of questions in the following two facets. One facet aims to explore their perceived transit effects in their living area in thirteen aspects. The other one aims to explore impacts of some transit effects on themselves or importance of some changes potentially caused by transit to themselves in the same 13 aspects. Respondents were asked to choose the degree from -2 to 2.

Table 2: Question list

Perceived transit effects in this area	Individual impacts or importance of changes caused by transit effect in this area
Q23 Property price	Q20 Impact of property price rising
Q24 Property rent	Q21 Impact of property rent rising
Q25 Living cost	Q22 Impact of living cost rising
Q36 Land development, urban image and open spaces	Q26 Importance of land development, urban image and open space improvement
Q37 Pedestrian environment	Q27 Importance of pedestrian environment improvement
Q38 Noise	Q28 Impact of noise
Q39 Neighborhood Safety	Q29 Importance of neighborhood safety improvement
Q40 Employment opportunity	Q30 Importance of employment opportunity increase
Q41 Commercial and service facilities	Q31 Importance of commercial and service facilities improvement
Q42 Community population change/floating population	Q32 Impact of community population change/floating population increase
Q43 Community harmony	Q33 Importance of community harmony improvement
Q44 Daily commuting convenience	Q34 Importance of daily commuting convenience improvement
Q45 Weekend travel convenience	Q35 Importance of weekend travel convenience improvement

4. Exploring social equity issues among different groups of people:

4.1 Social equity in different geographic and social contexts

Comparison study is based upon the four widely recognized dimensions of transit impact, which are economic, urban, social and travel impacts. Among different geographical locations, data are collected at two time periods before the opening of transit in 2011 and two periods after the opening. Their related impacts on individuals explored in the survey are also presented together to show the disparities in different social contexts.

As shown in *Figure 2*, for those mature station catchment areas, such as HHY and HTD, though a slight faster increase was seen after the opening in 2011, the increase rates are still slower than their corresponding reference regions. In the old city region, there was a significant increase in 2010 in the catchment area DP but returned slow again after that, which was due to a new residential property development. However, for those developing areas, such as catchment area JZL, there is a strong increase right after the opening. Therefore, in maturely developed areas, the effect of transit on

population accumulation is not so patent in a short period of time. However, in an area with a strong developing trend, the population accumulation effect is quite obvious.

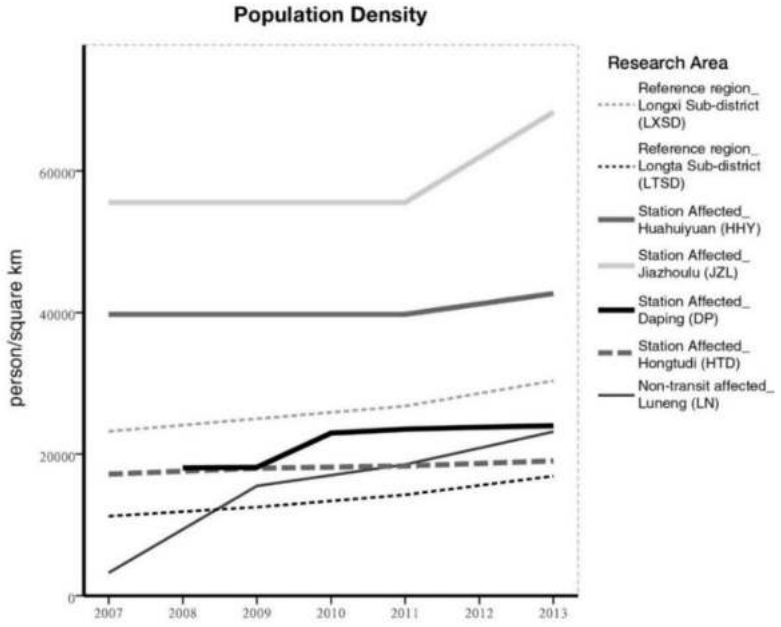

Figure 2: Population density in research areas

Source: Chongqing census data

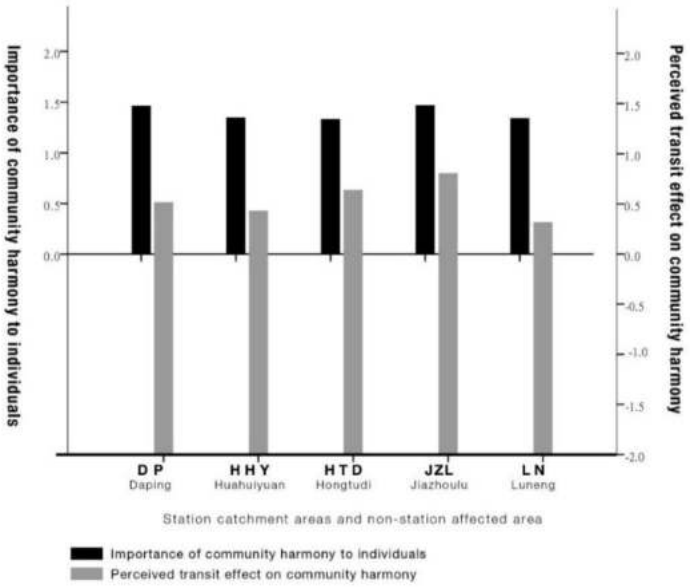

Figure 3: Perceived transit effect on community harmony and its importance to individuals

Source: primary survey data

In the survey (*Figure 3*), in relative aspect as perceived transit effect on community harmony (the grey columns), residents in mature developed area such as DP and HHY shows a lower evaluation of transit

effect on community harmony. Meanwhile residents in DP exhibits a higher importance of community harmony to them (the black column). However for fast developing area as JZL, residents tends to present a more positive attitude towards the transit effect on their community as well as a higher level of importance to themselves. Looking back at the census data, the population increase in the mature developed areas is actually much lower than in the fast developing area. That is to say, the survey result suggests residents in the mature developed area are more sensitive towards the community harmony change brought about by the transit. At the same time, the residents in the old city endowed more importance of community harmony to themselves.

As is shown in *Figure 4*, in catchment area as DP, employment increase is indeed obvious, although its population increase is not distinct. It suggests business and economic development in the old city is promoted by regeneration trend in the area. However, there is a great disparity of correspondence of residents and local employment. (see, *Figure 5*) It means lower proportion of residents in the area actually work there, and most of the new residents work in other parts of the city. Meanwhile most of the increased employment are provided to employees not residing there. On the other hand, as expected, in the developing region, in station catchment area as JZL, the employment increase is promoted greatly. However, for station catchment area as HHY, which is maturely developed but off the main transport corridor, both employment and population increase there is not so distinct.

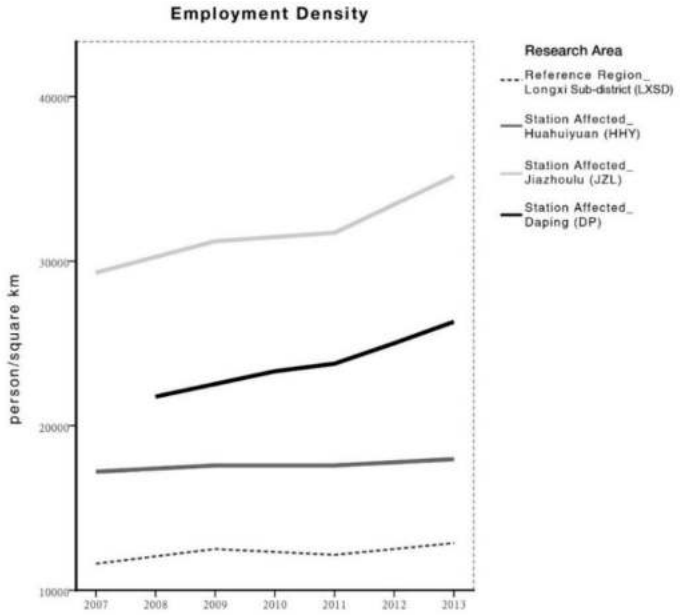

Figure 4: Employment density in research areas

Source: Chongqing census data

There is a disparity between the perceived transit effect on local employment increase in station catchment areas and importance to residents, across mature developed area and developing area, as well as across the old city and the new city. (see, *Figure 6*) Generally, residents in mature developed areas as DP, HHY, and HTD endowed relatively higher importance to local employment opportunities (black column) than developing areas such as JZL and LN. HHY exhibits the most disparity of highest

demand of local employment (black column) and lowest recognition of transit effect on its increase (grey column). In contrast to the fast employment increase in DP, the relatively high demand of local employment indicates the increased jobs are mostly not for the residents.

On the other hand, as shown in *Figure 6*, new developing catchment area JZL has lowest demand for local job compared to other station catchment areas, and highest recognition of transit effect on this aspect, which is consistent to the actual fast increase shown in the census data. The low importance of local employment for residents in this developing area indicate they are not restricted to work in the local area as others might be, because of higher car ownership or social privilege.

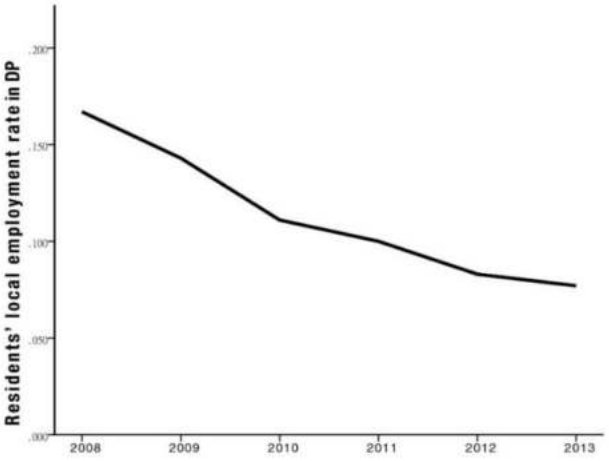

Figure 5: Local employment rate change in Daping Sub-district (DPSD)

Source: Chongqing census data

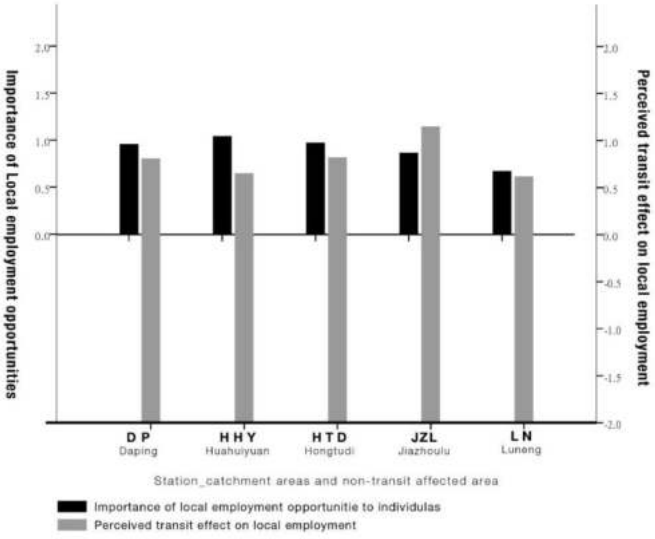

Figure 6: Perceived transit effect on local employment increase and its importance to individuals

Source: Primary survey data

4.2 General individual impact evaluation

Table 3 shows correlation analysis of income groups and transit use frequency, which is statistically significant. The table below shows the lower income level the groups belong to, the higher percentage of them choose transit as frequent travel mode and thus the more they depend on transit for their daily travels. What to be noticed is, though the low income group exhibits higher percentage of frequent transit use, it does not mean they have higher travel demand than other groups. The paper will analyse later in actuality their travel demand is much lower due to their opportunities and competence.

Table 3: Household income groups and transit use frequency

Household Income Groups(Yuan/Year) and Transit Use Frequency

		Transit use frequency proportion					Sum
		at least once every day	at least once every week	at least once every month	once several months	less than once last year	
Household Income Groups(yuan/year)	below50,000	22.90%	37.70%	16.50%	15.80%	7.00%	100.00%
	50,000-100,000	15.60%	40.00%	19.40%	21.10%	3.90%	100.00%
	100,000-200,000	13.30%	33.70%	19.90%	22.30%	10.80%	100.00%
	above200,000	8.70%	17.30%	26.90%	25.00%	22.10%	100.00%

Source: primary survey data

An ANOVA test is conducted on comparing the evaluation of the general impact of rail transit on their lives of different groups. Robust Tests of Equality of Means is checked and shows a significant difference among the four groups in general. Planned Contrast Tests reveal that evaluation of the lowest income group is significantly lower than the rest (p=0.000), and that of the mid-low income group is also significantly higher than the mid-high and highest income group (p=0.073). By plotting the data below in *Figure 7* it shows a quadratic trend. The mid-low income group exhibits the highest evaluation towards the transit impact on their lives, while the lowest income group exhibits the lowest evaluation.

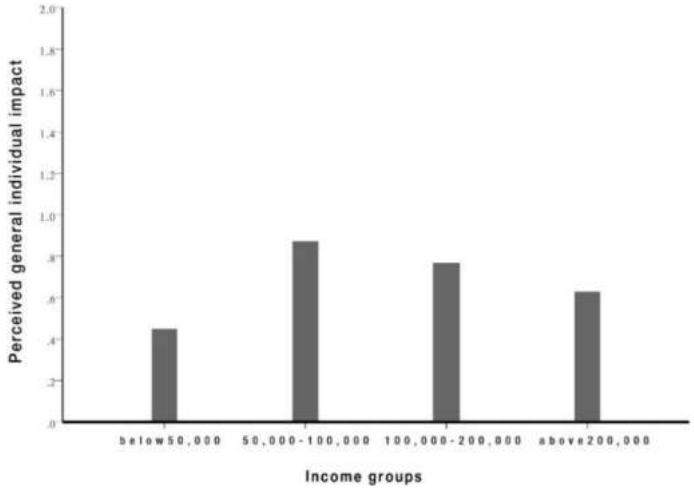

Figure 7: perceived general individual impact of transit among different income groups

Source: primary survey data

4.3 Multivariate analysis of separate aspects

In order to find the difference among population groups in the two facts of questionnaire study, which are perceived transit effect and individual impact, MANOVA analysis was adopted first. The MANOVA analysis was conducted on all variables together, aiming to count in any combined effects among variables. Furthermore, to break the linear combination in more detail, a discriminant analysis is carried out following the significant MANOVA, to detect what exactly distinguish the groups.

The perceived effect of rail transit

In the MANOVA analysis, using Pillai s trace, there was a significant differentiation groups on perceived rail transit effect by a linear combination of Q23, Q25, Q36, Q37, Q38, Q39, Q40, Q41, Q42, Q43 and Q44. The following discriminant analysis revealed three discriminant functions as shown in *Table 4*. The first explained 60.7% of the variance, canonical R^2= 0.068, whereas the second explained 25.1%, canonical R^2=0.028. In combination these discriminant functions significantly differentiate the income groups *(p=0.000)*. After removing the first function, the rest functions also significantly differentiate the income groups (*p=0.062)*.The correlation (see *Table 5*) between outcome variables and the discriminant functions revealed that Q25, Q23, Q39, Q40 loaded highly onto the first function, and Q43, Q41, Q42, Q44, Q36 loaded highly onto the second function.

Table 4: Eigenvalues: perceived transit effects of different income groups

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative%	Canonical Correlation
1	.068[a]	60.7	60.7	0.253
2	.028[a]	25.1	85.8	0.166
3	.016[a]	14.2	100	0.126

Table 5: Structure matrix: perceived transit effects of different income groups

Structure Matrix

Perceived transit effect	Functions		
	1	**2**	**3**
Q25 Living cost	.761*	-0.320	0.208
Q23 Property price	.645*	-0.095	-0.291
Q39 Neighborhood safety	.527*	0.115	0.173
Q40 Employment opportunity	.476*	0.338	-0.172
Q43 Community harmony	0.466	.571*	0.320
Q44 Daily commuting convenience	0.239	.549*	-0.296
Q41 Commercial and service facilities	0.378	.516*	0.223
Q42 Community population change/ floating population	0.278	.492*	0.298
Q36 Land development, urban image and open space	0.314	.374*	0.286
Q37 Pedestrian environment	0.294	0.048	.401*
Q38 Noise	-0.041	-0.054	-.100*

In *Figure 8*, the group centroids and function plot showed that Function1 variables Q25, Q23, Q39 and Q40 significantly discriminated the lowest income Group1 from the highest income Group4, and Function2 variables Q43, Q44, Q41, Q42 and Q36 significantly discriminated the mid-low income

Group2 from Group4 and 1.

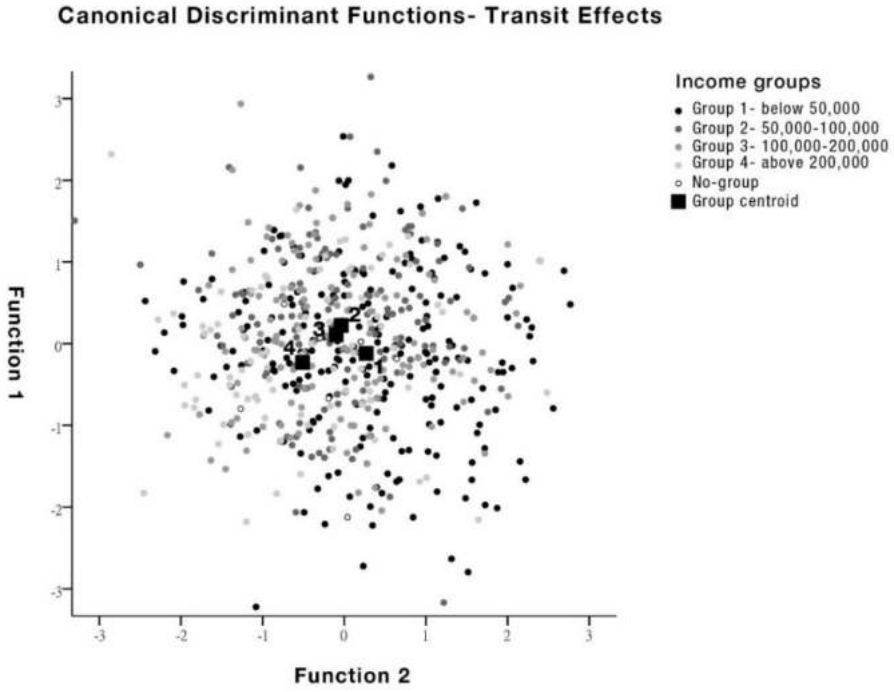

Figure 8: Canonical discriminant functions of perceived transit effects

The impact on individuals

Similar statistical analysis process was conducted on outcome variables of individual impact and importance of transit effects. MANOVA analysis suggests there was a significant differentiation (p=0.000) among income groups by a linear combination of Q20, Q22, Q26, Q28, Q29, Q30, Q31, Q32, Q33, and Q34. The following discriminant analysis revealed three significant discriminant functions. (*Table 6*) The first explained 84.5% of the variance, canonical R^2= 0.267, whereas the second explained 12.2%, canonical R^2=0.039. The correlation in *Table 7* between outcome variables and the discriminant functions revealed that Q20, Q22, Q30, Q31, Q29 load highly onto the first function, and Q26, Q34, Q33 load highly onto the second function.

Table 6: Eigenvalues: individual impacts and importance of transit effects of different income groups

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative%	Canonical Correlation
1	.267[a]	84.5	84.5	0.459
2	.039[a]	12.2	96.7	0.193
3	.010[a]	3.3	100.0	0.101

Table 7: Structure matrix: individual impacts and importance of transit effects of different income groups

Structure Matrix

Individual impacts of some transit effects or importance of some changes caused by transit	Functions		
	1	2	3
Q20 Impact of property price rising	.780*	0.322	-0.111
Q22 Impact of living cost rising	.651*	-0.362	0.178
Q30 Importance of employment opportunity increase	-.381*	0.272	0.373
Q31 Importance of commercial and service facility improvement	.329*	-0.057	-0.267
Q29 Importance of neighborhood safety improvement	.205*	-0.111	-0.062
Q26 Importance of land development/urban image/open space improvement	0.009	.560*	0.125
Q34 Importance of daily commuting convenience improvement	0.223	.392*	-0.08
Q33 Importance of community harmony improvement	-0.013	.210*	-0.198
Q32 Impact of community population change/floating population increase	0.238	-0.063	.715*
Q28 Impact of noise	0.012	0.004	-.173*

In *Figure 9*, the group centroids and function plot showed that Function1 variables Q20, Q22, Q30, Q31 and Q29 in combination discriminated the lowest income Group1 from the highest income Group4, and Function2 variables Q26, Q33, Q34 in combination discriminated the mid income Group3 (and Group2) from Group4.

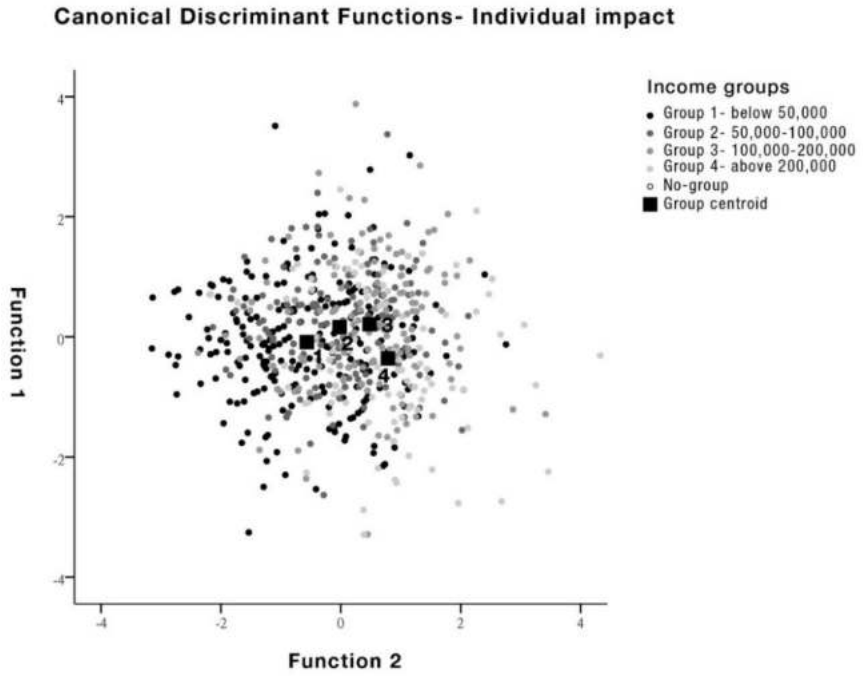

Figure 9: Canonical discriminant functions of impacts and importance of transit effects

4.4 Results

Derived from the MANOVA and discriminate analysis results, variables in the two facets that are perceived transit effect and evaluation of individual impacts and importance of transit effects,

respectively formulate two similar functions. The two kinds of functions in each facets have similar models to distinguish difference income groups. Variables that consist the two functions are presented with black and grey backgrounds in the table below. *Table 8* shows a correspondence of variables of the same function in the two facets.

Variables of Function1 can be amalgamated as `critical issues of living` affected by the rapid rail transit system. Property price, living cost, safety and local employment opportunities together form a linear combination and significantly distinguish the lowest income group from the highest one, in terms of both perceived transit effects and individual impacts. Secondly, variables of Function2 can be described as `further requirements influencing living standard` . Community harmony, daily co convenience, commercial and service facilities, community population change and floating population, urban image and open space form a second linear combination, which significantly differentiates the middle income groups from the highest income group.

Table 8: Variables of two discriminant functions to distinguish income groups on two facets of questionnaire study

Perceived transit effects in this area		**Individual impacts or importance of changes caused by transit effect in this area**	
Q23 Property price	Function 1	Q20 Impact of property price rising	Function 1
Q24 Property rent	Delete	Q21 Impact of property rent rising	Delete
Q25 Living cost	Function 1	Q22 Impact of living cost rising	Function 1
Q36 Land development, urban image and open spaces	Function 2	Q26 Importance of land development, urban image and open space improvement	Function 2
Q37 Pedestrian environment	Not significant	Q27 Importance of pedestrian environment improvement	Delete
Q38 Noise	Not significant	Q28 Impact of noise	Not significant
Q39 Neighborhood Safety	Function 1	Q29 Importance of neighborhood safety improvement	Function 1
Q40 Employment opportunity	Function 1	Q30 Importance of employment opportunity increase	Function 1
Q41 Commercial and service facilities	Function 2	Q31 Importance of commercial and service facilities improvement	Function 1
Q42 Community population change/floating population	Function 2	Q32 Impact of community population change/floating population increase	Not significant
Q43 Community harmony	Function 2	Q33 Importance of community harmony improvement	Function 2
Q44 Daily commuting convenience	Function 2	Q34 Importance of daily commuting convenience improvement	Function 2
Q45 Weekend travel convenience	Delete for multi-collinearity	Q35 Importance of weekend travel convenience improvement	Delete for multi-collinearity

Below in *Figure 10* and *Figure 11*, difference among the groups of the two facets are explained below respectively in the two Functions. In *Figure 10*, Function1 variables named `critical issues of living` are plotted. It shows consistence of variables between the above two facets. For individual impact of property price and living cost rise, evaluation of the lower income group is much more adverse than the higher income group. Though appraisal on the safety effect of transit in the catchment area by lower income group is also much higher than the higher income ones, their demand of safety in surrounding area is lower than others, as well as need of commercial facilities and service. Especially, evaluation of on perceived transit effect on local employment increase by lower income group is much higher than higher income groups. However, they also express much higher importance of local employment increase to them than the higher income ones.

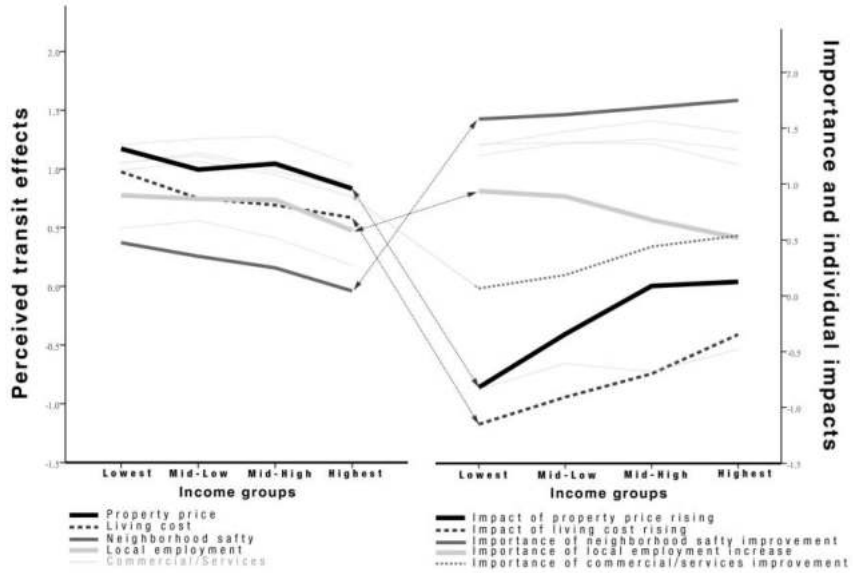

Figure 10: Function1 variables `critical issues of living`

In *Figure 11*, Function2 variables named `further requirements influencing living standar` plotted. It also shows consistence between the two facets. On commuting convenience, the lowest income group shows the least importance of commuting convenience to themselves. However, the mid high income group exhibits the highest importance of commuting convenience to themselves. What need to notice is a sensitive issue as the community population change and floating population increase in this area. The lower income groups exhibit more awareness of this aspect caused by the transit-lead development and acclaimed to receive the most adverse impact of it.

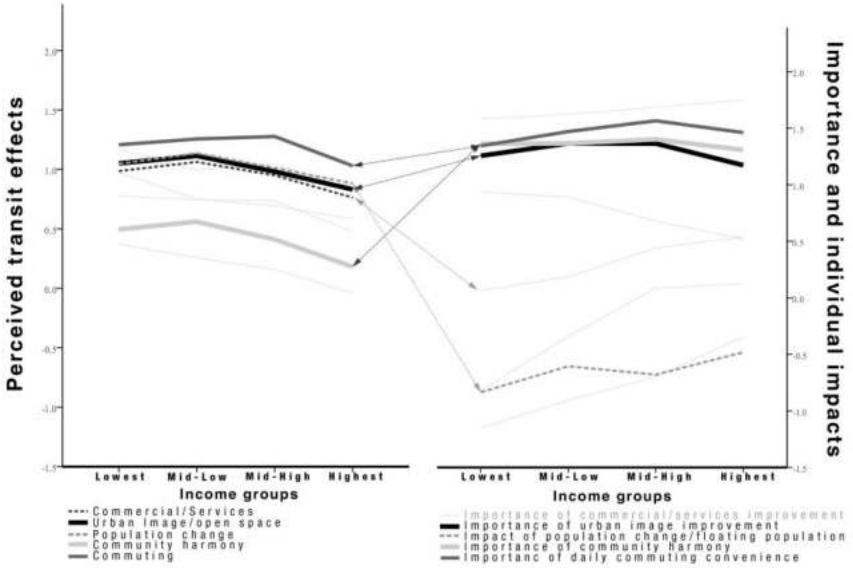

Figure 11: Function2 variables `further requirements influencing living standard`

As a result, the lowest income group generally exhibits comparatively higher level of sensitivity towards the transit effects on all the aspects above, as shown in Perceived transit effects in both Function 1 and 2. But in Function1 critical issues of living , impact of these changes on themselves are often much worse. However, for the mid low income group, their evaluation of perceived transit effects is the highest in Function2 further requirements influencing living standard . Meanwh mid high income group also exhibits the highest importance to themselves in Funtion2 variables. Also to be surprised, the highest income groups exhibits the lowest evaluation on perceived transit effect on nearly all aspects in both Function 1 and 2, although importance of some issues to them are much higher, especially those in Function2 variables.

5. Conclusion

Many researches put forward the argument that benefits are often distributed disproportionately among population groups, especially between the users who benefit from the use of a transport system and the affected who bears the adverse impacts. (Feitelson, 2002)There is also a substantial body of evidence suggesting that the low-income group bears the most adverse impact of new infrastructure investment. Often, however, the argument that people can be distinguished as the users and the affected are predicated on the assumption that the usage of that transport facility depends on the privilege of access. It can mostly be applied in circumstances of transport investment such as roads construction.

However, as for public transport investment such as rail transit system, this research finds that there is no viable dichotomy of population groups such as users and affected, depending on who benefits or loses. The users do not necessarily enjoy the benefits. In fact, the most frequent users can be those who are most adversely affected at the same time. As they often don t belong to the social advantage class, they depend more on public transport for their travel. As shown in *Table 3* of transit use frequency of each group, in comparison the lowest income group has much higher transit use frequency than the higher income groups daily and weekly. Although they can live near the transit station and enjoy the access advantage, they also suffer from the adverse impacts of the rail transit. Their scanty benefit from travel convenience is diluted by the adverse impacts they bear. The lowest income group exhibits the lowest evaluation of transit impact on their lives. It makes the benefit and compensation issues more complicated.

Meanwhile, the argument that assume poorer people receive more adverse impact is also predicated on a flimsy understanding of what aspects impact contains. It overlooks a threshold of equal benefit distribution of the transit system. The threshold is the demographic characteristic of income. The effect of rail transit tends to benefit a certain group of people most, as it does among locations. While the research result indicates the lowest income group receives the worst regeneration effect from the transit system, arguably, the mid-low income group are not so badly affected by the adverse impacts such as land and property value uplift. In fact, they exhibit positive attitudes towards the transit effects and the highest general evaluation of the transit impacts on their lives. Thus they can be said to benefit most from the transit investment. Meanwhile, the highest income groups exhibits receiving the least

benefit on all the aspects. The benefit distribution for them is not equal either.

In order to explore why the lowest income people benefit least from the transit, in a cross-tabulation of income groups and where people coming from, the proportion of migrants is much higher in lower income groups. The migrants of the lowest income group, who mostly come from the countryside and don t own property in the city, bear the adverse impact of property value uplift around the station. At the same time, the old residents of the lowest income group, though with proximity to rail transit stations, lack the competence required by the increased employment opportunities. With land redevelopment around the station, increased jobs are mostly either low level service jobs in restaurants and shops, or high level office jobs. Being not capable of taking the new office jobs, the old residents are also reluctant to take the service jobs which are considered by themselves more suitable for rural migrants. Combined with their economic constrains, many old residents would rather take the subsistence allowances from government than seek a job far outside their living area. This is why their commuting need is largely reduced. Therefore, although the lowest income group are quite acknowledged of transit effect, they also express their benefit are quite limited.

This research suggests that regeneration effect of transit system cast different social impacts across locations and populations. The expected results varies greatly from area to area, influenced by locational factors. Moreover, disparate individual impacts tend to aggregate among certain kinds of people. It exerts worse or better impacts on certain groups of residents in certain areas. These aggregations can trend, which potentially causes social inequity problems.

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