

Doctoral Dissertation

**Effects of Land Use and Transport on Quality of Life:
A Life-oriented Behavioral Analysis**

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Graduate School for International Development and Cooperation
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September 2015

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A Life-oriented Behavioral Analysis**

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A Dissertation Submitted to
the Graduate School for International Development and Cooperation
of Hiroshima University in Partial Fulfillment
of the Requirement for the Degree of
Doctor of Engineering

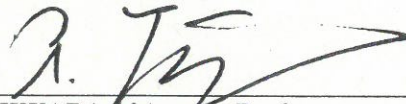
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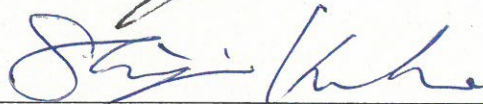
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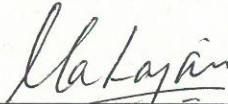
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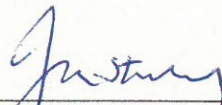
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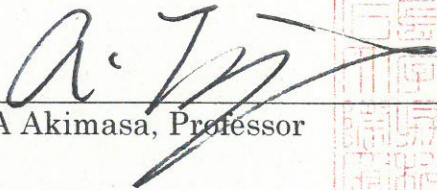
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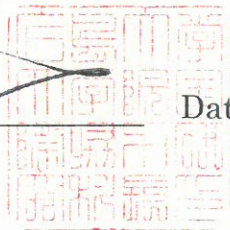
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Abstract

In the field of land use and transport studies, residential and travel behavior is an important topic and has been widely researched. As a part of life choices, residential and travel behavior are expected to be interdependent with other life choices, considering that residence is a basic element of human life and travel is a “necessity” for participating in various activities outside homes. Especially, various life choices might be interacted with each other, which are further linked with people’s quality of life. However, the above interdependencies have not been satisfactorily explored in the sense that little has been done to examine the interdependencies across a set of life domains, even though one can find studies dealing with several life choice variables. Behaviorally, ignorance of interrelated life choices in a choice model may result in serious biases in model estimation. From the policy making perspective, such ignorance may lead to a failure of consensus building across different sectors and different stakeholders. In line with such considerations, Zhang (2014, 2015) proposed a life oriented approach in 2010, which argues that people’s life choices in various domains (e.g., residence, social, health, education, employment, family life, leisure and recreation, finance, and travel behavior) are interdependent. For residential and travel behavior, it can be further argued that residential and travel results from various life choices. Considering such interdependencies, it is not unrealistic to claim that understanding of residential and travel behavior should not be constrained by the boundary of integrated land use and transport research. Unfortunately, studies consistent with such considerations have been scarce and under-researched. This study aims to fill in this research gap. First, I plan to examine the values of life-oriented approach proposed by Zhang (2014, 2015) in the context of land use and transport planning. Second, three social issues in Japan are targeted: (1) women’s labor participation and childcare, (2) young adults’ lives (e.g., out-migration), and (3) elderly

mobility. These three issues are closely related to land use and transport studies. Those not only involve various interrelated life choices, but also connect as social phenomena. By expanding the boundary of consideration to incorporate many aspects of life such as leisure and social life into the land use and transport related social issues based on the life oriented approach, this is beneficial to elicit insightful information into behavioral decision process under different real-life circumstances, and aid in developing increasingly richer structures used in behavioral appraisal and forecasting applications. Motivated by the foregoing considerations, my research questions are located.

1. How to examine the values of life-oriented approach proposed by Zhang (2014, 2015) in the context of land use and transport planning?
2. What reasons promote each social issue (e.g., elderly mobility) happen, especially from the perspective of land use and transport aspects?
3. How to offer the policy applications to solve or mitigate each social issue and improve the level of quality of life for the young, the women, and the elderly, respectively, in Japan?

In line with the above questions, this thesis consists of eight chapters.

Chapter 1 describes the research background, challenges, objectives, methods and expected contributions.

Chapter 2 gives a review of existing studies about land use, transport and quality of life. Firstly, studies associated with the definition and measurement of quality of life are summarized. Second, research regarding land use, transport and people's various life aspects (e.g., health) both from static and dynamic perspectives are reviewed. Then, research concerning the effects of land use and transport on three varied social issues - women labor participation and childcare, young adults' lives (e.g., out-migration), and elderly mobility are described. Finally, positions of this study is provided.

Chapter 3 introduces the data application in this study. In order to analyze the effects of land use and transport on quality of life under different contexts, among different cohorts, especially from static, dynamic and long-term viewpoints, different time-series data sets are needed. Three web-based survey data are employed in this study, two life choice survey data in 2010 and 2014, respectively, and a life history survey data in 2010. The two life choice surveys include very detailed information of individual's life choices (link with life domains of residence, social, health, finance, family life, education and learning, leisure and recreation, and employment) and individual characteristics (e.g., gender, age, occupation, education level, annual income, marital status, household composition, vehicle ownership, etc.). The first data set will be used in the analysis of capturing the interdependencies of life choices in the context of land use and transport planning and young adults' out-migration issue from a static viewpoint, women labor participation issue as well. The second one except the panel data (422 respondents participated two life surveys both in 2010 and 2014), others were collected mainly among elderly people from depopulated areas and non-depopulated areas, this data set will be used in the elderly mobility issue while the panel data set will be employed in the analysis of clarifying the interdependencies between land use, transport and quality of life from a dynamic perspective. The life history data will be used in the analysis of young adults' migration issue from a life course viewpoint.

Chapter 4 provides the empirical evidences of behavioral interdependencies across life choices in the land use and transport context both from a static view and a dynamic view. From a static viewpoint, to statically examine the interdependencies of life choices after allowing for the effects of land use attributes (distance to various establishments such as the nearest bus stop) based on an Exhaustive CHAID approach, and further quantify the effects of life choices and land use attributes on the indicators of quality of life by employing the Bayesian Belief Network. From a dynamic viewpoint, to illustrate the influences of past life

choices and current life choices (including residential choices and travel behavior) on present quality of life based on a structure equation model.

Chapter 5 deals with the issue of women labor participation and childcare in Japan. This study is not only to promote more women work out, also to balance their work and life, further on their quality of life improvement. Considering women's family responsibilities (e.g., childcare) associated work-family conflict, time related work-leisure conflict and stress concerned work-health conflict, a recursive multi-equation system is used to firstly identify the barriers to women labor participation in Japan, after controlling for the effects of land use, transport and life cycle stages; secondly to clarify the factors on women's good quality of family life, leisure life, health life and quality of life as a whole; thirdly to provide cross-sectoral policy implications into women's job participation and quality of life promotion, so as to balance their work and life.

Chapter 6 is concerned with young adults' lives particular in their out-migration behavior in Japan. Motivated by the worsening regional depopulation issue in Japan, more and more young adults migrate from non-metropolitan cities to metropolises, which is detrimental to the regional development. The former part of this chapter employs the life-oriented approach to identify the reasons for such migration trend of the young adults aged from 15 to 34 year-old from a static view. It tends to investigate the intertwined interdependencies among land use attributes and quality of life, penetrating the relevant life choices linked with other life domains into the classical relationship between residential choices and travel behavior, after allowing for the constraints of young adults' socio-demographics and job related choices, and the above complicated structure considers a structural equation model.

In the latter part of chapter 6, aim is to clarify the young adults' residential relocation choice based on a life history data from a long-term perspective. It focuses on their

residential relocation choices among three hierarchical city levels (megacities, medium-sized cities, local cities), by jointly considering three different young generations (1980s, 1990s, and 2000s) moving when they were 15-34 years old, based on a retrospective life history survey data collected in Japan in 2010. It incorporated the effects of socio-demographics, life events change features, and the quality of life oriented residential environment characteristics changes in the municipal level, by controlling for the attributes of young adults' original residential locations, and a simple Multi-nomial logit model is taken into account.

Chapter 7 focuses on elderly mobility issue in Japan. Motivated by the ever-increasing elderly persons in depopulated areas and the worsened transport environment caused by the bus deregulation law enacted in 2002 in Japan, more and more elderly have many obstacles to travel out especially with age. Facing at such increasingly serious elderly mobility crisis, this chapter intends to investigate the life oriented intertwined relationships between land use attributes (density of various establishments), elderly mobility behavior (travel distance, travel frequency, travel cost and main travel mode), elderly's essential life choice and quality of life particularly in depopulated areas, after controlling for the elderly's socio-demographics and their mobility tools availability, by estimating a structural equation model based on a comparison analysis with the elderly in non-depopulated areas.

Chapter 8 summarizes the findings of this study, further the limitations and directions for future research are discussed.

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1 Introduction

1.1 Background: Land use and transport planning and people's lives

The purpose of land use and transport planning is not to build buildings, electric light poles, waste treatment facilities, parks, roads, and railways and so on, but to support people's lives, economic activities, and protect the natural environment. In this sense, if the above infrastructure cannot contribute to the improvement of people's quality of life (QOL), economic growth for supporting people's lives, and/or protect the natural environment, land use and transport planning is meaningless. In other words, the outputs (e.g., length of roads, areas of parks, and number of facilities) of land use and transport planning are not important, but the planning outcomes (e.g., a higher level of QOL and the minimum level of environmental damages) is essential.

This study focuses on people's lives in the linkage with land use and transport planning. Land use planning provides people with places for activity participation and services for realizing the purpose of activity participation, and transport planning aims to assist people's travel between places. Among various places, residence is the most fundamental place in people's lives, school is a place for people to acquire knowledge and enhance abilities for survival and enjoying life, workplace is for people to earn money for meeting various life needs and/or value realization, parks provide people with various functions (e.g., relaxation, bird watching, walking and jogging, and play with kids), and roads are provided for connecting different places to support people's lives. Thus, life activities are performed at various places. The different life choices are usually decided over different time scales under the influence of time and monetary constraints and the various needs of households and their members, people's decisions on various life choices may not be independent of each other. In the field of land use and transport studies, residential and travel behavior are important topics and have been widely researched. As a part of life choices, residential and travel behavior are expected to be

interdependent with other life choices, considering that residence is the most fundamental component of human life and travel is a “necessity” for participating in various activities outside homes. Especially, various life choices might be interdependent with each other, which are further linked with people’s QOL. For example, people’s QOL has been studied in link with life domains such as residence (Arifwidodo, 2012; Thomas et al., 2015), social activities (Serag El Din et al., 2013; E. D. Diener and Suh, 1997), health (Barton, 2009; Frank et al., 2006; Heath et al., 2006), education (Plagnol and Scott, 2011), employment (Bannai and Tamakoshi, 2014; Black et al., 2014), family life (Brown et al., 2015; Spitze, 1984), leisure and recreation (Andereck et al., 2007; Dolnicar et al., 2013), finance (Far et al., 2010; Jehn, 2014), and travel behavior (Steg and Gifford, 2005; Cao and Ettema, 2014; Abou-Zeid et al., 2012). Here the illustration of relationships between land use and transport planning and people’s life aspects are showed in Figure 1-1.

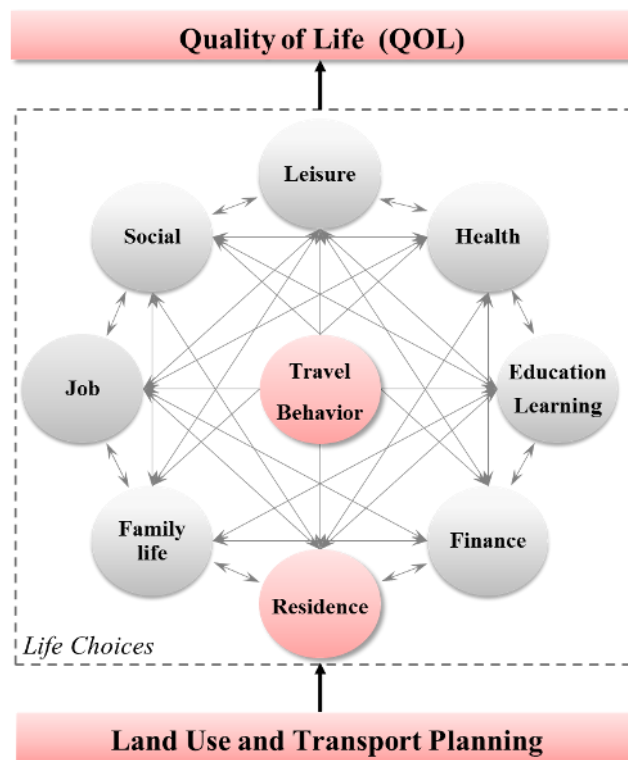


Figure 1-1 Land use and transport planning and people’s lives

The interdependent life choices not only suggest that land use and transport planning must be made in an integrated way, but also imply that land use and transport planning should be made in collaboration with other sectors. For example, child care (Oshio, Sano, & Kobayashi, 2010), elderly mobility (Banister and Bowling, 2004), health promotion (Sarmiento et al., 2010), development of urban tourism (Dolnicar et al., 2013), and urban regeneration policies (Khalil, 2012) all require the development of cross-sectoral approaches.

1.2 Life Oriented Approach

To better understand the behavioral interdependencies across life choices, relevant theories have been developed in the fields of travel behavior analysis, time use studies, home economics, environmental behavior theory, health behavior theory, and tourist behavior studies, etc. However, existing theories only deal with a limited range of the whole life. No theory has been proposed to cover the whole life in an integrated way (Zhang, 2014, 2015). Such a gap should be filled by developing interdisciplinary approaches. Motivated by such considerations, Zhang (2014, 2015) proposed a life-oriented approach in 2010, which argues that people's life choices in various domains (e.g., residence, social, health, education, employment, family life, leisure and recreation, finance, and travel behavior) are interdependent, and understanding of life choices should not be constrained by the boundary of any single discipline. However, most studies have examined such interdependencies by only targeting several limited categories of choices and rarely study has investigated a set of life choices covering major life domains in a comprehensive way. Recently, a Japanese book entitled “市民生活行動学 (Life-oriented Behavioral Studies)” (Life-oriented Behavioral Studies Subcommittee, JSCE-IP, 2015) launched by Zhang provides a detailed literature review and shows many empirical evidences closely related to life choices. This was published by the Japan Society of Civil Engineers

(JSCE) in March 2015. This book has four parts. Part 1 deals with interrelated behaviors associated with the life spheres of residence, travel behavior, shopping, energy consumption, health, tourism, and time use. Part 2 describes the changes of life choices in response to changes of social environments such as considerations of car-dependent, information and communication technologies (ICT), women's labor participation, and elderly mobility. Part 3 treats behavioral changes in life, especially mobility management is described. And Part 4 discusses the future challenges of life-oriented behavioral studies.

Consistently with the above research, life-oriented approach should be further developed as a common decision support method for various public policies. Particularly in land use and transport policies making, life-oriented approach argues that residential and travel results from various life choices and therefore any understanding of residential and travel behavior is secondary to a fundamental understanding of life choice decisions. From the behavior viewpoint, the ignorance and inability of understanding residential and travel behavior from the life choice perspective may lead to biased estimation of residential and travel demand and behavioral changes, and from land use and transport policy viewpoint, the ignorance and inability of reflecting residential and travel behavior decisions from the life choice perspective may lead to a failure of consensus building. In case of general urban policy, the relevance and importance of life-oriented approach is more obvious because urban policy needs to reflect people's various life aspects into the policy decision-making process (Zhang, 2014). The life-oriented approach suggests that successful evidence-based land use and transport policies should be decided together with policies in other significantly relevant sectors (e.g., health and environment) and such cross-sectoral policies could contribute to the improvement of people's QOL in a better way.

1.3 Challenges

To put the life-oriented approach into practice, there are various challenges. Specifically, first, including large amounts of life choice questions into survey will make practical applications difficult. Innovative survey methods are therefore required. Second, integrated behavior models covering various life domains should be developed by reflecting dynamic behavioral decision-making mechanisms at different time scales. However, even for behavioral interdependences across life domains at a single time point, it has not well-represented. Third, relationships between life choices and QOL in the context of various urban studies have not satisfactorily examined. Especially in recent years, studies on subjective well-being have been advanced remarkably. Last but not the least, it is important to clarify how to make better use of the insights from various studies on life choices for supporting decisions on cross-sectoral urban policies making.

What's more, studies on the life-oriented approach are expected to be behavior-oriented or issue-oriented:

From the behavior-oriented perspective, it is easier to conduct. For example, in case of travel behavior, it may result from not only daily activities, but also various long-term life decisions (e.g., employment, residential behavior, family formation). In case of health behavior, personal lifestyle habits are important for the promotion of people's health, but at the same time, residential environment is also important. How various activities are performed under different residential environments is relevant to health. One more example is household energy consumption behavior, which is a result of decisions on residential location, ownership and usage of various electronic and electric appliances, household members' time use patterns, etc. Therefore, these behavioral aspects should be considered together.

From the issue-oriented perspective, taken elderly mobility issues as an example, studies on how elderly's mobility behavior affected by the regional land use and transport planning, and how elderly's mobility behavior affect their various life activities and further on their QOL are relevant. Conversely, different life activities might involve different mobility needs. In this sense, elderly mobility and their life activities might interrelated. Other examples include car-dependent life, women's labor participation, as well as traffic safety. Traffic safety is not just an engineering issue. It also involves various behavioral issues. Literature (e.g., Lamble, et al., 1999) has identified ten driving tasks relating to traffic safety, where decisions on activity choice, travel mode and departure time choice, and recognition of route alternatives and travel time, and multitasking during driving are argued to be related to the occurrence of traffic accidents. Therefore, studies of life choices should be analyzed in the context of various social issues.

Unfortunately, studies in line with the above considerations have still been greatly scarce and under-researched.

1.4 Issues targeted in this study

Nowadays, transport policy analysis is expanding its scope to include land use, which is strongly affected by residential location and housing attributes decisions making that in turn require the supportive study of other decisions such as labor force participation, work place, relocation (mobility), and the variety of life decisions surrounding the individual's life spheres such as leisure and health life (Sanchez et al., 2004; Heath et al., 2006; Sun et al., 2014). In parallel, a shift in policies aiming at an improvement of quality of life instead of economic appraisals is necessary (Steg and Gifford, 2005; Lucas et al., 2007; Khalil, 2012). Moreover, today it is needed more than ever because of an aging population with diverse attitudes and

behavior, particularly in Japan. Closer attention is requested to pay to young adults, women, elderly persons and their needs, especially major changes continue to take place in labor force participation and leisure/health related activities engagement, accompanied by increased diversity in land use and transport planning (Paolo et al., 2014; Chang et al., 2014). Therefore, in order to improve quality of life as a whole, reasons to pay more attention to the lives of different population cohorts such as women, young adults and elderly persons are interpreted here.

In Japan, the women labor participation rate is much lower than any other developed nations. Majority due to the family childcare responsibilities, many women drop out of the workforce following childbirth. Besides, there are two other big obstacles related to the land use and transport field hinder women working out mentioned in the literature, first is the job accessibility, and second is lack of the childcare facilities surrounding the residence. To mitigate such work-family conflict, most families, especially young couples, would make the migration decision – move to places that will maximize their family life benefits, such as the places where can offer more job chances to women, particularly more flexible positions, and the places where have more childcare or welfare facilities, so as to women could work out without child burdens. And much of such research has documented the effects of migration on the labor-force status of women (Sandell, 1977; Spitze, 1984; Shihadeh, 1991). Further another body of research stated that many women benefits from family migration (Clark and Maas, 2015). In order to satisfy the demand of residences with good job availability/accessibility and high density of childcare/welfare facilities, compared with old couples, more and more young couples would make the migration decisions moving from the small/local cities to the bigger cities/megacities, and such kind of out-migration behavior is quite popular among the young adults in Japan now. However, Japan is experiencing a population shrinking and ageing at a faster speed than any other developed countries. With more seriously aging society, if more and

more young adults migrate from small cities to the big cities or metropolitan areas for new job or new residence, the depopulation issue of local areas would be more terrible than ever before. Recently increasingly both academic and government agendas are focusing on the national depopulation issues (Edgington, 2012; Oeda et al., 2012). Such depopulation is primarily driven by the out-migration of young, often the brightest adults (Stockdale, 2006). Moreover, Muilu and Rusanen (2003) claimed that the young people are in a key position as far as the future of the depopulated areas especially in the remote rural areas, in particular, without renewal of their population structure, these areas cannot remain viable or maintain their economic functions in the long term, based on an analysis of the 15~24-year age cohort in Finland. Therefore, it is further assumed that if the movement of young adults from rural areas to big cities would continue unabated, it could jeopardize the regional development in Japan. Further, accompanied by such young adults' migration out activity, motivated by the ever-increasing elderly persons in depopulated areas and the worsened transport environment caused by the bus deregulation law enacted in 2002 in Japan, more and more elderly would have the obstacles to travel out especially with age. Absolutely, mobility behavior of elderly persons would be largely affected by such kind of depopulation issue. As time goes on, when the living environment become worse and worse in the local regions, more and more women would lose jobs, more and more young adults would migrate out for a better life acquirement, and then the lives of elderly persons would be tasteless, further damage Japanese long life expectancy and sustainable society in a long run. This will be a vicious circle.

Consistent with the above considerations, three important issues in Japan are targeted: (1) women's labor participation and childcare, (2) young adults' lives (e.g., out-migration), and (3) elderly mobility. These three social issues are closely related to land use and transport planning. Those not only involve various interrelated life choices, but also connect as social phenomena.

1.5 Objective

This study aims to fill the research gaps, improving people's quality of life from the perspective of land use and transport planning in a more comprehensive way. Concretely, first, I plan to re-confirm Zhang (2014)'s argument to examine the values of his life-oriented approach, by capturing the interdependencies of life choices especially the residential and travel behavior, after incorporating the land use attributes into the analysis. This is for better understanding the behavioral and policy implications in the context of land use and transport studies. Second, I attempt to clarify similarities and dissimilarities of behavioral and policy analysis results by focusing on varied social issues that are related to land use and transport context, and three important issues in Japan are targeted: (1) women's labor participation and childcare, (2) young adults' lives (e.g., out-migration), and (3) elderly mobility. Those not only involve various interrelated life choices, but are also connected as social phenomena.

Therefore, this study made an initial attempt first to offer the empirical evidences of behavioral interdependencies across life choices in the land use and transport context, second to deal with three issues - low women labor participation, young adults lives (e.g., out-migration), and elderly mobility based on the life oriented approach, by expanding the sphere of considerations to many aspects of life such as leisure and social life. Herein, the policy implications of this study are two-fold. First, this study could inform policy makers how the individuals would improve their quality of life in response to urban strategies (e.g., economic strategy, employment strategy). Second, clarifying the influence of land use and transport on their relevant life choices could better evaluate the effects of land use and transport policy by explicitly incorporating the policy outcomes into the evaluation process, which could better facilitate the consensus building.

1.6 Methodology

Here, research methods are described from the following three aspects: data, analysis approaches, and factors introduced in this study.

In order to analyze the effects of life choices on quality of life in the context of land use and transport planning, under different social circumstances, among different population cohorts, particularly from static, dynamic and long-term viewpoints, different time-series data sets are needed. Therefore, I employ the data from three web-based surveys – two life choice surveys in 2010 and 2014, respectively, and a life history survey in 2010. Each life choice survey includes very detailed information of individual's life choices (link with life domains of residence, social, health, finance, family life, education and learning, leisure and recreation, and employment) and individual characteristics (e.g., gender, age, occupation, education level, annual income, marital status, household composition, vehicle ownership, etc.). The first data set will be used in the analysis of capturing the interdependencies of life choices in the context of land use and transport planning, women labor participation and childcare, as well as young adults' lives from a static viewpoint. The second one except the panel data (422 respondents participated the surveys twice since 2010), others were collected mainly among elderly people from depopulated areas and non-depopulated areas, this data set will be used in the analysis of elderly mobility behavior, while the panel data set will be employed in the analysis of clarifying the interdependencies between land use, transport and quality of life from a dynamic perspective. The life history data will be used in the analysis of young adults' out-migration decision making from a life course viewpoint. In addition, to explain a life choice variable, besides the variables of other life choices, land use and transport related factors, household and individual attributes are introduced. Land use attributes refer to residential environment characteristics, which are represented by density of establishment of each type such as

kindergarten and welfare facility, population density and employment density, as well as distance to the nearest public facilities such as railway station and supermarket. Travel behavior is featured by household vehicle ownership, and concerning each life domain in the form of travel mode choice, travel frequency, travel party and activity time. Specially, mobility behavior of the elderly is characterized by travel mode choices, travel distance (Km/year), travel cost (Yen/month) and frequency (Time/month). In terms of socio-demographics, such as gender, age, occupation, education level, annual income, marital status, household sizes are considered. Due to the uncertainty and complexity of the interdependencies of life choices, several methodologies are requested to employ in this study to deal with such interdependencies.

(1) Exhaustive Chi-squared Automatic Interaction Detector (CHAID): in order to statically capture what kind of life choice variables and land use attributes have impacts on the target life decision (e.g., residence property, vehicle ownership, leisure frequency and so on), and life outcomes (e.g., life satisfaction, happiness and so on), a simple approach is more suitable. CHAID, a type of decision tree technique, which is a data mining algorithm based on adjusted significance testing which can be used for classification and detection. Further, exhaustive CHAID can pick out the predictors with the best split. It also can deal with the missing data. Due to different population cohorts have different life choice items, it is appropriate to employ this approach.

(2) Bayesian Belief Network (BBN) approach: in order to quantify the influence of various life choices and land use attributes on QOL, a sophisticated method is required. BBN is a useful tool to observe the complex systems for decision making based on probabilistic causation, it has advantages on modeling reality, assisting decision making, diagnosis, especially in prediction. Due to the BBN structure can be built based on the result of exhaustive CHAID above, it is easier to conduct this model to quantify the effects on target variables.

(3) Structural Equation Model (SEM): in order to clarify the internal mechanisms of relationships between land use, transport and people's lives, due to different population cohorts have varied life interests, an applicable and visible method is requested. It is a very powerful tool and is increasingly being used in travel behavior research for successfully capturing direct and indirect effects. It is widely used in this study, first to illustrate a dynamic effects of life choices on QOL based on the above introduced panel data. Second to investigate the interdependencies between land use attributes and quality of life among the young adults aged from 15 to 34 year-old in Japan from a static perspective, further to identify the reasons of their out-migration behavior. Third to deal with the complicated life oriented intertwined relationships between land use attributes, elderly mobility behavior (travel distance, travel frequency, travel cost and main travel mode), elderly's essential life choice and quality of life in the depopulated areas, after controlling for the elderly's mobility tools and socio-demographics.

(4) Recursive multivariate probit model: in order to grasp the impacts of land use and transport on women's labor participation, simultaneously capture the significant factors on women's five life outcomes – good family life, good leisure life, good health life, self-rated happiness and life satisfaction, all of which are expected to be affected by women's labor participation. While some recursive relationships exist among those five life outcomes, such as the good family life would contribute to happiness attainment, therefore, a method can deal with such kind of "pathways model" is necessary. Recursive multivariate probit model, which fits set of binary dependent variables with defined stages, not ones with simultaneous causation. It match with my research idea and goal, first to identify the barriers for women labor participation; second to examine a persistent impact of women job participation on the subsequent life outcomes, as well as define the obscure relationships among those five life

outcomes, so as to mitigate women's work-family conflict, work-leisure conflict, and work-health conflict, achieving their work-life balance, further on their QOL attainment.

(5) Multinomial logit model: in order to examine the residential relocation decision making mechanism of different young generations from a life course perspective, and due to young adults who originally lives in the different city levels have varied alternative relocation choices, a simple discrete choice model is appropriate and reasonable. Logit model also can deal with the sensitivity analysis. It can clearly illustrate the significant factors on the young adults' residential relocation choices, after allowing for the effects of socio-demographics, life events change features, and changes of the quality of life oriented residential environment characteristics in the municipal level.

1.7 Contribution

Emphasizing the quality of life attainment and improvement, this study contributes by employing a life-oriented approach, which all the major life aspects related to residence, social, health, education, employment, family life, leisure and recreation, finance, as well as travel behavior are incorporated. First, this study made an initial attempt to examine the values of life-oriented approach from different time scales, by investigating the interdependencies of life choices (including residential choice and travel behavior), after allowing for the effects of land use attributes. Second, this study deals with three social issues especially from the stance of land use and transport aspects – women labor participation and childcare, young adults' lives (e.g., out-migration) and elderly mobility, based on the life-oriented approach, which is expected to inform policy makers how the population groups would improve their quality of life in response to urban strategies (e.g., economic strategy, employment strategy), and how to

better evaluate the effects of land use and transport policy by incorporating the policy outcomes (e.g., health) into the evaluation process.

From the behavioral perspective, at a single time point, this study first focuses on capturing the statistically interdependencies of life choices, after controlling for the effects of land use attributes, based on an Exhaustive CHAID approach. Further, this study quantifies the effects of land use attributes, residential and travel behavior, as well as other life choices on quality of life comprehensively based on a Bayesian belief network approach. Second from a dynamic view, motivated by people's time-varying life choices, especially in response to residential location changes or employment changes over time, this study explores the effect of life choices made and quality of life obtain in the past, on the current life decision making and quality of life attainment, after controlling for the effects of key life events over time. This complicated system considers a structural equation model based on a panel data. Either from a single time view or a dynamic view, both show the values of life-oriented approach to better understand the interrelationships between land use, transport planning and people's lives.

From the practical perspective, a thorough understanding of varied social issue from a life oriented approach can provide more appropriate insights for policy making towards sustainable society development. Concerning the issue of women labor participation and childcare, in order to promote more women to take up the paid work, further balance their work and life, this study firstly identifies the barriers of women labor participation, especially from the stance of land use and transport aspects. Secondly clarifies the significant factors on women's quality of life improvement, after considering women's family responsibilities (e.g., childcare) associated work-family conflict, time related work-leisure conflict and stress concerned work-health conflict in a comprehensive way. Regarding for the young adults' lives, this study contributes a lot to understand the internal mechanism of their residential relocation decision making behavior from different time scales. Turning to the elderly's lives, this study

offers a linkage between land use, elderly mobility behavior and the essential life choice, as well as quality of life, further provides the effective land use policy implications to improve their mobility and lives.

1.8 Structure of the thesis

This thesis is composed of eight chapters, as shown in Figure 1-2. The structure is organized as follows.

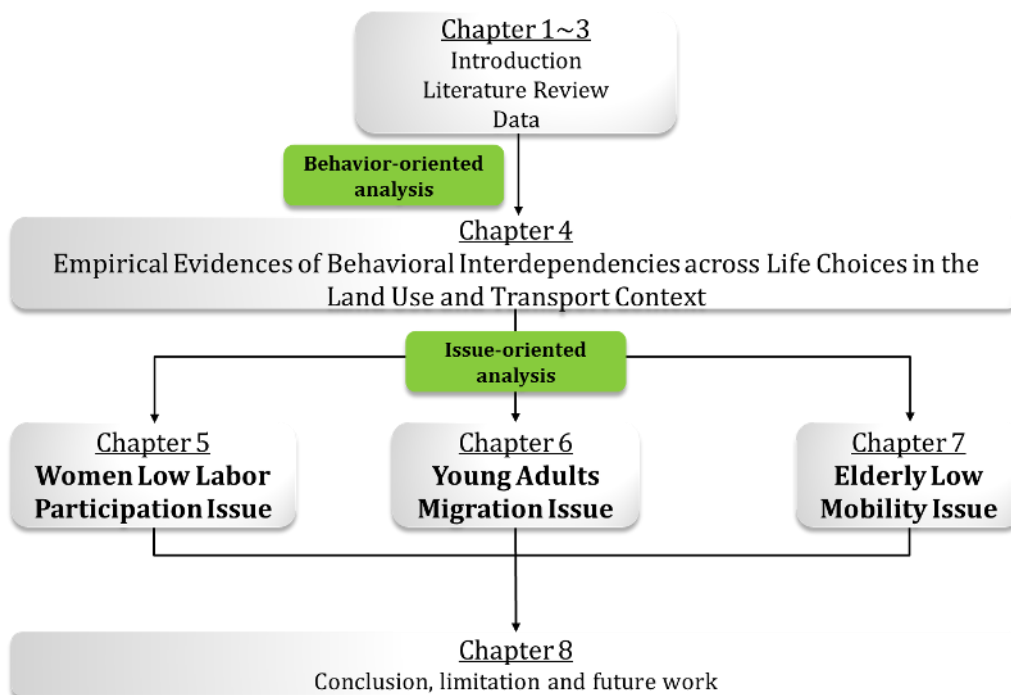


Figure 1-2 The Structure of thesis

Chapter 1 introduces the research background, challenge, objective, methodology, and contribution.

Chapter 2 gives a review of existing studies about land use, transport and quality of life. Firstly, studies associated with the definition and measurement of quality of life are summarized. Second, research regarding land use, transport and quality of life both from static and dynamic perspectives are reviewed. Then, research concerning the effects of land use and

transport on three varied social issues - women labor participation and childcare, young adults' lives and elderly mobility are described. Finally, an integrated framework of life choice studies is given.

Chapter 3 introduces the data used in this study. In order to analyze the effects of land use and transport policies on quality of life based on different urban issues, among different cohorts, especially from static, dynamic and long-term viewpoints, different time-series data sets are needed. Three web-based survey data are used in this study, two life choice survey data in 2010 and 2014, respectively, a life history survey data in 2010. The life choice survey included very detailed information of individual's life choices (link with life domains of residence, social, health, finance, family life, education and learning, leisure and recreation, and employment) and individual characteristics (e.g., gender, age, occupation, education level, annual income, marital status, household composition, vehicle ownership, etc.). The first data set will be used in the analysis of capturing the interdependencies of life choices in the context of land use and transport planning, women labor participation and childcare, as well as young adults' lives from a static viewpoint. The second one except the panel data (422 respondents participated both life surveys twice in 2010 and 2014), others were collected mainly among elderly people from depopulated areas and non-depopulated areas, this data set will be used in the analysis of elderly mobility behavior, while the panel data set will be employed in the analysis of clarifying the interdependencies between land use, transport and quality of life from a dynamic perspective. The life history data will be used in the analysis of young adults' out-migration decision making from a life course viewpoint.

Chapter 4 provides the empirical evidences of behavioral interdependencies across life choices in the land use and transport context both from a static view and a dynamic view. From a static viewpoint, to statically examine the interdependencies of life choices after allowing for the effects of land use attributes (distance to various establishments such as the nearest bus

stop) based on an Exhaustive CHAID approach, and further quantify the effects of life choices and land use attributes on quality of life by employing the Bayesian Belief Network. From a dynamic viewpoint, to illustrate the influences of past life choices (including residential choices and travel behavior) and current life choices on the present quality of life based on a structure equation model.

Chapter 5 deals with the low women labor participation issue in Japan. This study focuses on promoting more women work out, simultaneously to balance their work and family life, by considering their family responsibilities (e.g., childcare) associated work-family conflict, then time related work-leisure conflict and stress concerned work-health conflict. And a recursive multi-equation system is introduced to firstly identify the barriers to women labor participation in Japan, after controlling for the effects of land use, transport and life cycle stages; secondly to clarify the factors on women's good quality of family life, leisure life, health life and their quality of life; thirdly to provide cross-sectoral policies implications into women's job participation and quality of life promotion.

Chapter 6 is concerned with young adults' lives in Japan. Motivated by the worsening regional depopulation issue in Japan, more and more young adults migrate from non-metropolitan cities to metropolises, which has a detrimental effect on the regional development. The former part of this chapter employs the life oriented approach to identify the reasons for such out-migration behavior of the young adults aged from 15 to 34 year-old from a static view. It tends to investigate the intertwined interdependencies among land use attributes and quality of life, penetrating the relevant life choices linked with other life domains into the classical relationship between residential choices and travel behavior, after allowing for the young adults' socio-demographics and job related constraints, and the above complicated structure considers a structural equation model.

In the latter part of chapter 6, aim is to clarify the residential relocation decision making mechanism of young adults from a time course perspective. It focuses on their residential relocation choices among three hierarchical city levels (megacities, medium-sized cities, local cities), by jointly considering three different young generations (1980s, 1990s, and 2000s) moving when they were 15-34 years old, based on a retrospective life history survey data collected in Japan in 2010. It incorporated the effects of socio-demographics, life events change features, and changes of the quality of life oriented residential environment characteristics in the municipal level, finally a simple Multinomial logit model is taken into account.

Chapter 7 focuses on elderly mobility behavior in Japan. Motivated by the ever-increasing elderly persons in depopulated areas and the worsened transport environment caused by the bus deregulation law enacted in 2002 in Japan, more and more elderly have the obstacles to travel out especially with age. Facing such increasingly serious elderly mobility issue, this chapter intends to investigate the life oriented intertwined relationships between land use attributes (density of various establishments), elderly mobility behavior (travel distance, travel frequency, travel cost and main travel mode), elderly's essential life choice and quality of life in depopulated areas, after controlling for the elderly's mobility tools and socio-demographics, by estimating a structural equation model based on a comparison analysis with the elderly in non-depopulated areas.

Chapter 8 summarizes the findings of this thesis, further the limitations and directions for future research are discussed.

2 Literature Review

2.1 Definition and measurement of quality of life

Beginning in the 1960s of the last century, the question of quality of life (QOL) arose due to continuing economic success. The social costs of economic growth got more and more into public awareness, especially the environmental damages and the loss of future resources. Moreover, the doubts grew that increasing GDP at a high level could not contribute to increasing people's QOL (Tang, 2007). Therefore, social scientists increasingly focus on the study of QOL (Sirgy et al., 2000; George, 2006), that has also attracted increased attention in urban studies (Khalil, 2012; De Vos et al., 2013; Serag El Din et al., 2013). However, defining QOL is difficult because it is a subjective experience dependent on an individual's perceptions and feelings. There are over 100 definitions and models of QOL, though there is an agreement in recent years that it is a multi-dimensional and interactive construct encompassing many aspects of people's lives and environments (Schalock, 1996). E. D. Diener and Suh (1997) offered that QOL is in terms of the experience of individuals. If a person experiences her/his life as good and desirable, it is assumed to be so, and factors such as feelings of joy, pleasure, contentment, and life satisfaction are paramount. Obviously, defining the QOL is most associated with the SWB tradition in the behavioral sciences. Further, Andereck, et al. (2007) and Uysal, et al. (2012) stated that QOL refers to one's satisfaction with life and feelings of contentment or fulfillment with one's experience in the world. It is about how people view, or what they feel about their lives. Similar situations and circumstances may be perceived differently by different people (Taylor and Bogdan, 1996). QOL is a multi-faceted and complicated concept. It is defined as a constellation of components which can consist of three dimensions - positive, negative and future expectation (Glatzer, 2012). The reason why future expectations should also be emphasized as a component of QOL, to be regarded, it is a very

different experience if somebody in a bad situation looks optimistic into the future compared with them seeing no way out.

Regarding for the QOL measurement, two new scientific approaches to measuring QOL have been initiated – “objective” or social indicators, and the measurement of subjective well-being (SWB) during the last few decades. The social indicators are societal measures that reflect people’s objective circumstances in a given cultural or geographic unit. The hallmark of social indicators is that they are based on objective, quantitative statistics rather than on individuals’ subjective perceptions of their social environment. And indicators such as infant mortality, doctors per capita, longevity, homicide rates, police per capita, and rates of rape can be assessed to detect the QOL. Yet objective indicators do not tell us how individuals perceive and experience their lives. While subjective evaluations define more precisely the experience of life. SWB refers to how people experience her or his whole life, as well as specific life domains, and includes both cognitive judgements and affective reactions (Diener, 1984; Myers and Diener, 1995). Concepts encompassed by SWB include positive and negative affect, happiness, and life satisfaction (Gilbert and Abdullah, 2004). Happiness has been defined as transitory moods of “gaiety and elation” that people feel toward their current state of affairs (Campbell, 1976). Happiness is an affective mood or state (Bowling, 1995). Whereas life satisfaction refers to a cognitive sense of satisfaction with life (Kahn and Juster, 2002; E Diener, 2000). Happiness pertains to shorter time frames, it detects self-reported feeling or emotions during an interval or activity episode, while life satisfaction is a cognitive evaluation and pertains to the long-term phases (E. D. Diener and Suh, 1997; Diener, 2009). Both affect and reported satisfaction judgments represent people’s evaluations of their lives and circumstances.

Specifically, providing more details related to happiness and life satisfaction, it is showed that happiness has been usually measured based on a question, “Taken all together, how happy would you say you are?” (Easterlin, 2001; Veenhoven, 1984, 2012a). On a 10-point

scale, in which ten represents maximum happiness, one represents maximum unhappiness, and five represents neutrality, the median response was slightly over seven and the mean response not much lower (Ed Diener and Myers, 1996). As stated by Veenhoven (2012a), people may also derive happiness from a specific life domain (e.g., a happy marriage, a good job). Veenhoven (2012a) found that there is only limited evidence about how different decisions affects happiness, and suggests that studies on the effects of time and monetary choices on happiness should be prioritized as an important research issue. Zimmermann (2014) also supported this argument. Dutt (2008) further argued that happiness does not depend on consumption and income alone, but on many other things. People usually spend their income and time for various types of life choices, such as education, housing, vehicles, tourism and leisure activities, and daily shopping. In addition, life satisfaction is a cognitive measure of QOL (Kahn and Juster, 2002), it is widely accepted that life satisfaction has been measured based on the question, “Now I want to ask you about your life as a whole. How satisfied are you with your life as a whole these days?”. This question, from the 1976 national survey of the quality of American life (Campbell, 1976), is typical of that asked in many subsequent surveys. And a five-point scale, ranging from completely satisfied to completely dissatisfied, was used. Measures of overall satisfaction with life allow respondents to weigh each life domain according to their own standards to form an evaluation of their satisfaction (Ed Diener, Emmons, Larsen, & Griffin, 1985). Moreover, life satisfaction is jointly determined by context-specific factors in life domains. Some are simple summations or averages of domain-specific satisfaction scores. Others have used weighting procedures in which responses to the direct question about overall life satisfaction are dominant (Campbell, 1976). Individuals judge different aspects of life more importantly than others and so it is important to understand which life domains contribute to life satisfaction. These questions depend on the value an individual attaches to different experiences in life or the value they attach to various life domains (Sirgy,

2010). How the domains interrelate, and which domains contribute most overall to life satisfaction, is unclear, however (Dolnicar, et al., 2012).

2.2 Land use, transport and quality of life

For individuals, the scientific understanding of quality of life (QOL) can guide important decisions in life such as where and how to live, how to travel (E. D. Diener and Suh, 1997). First, as complex structural system of people's QOL, it is better to clarify how the life decisions made in different life domains affect people's QOL. In the literature, offering the evidences from the life domain approach, QOL is connected with various life domains, including residence, leisure & recreation, job, health, social, finance, education & learning and family life (Knot, 1975). The life domain approach describes that satisfaction with each life domain determines overall well-being (Campbell 1981; Campbell et al. 1976). These and other studies on domain satisfaction suggest that satisfaction with health, family and finances are most important for overall life satisfaction (Cummins 1996; Salvatore and Munoz Sastre 2001; Van Praag et al. 2003). An earlier cross-sectional study by Cantril (1965) also indicates that economic factors, as well as health and family, rank highly among people's personal concerns. Specifically, observing from the residence domain, Wang (2004) found that residential satisfaction of young adults is influenced by individual local identity, financial capability, residence type and environment index on comfort, convenience and health; further showed that housing ownership is core to the higher residential satisfaction level, based on a study in Beijing, China. As for leisure domain, Brajša-Žganec et al. (2010) identified that engaging in important leisure activities contributes to QOL, while the pattern of leisure activities somewhat varies by age and gender. Linked to the financial life, Clark et al. (2008) provide a good literature review of the effect of income on QOL, and they conclude that the relationship is generally positive.

And further Headey et al. (2008) were able to demonstrate that household income allocation is a stronger predictor of life satisfaction than household income alone. In terms of social life, Diener and Seligman (2002) found that social relationships is a major distinguishing factor on the college students' happiness, those who are happiest tend to have strong relationships with friends, family, partners than the unhappiest. Turning to the family life, Campbell et al. (1976) found that satisfaction with family life is a strong and significant predictor of overall QOL. In terms of job life, Alexopoulox et al. (2014) verified that higher levels of stress and longer working time are related to the job satisfaction and further on the worker's QOL, and the magnitude of these associations varied depending on age, gender.

Second, due to this study is mainly focus on the effects of land use and transport planning on people's QOL, it is important to consider how land use and transport planning is positive for people's lives. There are at least four key ways (Barton, 2009). First, reduce the inequalities that exist in access to housing, public facilities and transport for different socioeconomic groups and vulnerable groups in the population, such as the elderly or children, further beneficial for their lives. Second, increase the amount of incidental physical activity necessary to reduce the burden of disease, disability and mortality due to sedentary life styles, further beneficial to health improvement, by offering and improving mixed use communities, and providing active transport (e.g., walking/cycling). Third, contribute to the improved living environment by the reduction of air and water pollution and greenhouse emissions from cars, combating the threat of climate change; Fourth, contribute to a changed social environment by improving the accessibility to different public facilities, the livability of streets, making people safer, expanding their social network, engaging more leisure activities, improving communication between people and therefore improving community cohesion.

Although previous studies have extensively explored the relationship between other life domains and QOL, limited attention has been paid to travel behavior which facilitates or

constrains QOL (Ettema, 2010). Actually, transport activities is expected to influence QOL in two ways based on travel behavior theories. First, traditional theory states that travel is a demand derived from spatially-separated activities. Travel enables people to reach different locations to carry out their activities, and the utility of the activities contributes to individuals' QOL (Ettema, 2010). Second, travel behavior also plays important roles in meeting human being's various needs. Specifically, Basmajian (2010) conclude that commuting is not just an inconvenience but also an active and meaningful experience. The positive utility of travel carries various benefits such as independence, status, control, and therapy (Salomon and Mokhtarian, 1998), most of which are associated with the dimensions of people's QOL. However, the degree to which travel behavior affect QOL varies. Turksever and Atalik (2001) found commuting mode was a significant predictor to people's QOL; yet public transportation accessibility and traffic congestion were not. Gagliardi et al. (2010) found driving a car was an important predictor of mobility satisfaction in Italy and Germany but driving was not a significant predictor of people's QOL.

Additionally, existing studies indicated that many of the multifarious links between land use and well-being are still under-examined, and more in-depth studies about the linkage between QOL (De Vos et al., 2013; Vos, 2015), residential choices and travel behavior are required so as to understand behavioral interdependencies across life domains in a logical and systematic way (Zhang, 2014). De Vos et al. (2013) confirmed that travel behavior are both constrained and enabled by longer-term choices regarding lifestyle, and residential location, etc., which are all related to SWB. Nordbakke and Schwanen (2013) showed that residential environment with convenient transport systems (e.g. living close to a public transit network) can generate feelings of freedom, competence and belonging, and greater motility (e.g., residential environment change), can also give people the passion and confidence that they are capable of realizing certain goals. Savasdisara (1998) analyzed that the physical and socio-

environmental components of residential neighborhoods affect people's QOL and found that environmental factors such as accessibility to work, shops and parks were very important predictors of QOL. Liu (1999) found that Hong Kong's residents regarded easy access to public transportation and the convenience of shopping facilities were primary dimensions of residential satisfaction. Kung and Li (1974) concluded that since residential-commerce land use was so mixed in Taipei, the availability of transportation services became a critical issue to local residents pursuing high level of QOL, such as public transportation parking, and road connectivity. Based on these ways, it is clearly reflected that land use and transport planning is closely related to people's lives and their quality of life improvement.

2.3 Dynamics of land use, transport and quality of life

Achieving the improvement of people's quality of life (QOL) is identified as one ultimate goal of many contemporary planning endeavors and has become central to formulation of land use and transport policies (Lotfi and Solaimani, 2009). Also, promoting people's QOL is regarded as a meaningful way of evaluating urban development and social progress. Besides, people's QOL, which can be roughly captured from these essential life choices involving residence, social, health, education, employment, family life, finance, leisure and recreation life domains, as well as relevant travel behavior (Knox, 1975; Zhang, 2014). What's more, the different life choices are usually decided over different time scales under the influence of limited time and monetary constraints as well as the various needs of households and their members (Zhang et al., 2012). Thereby, after embedding relevant other life choices such as social and leisure related decisions into the integrated land use and transport system, the effect of land use and transport on people's QOL should be re-considered and re-evaluated. Ritsema van Eck et al. (2005) found that land use pattern and transport shape the individuals' life

decisions and their QOL. They discovered that high-density neighborhood offers individuals the best opportunities to realize daily activities due to shorter distances and greater accessibility, and further highlight the necessity of a life-style oriented approach in planning the spatial configurations of residential areas. Given that individuals in high-density settings can fulfill their daily obligations (e.g. picking up children to and from school) with less effort and they can, within a given travel time budget, access a greater range of rewarding (leisure/social) activities enabling personal growth and flourishing, such as visiting a theatre, engaging in education/courses and meeting friends and other social contacts, satisfy their social and leisure lives, further improve their QOL as a whole. Particularly, as time goes on, changes in residence/work places, or vehicle ownership, may have a significant impact on the people's present/prospective QOL, which may conversely affect the future life choices as well (Dolnicar et al., 2013). As residential choices and travel behavior are just a part of people's life choices, the effects of land use and transport policies on people's QOL may not be fruitful after controlling for the intervention of other life choices. Based on the above considerations, it is indicated that a systematic investigation of various life choices, including residential choices and travel behavior, as well as QOL especially from a dynamic viewpoint would be of value. However, many links between life choices and QOL, embedded into land use and transport planning, are still scarce, particularly from a dynamic or long-term perspective.

Transport researchers have followed trends in other disciplines and started to pay increasing attention to subjectively experienced well-being and how this relates to travel behavior from a dynamic/life course perspectives. It is well-known that travel behavior are both constrained and enabled by life events (Sharmeen et al. 2014; Oakil, 2015), life cycle stages (Higgins et al., 1994; Lee, 2015), life course (Scheiner, 2014; Schoendule et al., 2015), longer-term choices regarding lifestyle (Ritsema van Eck et al., 2005), residential location (Acker and Acker, 2014; Veronique Van Acker et al., 2010) and so on, further these are related to peoples'

well-being (De Vos et al., 2013). Many typical life events tend to cluster at certain stages of the life course and may have negative consequences for well-being if they do not occur at the usual age (McLanahan and Sorensen 1985). For instance, family formation (household structure change) usually occurs in young adulthood, while exit from the labor market is typically experienced towards the end of the life course. In a recent study Powdthavee (2009) found that people who became severely disabled eventually reverted to their previous levels of satisfaction in various domains of life, with the exception of satisfaction with health and income which remained significantly lower than before the onset of disability. And Plagnol and Scott (2011) further supported that it is important for future research on QOL to take a life course perspective as changes in the conceptualization of QOL may be linked to life course events, by showing that entering a partnership and retirement have the largest effects on QOL. Additionally, Sharmeen et al. (2014) offered that birth of first child in the following year, travel behavior such as car acquisition and residential choices such as living area are independent. It means that policies aiming to reduce car use by changing housing situation may not be fruitful as car ownership are affected by other life choices rather than changes in residential situation. Then, more detailed and longitudinal data is required. Scheiner (2014) noted that some key events including the birth of a child, job participation, and changes in residential choices are found to have significant effects on travel mode choices. Abou-Zeid et al. (2012) also indicated that well-being is shaped by residential attributes, the dimensions of activities and trips - type of activity, duration of activities, persons with whom they are undertaken, travel mode used and so forth. However, in consistent with the statement of Plagnol and Scott (2011), it needs to be pointed out that one cannot completely rule out reverse causality as it is possible that an individual's QOL influences which events they will experience. For instance, someone who believes in the importance of family is probably more likely to enter a long-term partnership and have children than someone who considers their career to be more important. And negative

feelings such as stress attainment can lead to immediate adjustments to people's activity and travel patterns and can have a spill-over effect on the subsequent travel behavior, as well as on residential location choice. These reverse effects deliver that people may decide to change their residential location, disposal or acquire vehicles, or reconfigure their mobility and activity patterns in order to obtain higher level of QOL. Hence, it is important to consider the multiple time-scales implicated in the relationships between travel behavior, residential choices and QOL, as QOL is temporally complex and has short-term and long-term dimensions.

2.4 Women labor participation and Childcare

Economic, subjective and social indices can all shed light on a society's quality of life, as well as on how specific factors influence well-being. An example of the way researchers analyze how unemployment affects the quality of life should prove instructive in this regard. For a researcher proceeding from a normative ideal, involuntary unemployment is an evil, and social indicators can indicate the extent of this in a society. In addition, the social indicator researcher might analyses what other outcomes co-vary with unemployment, such as poorer healthcare or the likelihood of committing crimes. In contrast, the subjective well-being researcher wants to know whether unemployment affects people's moods and life satisfaction. The subjective well-being perspective also asks when people will enjoy their work. Finally, the economist will analyze unemployment in terms of its causes. Is there a discrepancy between the education of the available workforce and the jobs available? Do welfare payments induce people to choose unemployment instead of accepting lower paying jobs? Does the minimum wage law prevent some people from being hired? Notice, however, that how much people enjoy work can influence rates of unemployment. Thus, subjective well-being measurement can tell us interesting and different things about the causes, consequences, and experience of

unemployment (Ed Diener and Myers, 1996; Plagnol and Scott, 2011; Khalil, 2012; Barton, 2009; Ettema et al., 2011).

In the context of employment decentralization in metropolitan areas in the US, Kain (1968) showed that disconnection between residential and job location negatively affected employment among African Americans, who tend to be concentrated in the inner city. After this seminal work, several empirical studies have confirmed that insufficient job accessibility has a negative effect on labor market outcomes in decentralized cities and accounts for a substantial part of the labor market penalization experienced by the most vulnerable workers (Ihlanfeldt and Sjoquist, 1998, Ihlanfeldt, 2006 and Zenou, 2008). While the Moreover, physical distance from jobs could also hamper job searches by negatively affecting local social interactions, as recently suggested by Zenou (2013). The idea is that since all workers residing in a spatially disconnected neighborhood are affected by the detrimental effect of distance, the average unemployment rate tends to be higher and it is consequently more difficult to obtain information on job opportunities from social networks (which are likely to operate on the local level). Therefore, spatially mismatched workers are denied access to good network connections that are likely to foster employment and job quality. Other recent research has found that female labor participation is positively associated with a more neutral tax treatment of second earners, child care subsidies, and paid maternity leave, housing and assistance program performance (Loprest, 1999; Pearlmutter et al., 1999; Loprest and Zedlewski, 1999; Schumacher and Greenberg, 1999). The majority of this research relied on survey data from recipients and/or administrative records and, despite transport accessibility being cited as an obstacle to employment, none of these studies explicitly accounts for transport or employment accessibility. An exception is an analysis by Pearlmutter et al. (1999), who considered possession of a driver's license as a proxy for transport accessibility. They found that possessing a driver's license was positively associated with the use of childcare subsidies by

AFDC recipients in Ohio. Eleven other studies (surveys) in Arizona, California, Florida, Georgia, Illinois, Missouri, Ohio, South Carolina, Wisconsin, Washington and Washington, DC, reviewed by Isaacs (1999) did not include job accessibility measures. These examples highlight a significant dearth of evidence about job accessibility and labor participation.

2.5 Young adults' migration behavior

It is now widely recognized that there is a close interplay of one's migration choice and quality of life (QOL) (Berger and Blomquist, 1992). Herein, migration is the movements of changing residence from leaving one place to entering another, while mobility is defined as the "potential" for movement, and this potential is conditioned based on the mobility tools such as car (Spinney, Scott, & Newbold, 2009). Migration is contingent on personal characteristics including life-course attributes and on location - specific characteristics including different amenities. Amenities are not measures of overall residential desirability of places, but rather place-specific attributes that people differentially value at different stages of their life. It is also critical to recognize that places offer bundles of amenities: consequently migrants must sometimes take the bad with the good in choosing the place where its set of attributes best satisfies their tastes and preferences (Ronald L. Whisler, et al., 2008). Such migration will lead to shifts in the relative importance of different demographic groups such as young adults and elderly persons. Thus, demographic changes in combination with varied migration patterns may trigger substantial shifts in nation's population distribution and, ultimately, in the valuations of QOL.

In Japan, a majority of young people have continued to migrate from local cities to the three major metropolitan areas (Tokyo, Osaka and Nagoya regions) for new job or new residence, where around half of the nation's population is now concentrated. Accompanied

with the serious aging society in the whole Japan, more and more researchers realized that if young adults' migration behavior from rural/local areas to bigger cities would continue unabated, it could aggravate the depopulation problem and further hinder the regional development in the local cities of Japan. As migration behavior is closely related to the young adults' QOL, first and foremost, from a static perspective, it is request to understand the relationship between land use, young adults' travel behavior and their QOL, is there any geographically different, so as to know more details of such migration behavior of young adults. Second, it is necessary to understand the internal mechanism of young adults' residential relocation/migration decision making, especially from a life course viewpoint. Both research will help government to understand the reasons and motivations of such young adults' migration behavior formation, and then assist the local government to take measures to keep more young adults who are the primary pillar of local labor force market in the local cities.

2.5.1 Land use, transport and young adults' quality of life

Quality of life (QOL) refers to one's satisfaction with life and feelings of contentment or fulfillment with one's experience in the world (Taylor and Bogdan, 1996; Uysal, et al., 2012). It is about how people view, or what they feel about their lives (Uysal, et al., 2012). Many argue QOL is best studied from the perspective of the individual (Taylor and Bogdan, 1990). Japan is widely known as a country where people experience a good QOL. However, Inoguchi and Fujii (2009) found that Japan is a society undergoing a variety of profound changes, and these changes are influencing how they live and what they experience and value in the private and public spheres of their lives. Further, in order to figure out what domains affect the Japanese' overall QOL most powerfully, they classified sixteen specific life domains into three groups. The first group called "material life sphere", consists of housing, standard of living, household

annual income, education, and job domains. The second group is “post-material life sphere”, contains health, friendships, marriage, family life, leisure, and spiritual life domains. And the third group called “public life sphere”, includes neighbors, public safety, environment, welfare system, and democratic system. As a result, the Japanese people tend to be most satisfied with the post-material sphere of life, shows a significant impact on the QOL, while friendships and spiritual life in the post-material sphere of life are an important determinant. In line with Sing’s (2009) study Hong Kong people have a great desire for material life, however, which is not beneficial for their QOL improvement. However the above findings are slightly different with the case study in China, Shu and Zhu (2009) discovered that the Chinese people’s high levels of satisfaction with their interpersonal, material, and nonmaterial life domains all have a positive influence on their QOL. Accordingly, it is really important to stratify the QOL in the specific studies.

Numerous literatures discover that people’s QOL is also greatly affected by the socioeconomic characteristics. The QOL of adults has been shown to vary markedly across the dimensions of social status (Östlin et al., 2006), geographic location (Cummins et al., 2002), health status (Spiro and Bosse, 2000), age range (Levenson, 2000), as well as household composition change (Williams, 1999). However, Diener and Suh (1997) state that gender differences do not seem to significantly influence how satisfied a person is with their life based on the studies in different countries. In particular, QOL is embedded into various spheres of young adults’ life. Observing from the residence domain, Wang (2004) found that residential satisfaction of young adults is influenced by individual local identity, financial capability, residence type and environment index on comfort, convenience and health; further showed that housing ownership is core to the higher residential satisfaction level, based on a study in Beijing, China. Within leisure research, approaches to measuring quality of life have often focused on place-centered indicators such as the frequency of leisure facility usage. Lloyd and Auld (2002)

propose that person-centered criteria such as satisfaction with leisure experiences or attributes of leisure need to be included as well in order to offer a more comprehensive review. Leisure is a vital component of quality of life, leisure is a complex and fascinating domain of study and one that deserves much attention. Linked to the financial life, Clark et al. (2008) provide a good literature review of the effect of income on quality of life, and they conclude that the relationship is generally positive. And further Headey et al. (2008) were able to demonstrate that household income allocation is a stronger predictor of life satisfaction than household income alone. As for the social life and family life, Diener and Seligman (2002) found that social relationships is a major distinguishing factor on the college students' happiness, those who are happy have strong relationships with friends, family, partners than those who are less happy. Campbell et al. (1976) found that satisfaction with family life is a strong and significant predictor of overall quality of life. In terms of job life, Alexopoulox et al. (2014) verified that higher levels of stress and longer working time are related to less job satisfaction and further on the worker's quality of life, and the magnitude of these associations varied depending on age and gender. Although these efforts have been made recently, little study has been focused on young adults' QOL, and conducted the specific research to examine the impacts of young adults' travel behavior (which would be affected by land use attributes as well as decision maker's personal constraints) on other life domains, and its consequences, i.e., these impacts on their QOL. In line with such considerations, this study plan to focus on a full population cohort of young adults aged from 15 to 34 year-old in Japan, it attempts to fill this gap and examine the impacts of land use on their different life domains and further on their QOL, geographically in both metropolitan areas and non-metropolitan areas. Therefore, this study initiates to examine the impact of land use, socioeconomic characteristics and various life choices on the Japanese young adults' QOL, and further to understand the young adults' lives.

2.5.2 Young adults' residential relocation behavior

Residential relocation is a concept that has been widely researched in various fields including transportation, urban planning, housing policy, regional science, economics, sociology, and geography. There is considerable literature devoted to modeling and describing residential location choice behavior; however, an understanding of the underlying factors that contribute to the residential relocation choice continues to be a challenging issue and in need of further enquiry. Particularly in the increasing recognition of the importance of residential relocation phenomenon from a wide range of perspectives, residential relocation decisions affect land use patterns, travel demand, housing consumption, housing values and property tax revenues, and urban landscapes, and have therefore been studied by researchers from a variety of disciplines. A majority of research has shown that at least three categories of factors affect residential relocation choice. The first category corresponds to household demographic and socio-economic factors. Previous studies have indicated that relocation is highest among younger adults (Lee and Waddell, 2010) and lowest among older households (Bailey and Livingston, 2008). Many research efforts have found that residential relocations are also high among households who have experienced life course changes in household structure, lifecycle stage, employment, marriage, child birth, divorce or retirement (Prillwitz and Lanzendorf, 2007; Mulder and Cooke, 2009; Gobillon and Wolff, 2011). Household income also affects residential relocation decision. Zheng et al. (2006) found that high-income households tend to locate to the central city, whereas low-income families are forced to choose residential locations in the suburbs because of budget constraints, based on the study conducted in five large Chinese cities. The second category of attributes influencing residential relocation are the housing characteristics such as housing price (Lee and Waddell, 2010), housing area - living size of the house (Olaru et al., 2011), and residence property – rental or owned (Kim and Morrow-Jones,

2005). Previous research suggests that renters are about twice as likely to move as home owners. In terms of homeownership in China in recent years, it was less than 20% in the 1980s, but rose to more than 70% in 2000 (Huang and Jiang, 2009). The third category of factors relevant to residential relocation decision is residential environment characteristics linked with both work and non-work activities. Several studies have reported that accessibility to shopping and retail destinations (Lee et al., 2010; Haugen et al., 2012), leisure/recreational opportunities, health care facilities, and open space (Chen et al., 2008) are shown to be significant in making residential relocation choice. Zondag and Pieters (2005) have shown that households are less likely to move from high accessibility locations.

However, it has been realized that the dominant static perspective in the field of residential relocation research and the use of cross-sectional survey data is inadequate to detect trends at the individual/household level. Longitudinal data is able to consider the temporal dynamics (state dependence and future expectation effects) of choices, while cross-sectional data methods cannot. Longitudinal surveys and qualitative methods can be favored over cross-sectional surveys because only the former makes it possible to analyze dynamical cause-effect relationships between relevant factors. For instance, a residential relocation is often accompanied by a change of household attributes, socio-demographics and spatial contexts. A deeper understanding of the process of residential location change and the interrelationships between the changes of spatial contexts and life events can only be achieved by using longitudinal data. Therefore, retrospective data collection with quantitative survey instruments has extensively been practiced in travel behavior research (Beige, 2008; Behrens and Mistro, 2010; Klinger and Lanzendorf, 2012), as well as in social sciences studies (Belli et al., 2007). Further, there has been an explicit recognition of the need to use longitudinal data to study residential relocation or mobility decision processes, a point that has also been stressed by Hollingworth and Miller (1996), who use a retrospective interviewing technique to obtain

historical residential mobility information instead of the long-term panel survey. The panel survey approach has the advantage of reliability, though such an approach is expensive, time-consuming, and may suffer from household attrition problems. The retrospective survey approach is relatively easy and convenient, although such surveys covering long periods do raise questions regarding the accuracy of memory recall. Additionally, a rich set of multiple duration models are now available to capture the temporal dependencies within the same life course process as well the dependencies across life course processes (Kortum et al., 2012; Eluru et al., 2009; Beige and Axhausen, 2012). Beige and Axhausen (2008) use a retrospective survey of households in Zurich, Switzerland, to study the influence of life events on long-term mobility decisions over a 20-year period. Zhang et al. (2014) confirms obvious two-way cause-effect relationships over the life course between residential and car ownership biographies that are further influenced by household structure and employment/education biographies. Especially, not only short-term but also long-term state dependence and future expectations within and across life domains are clarified, based on a web-based retrospective survey data.

Considering a life course perspective is crucial for residential relocation research, this study attempts to fill the research gap to figure out the internal mechanism of the young adults' residential relocation decisions making. Therefore, this study initiates to disentangle the young adults' residential relocation choice based on a retrospective life course approach, allowing for the effects of life events change features, quality of life oriented residential environment characteristics changes in the municipal level, as well as household attributes and socio-demographics of young adults in Japan.

2.6 Elderly mobility

It is generally agreed that there is an important relationship between mobility and the quality of life (QOL) of older persons. Loss of mobility is seen as resulting in a substantial diminution of well-being, as happens when a person can no longer safely drive a car or when physical movement is significantly hindered through age-associated disability. Concern about this loss of mobility has prompted many reports and meetings aimed at identifying appropriate responses, whether in terms of policy, operational practice or technology (Metz, 2000). Mobility behavior of the elderly has been studied in different disciplines, such as health science, sociology, gerontology, urban planning, and transport planning, the literature is numerous and comprehensive especially in developed countries. These researchers have identified physical health, age, gender, education level, income, household characteristics, the possession of a driving license, vehicle availability, and transit accessibility are all associated with the mobility behavior of the elderly (Mercado et al., 2010). Moreover, previous research has shed light on the influence of residential environment on the mobility behavior of the elderly. Kim (2003) stated that transit accessibility and population density were associated with travel mode choice of the elderly. A study (Rosso et al., 2011) further provided that safety, and proximity to destinations such as retail and green spaces, are associated with mobility of senior citizens. Moreover, Waldorf (2003) and Giuliano (2004) found that the elderly in urban areas were less likely to have automobile dependence than those in suburban areas. A case study of senior travel and land use further demonstrated that the elderly in mixed land use and compact communities were more likely to walk and use public transit than were their counterparts in suburban communities (Lynott, 2005). A qualitative study on neighborhood design first revealed that diverse services within walking distance provide older people options to walk instead of driving the car to daily activities, second showed that public transit is important to

the elderly, and is essential to people with mobility constraints (Michael et al., 2006). However, these studies are unable to identify the comparative effects of land use patterns on the elderly mobility behavior due to lack of a comparison group such as the young (Cao et al., 2009, 2010). Cao et al. (2010) explored the ability of neighborhood design to preserve accessibility for the elderly by enabling a shift from driving to transit and walking. While controlling for residential preferences and attitudes towards transportation, this study compared the residential choices of the elderly and the young with respect to neighborhood design. The results firstly showed that older people drive less and use alternative modes more often than younger people, secondly found that enhancing accessibility to the nearest establishment of each type (e.g., transit facilities, welfare facilities) has a much larger effect on the elderly than on the young, it tends to be a promising strategy for promoting elderly's mobility. Therefore, better insights towards the influence of residential environment characteristics on the mobility behavior of the elderly people shall be useful in developing policies aimed at bettering the life and health of the elderly.

Planning for elderly mobility has important consequences: if they drive, they may reach the activities they need and their accessibility and mobility is maintained; if they don't drive, or if owning and operating a car becomes financially burdensome, their mobility maybe significantly restricted, with negative implications for QOL (Harrison and Ragland, 2003; Charness, 2003). Here, elderly mobility issues are not just a land use and transport issue, but also intertwined with issues discussed in different disciplines. From a mental health perspective, Marottoli et al. (1997) confirmed a negative effect of driving cessation on depressive symptoms of older persons. From a social perspective, Marottoli et al. (2000) examined driving cessation would result in the reduction of older persons' out-of-home activities which is often a key ingredient in measure of social interaction. From a leisure life perspective, transport availability can be regarded as a kind of mobility constraints for the older people in tourism decisions (Crawford et al., 1991). From a family life perspective, when the elderly people cannot travel

by themselves, their family members would pick them up or drop them off, so that their family members would suffer from not only physical – such as take the elderly to hospital, but also mental burdens – such as stress and anxiety (Chikaraishi et al., 2012).

Considering these studies done in different disciplines, it is pointed out that land use and transport policies should not be evaluated based on the improvement of the accessibility, but also its impacts on other life domains relevant to the older people's QOL, including social, health, leisure, and family life domains. In fact, recently, a number of researchers have pointed out the linkage between the mobility behavior of elderly and QOL. For example, the amount of distance walked by an elderly person determines his/her mobility state and indirectly affects his/her QOL (Berg et al., 2011). Musselwhite and Haddad (2010) conceptualized travel needs in a hierarchical manner: The primary travel needs are utilitarian needs, including making appointments, accessing shops and services, walking in a safe environment, etc.; the secondary travel needs are affective needs, i.e., the need for independence, control, status, roles; and, the tertiary travel needs are aesthetic needs, i.e., the need to travel for its own sake. They pointed out, though the most transportation studies have focused on the primary travel needs, whether the secondary and tertiary travel needs are satisfied or are important for QOL. Similarly, Metz (2000) emphasizes the importance of exploring destination-independent benefits of travel, including psychological benefits of movement, exercise benefits, involvement in the local community, and potential travel. He also argue that, though measuring these benefits directly are not easy, it could have some plausible proxy measures, such as time voluntarily spent outside the home, and time of involvement in social interaction outside the home. In this sense, elderly's time use analysis would be crucial to examine the impacts of transport policies as a whole for elderly people. Zhang and Fujiwara (2006) investigated how the elderly's time use behavior is influenced by travel time by estimating a time allocation model with intra-household interactions based on a one-week activity diary survey conducted in a depopulated

area in Shimane Prefecture, Japan. They confirmed that reducing the total travel time mainly resulted in longer time allocated to in-home and out-of-home independent activities than other types of activities, where differences between husband and wife were remarkable, based on a simulation analysis. In this regard, Spinney et al. (2009) measured daily exposure to psychological and community benefits of travel by using time use data. Other efforts currently made by a number of researchers are to explore the linkage between elderly travel behavior and their QOL (Banister and Bowling, 2004). Although these efforts have been made recently, greater understanding of the impacts of elderly's mobility behavior (which would be affected by land use attributes as well as decision maker's socio-demographics) on other life domains, and its consequences, i.e., these impacts on QOL would be of value.

2.7 Research Question of this thesis

Quality of life is a complex, multifaceted construct that requires multiple approaches from different theoretical angles (E. D. Diener and Suh, 1997). Existing studies indicated that many of the multifarious links between land use, travel behavior and well-being are still under-examined (De Vos et al., 2013), and more in-depth studies about the linkage of residential choices, travel behavior and quality of life are required, so as to understand the behavioral interdependencies across life domains in a logical and systematic way (Zhang, 2014). Therefore, trans-disciplinary approaches are required. In line with such consideration, the life-oriented approach is employed (Zhang, 2014). This approach provides a holistic and comprehensive behavior theory to deal with more general behavioral issues in urban and transport planning, by encompassing a variety of life domains (Zhang, 2014). It is hoped to provide new insights into analyzing the relationships of land use, transport and quality of life, particularly in the context of different social issues (e.g., elderly mobility).

Motivated by the forgoing literature review, it is better to conduct a quality of life oriented research from the stance of land use and transport planning, based on the strengths of other's contributions in a collaborative effort to integrate various disciplines of social science. As mentioned before, this study aims to fill the research gap - clarify the effects of land use and transport planning on quality of life based on a life-oriented behavioral analysis, under different social circumstances, among different population cohorts, from both short-term and long-term, so as to illustrate the utility of relevant land use and transport policies. Here, three social issues in Japan are targeted: (1) women's labor participation and childcare, (2) young adults' lives (e.g., out-migration), and (3) elderly mobility. These three social issues are closely related to land use and transport studies. Those not only involve various interrelated life choices, but also connect as social phenomena. In line with such aims, first and foremost, research questions are located.

1. How to examine the values of life-oriented approach proposed by Zhang (2014) in the context of land use and transport planning?
2. What reasons promote each social issue (e.g., elderly mobility) happen, especially from the perspective of land use and transport aspects?
3. How to offer the policy applications to solve or mitigate each social issue and improve the level of quality of life for the young, the women, and the elderly, respectively, in Japan?

Second, definitions of important concepts (e.g., quality of life, happiness, life satisfaction, life choice) as well as meanings of key terminologies (e.g., depopulated area) employed in this thesis are introduced in Table 2-1.

Table 2-1 Definitions of important concepts mentioned in the thesis

Concept	Definition	Measurement	Indicator	Source
Quality of life	One's satisfaction with life and feelings of contentment or fulfillment with one's experience in the world. It is about how people view, or what they feel about their lives.	Measurement of subjective well-being: positive and negative affect, happiness, and life satisfaction.	Life Satisfaction; Happiness	Andereck, et al., 2007; Uysal, et al., 2012
Life Satisfaction	A cognitive sense of satisfaction with life. Life Satisfaction pertains to the long term phases.	How are you satisfied with your life and your each life domain? (1: Very dissatisfied, ..., 5: Very Satisfied).	Overall Life Satisfaction; Satisfaction with Residence; Satisfaction with Health; Satisfaction with Social; Satisfaction with Finance; Satisfaction with Leisure; Satisfaction with Family Life; Satisfaction with Job; Satisfaction with Education.	Diener et al., 1985; Kahn and Juster, 2002; Sirgy, 2010
Happiness	An affective mood or state, refers to transitory moods of "gaiety and elation" that people feel toward their current state of affairs. Happiness pertains to shorter time frames.	1. As a whole, how happy are you feeling currently? (0: Very Unhappy, ..., 10: Very Happy) 2. In the specific domain level, what percentage of the time are you in a bad mood, a little low or irritable mood, in a mildly pleasant mood, and in a very good mood (totally is 100%)?	Overall Happiness; in a bad mood, a little low or irritable mood, in a mildly pleasant mood, and in a very good mood of Social life, Leisure life, Job life and Family life, respectively.	Campbell, 1976; Bowling, 1995; Ed Diener and Myers, 1996; Easterlin, 2001; Easterlin, 2001; Veenhoven, 1984, 2012a.
Life Choice	The quality of life oriented decisions that closely linked with life domains of residence, social, health, education, employment, family life, leisure and recreation, and finance, as well as travel behavior.		Details are showed in Chapter 3 and Chapter 4.	Zhang, 2014
Labor Participation	A status of the working-age persons (from 15 to 64 years old), who supply labor for the production of goods and services.	Among the working age population, what proportion is employed or actively looking for employment.		The World Bank
Depopulated Area¹	The areas in which the population has been decreasing while the elderly population has been increasing at a tremendous speed.	The rate of population decrease over 35 years. 1). The population decrease rate is 30% and over; 2). The population decrease rate is 25% and over, and the ratio of people aged from 65 years old is 24% and over; 3). The population decrease rate is 25% and over, and the ratio of people aged from 15 to 30 years old is 24% and over; The rate of population decrease over 25 years. 1). The population decrease rate is 19% and over;		Oeda et al., 2012
Mobility	In transportation field, mobility is defined as the "potential" for movement, and this potential is conditioned based on the mobility tools one has access to-car, public transit, etc.		Availability of Travel mode; Frequency of Car Usage; Travel Distance (Yearly); Travel Cost (Monthly).	Spinney et al., 2009

¹ 過疎地域自立促進特別措置法の概要. http://www.soumu.go.jp/main_content/000290499.pdf.

3 Data

Japan is not only known for its high life-expectancy (Coulmas, 2008), but also for its relatively traditional, rigid social structures with predetermined life courses and career paths (Sugimoto 2010), especially the narrow wealth gap and high civilization. These stable features suggest that emphasizing QOL is more evident and feasible in Japan than in other societies (Inoguchi and Fujii, 2009). Moreover, in order to analyze the effects of land use and transport policies on quality of life based on different urban issues, among different cohorts, especially from static, dynamic and long-term viewpoints, different time-series data sets are needed. Therefore, Zhang (2014) and his lab members conducted three web-based surveys – two life choice surveys in 2010 and 2014, respectively, a life history survey in 2010, those are stretching three different levels of cities of whole Japan. Megacities include Tokyo, Yokohama, Osaka, and Nagoya 4 regions, Medium-sized cities contains Sapporo, Sendai, Saitama, Kawasaki, Kyoto, Kobe, Hiroshima, and Fukuoka, and the remaining local cities (around 170 ones). The first data set will be used in the first section of Chapter 4, Chapter 5 and the first section of Chapter 6. The second one except the panel data (422 respondents participated the surveys twice since 2010), others were collected mainly among elderly people from depopulated areas and non-depopulated areas, this data set will be used in Chapter 7 and the panel data set will be employed in the second section of Chapter 4. The third one will be used in the second section of Chapter 6. The details of data application for each chapter are illustrated in Figure 3-1.

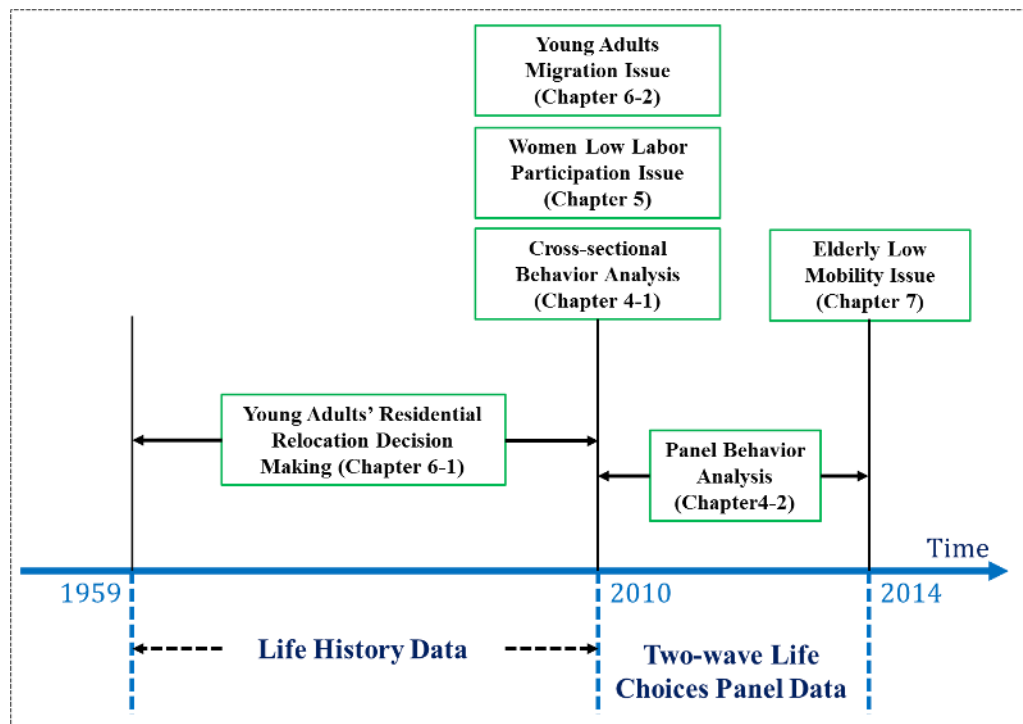


Figure 3-1 The details of survey data application

3.1 A web-based life choice survey in 2010

For the purposes of this study, Zhang et al. (2011) conducted a web-based life choice survey in Japan in January 2010 with the help of an Internet survey company, who had more than 1.4 million registered panels at the time of survey. Respondents were randomly selected from the registered panels by considering the distributions of age, gender, and residential areas (here, refer to prefectures) across the whole population in Japan. Zhang et al. (2011) argue that such web-based survey is the most effective way to control the sample composition which can hardly be achieved by other methods. However, it cannot deny the fact there are some sample selection biases; considering that the Internet usage rate in Japan reached 75.5% in 2010, the Internet might be an acceptable media to conduct such survey. As a result, 2,188 respondents participated in the survey, and 2,178 provided valid answers for this study. The survey included

very detailed information of individual's different life domains, relevant question items are shown below.

- 1) Residence: location (zip code), duration, price (rental fee or purchase price), types, stories of building, living area, number of rooms, distance to daily facilities, etc.
- 2) Family budgets: income and expenditure.
- 3) Health: subjective health condition, experience of accidents and illness, sleeping time, frequency and activity time of different types of physical exercise, and distance to places of physical exercise.
- 4) Neighborhood: frequency of neighborhood communication, participation in community activities
- 5) Education & learning: academic degree, learning frequency and time, distance and major travel modes to different types of learning facilities
- 6) Job: location of workplace, commuting mode, job type, working days and hours per day, start and end time for a normal working day, paid holidays in contract and number of holidays actually taken, working duration (years)
- 7) Family life: in-home and out-of-home time use with family members on weekdays and weekends, communication frequency with relatives, care giving to pre-school children, the elderly or the disable family member
- 8) Leisure & recreation: discretionary time on weekdays and weekends, use of leisure time at different facilities (activity duration, frequency, distance to place, travel party and major travel mode), tourism (domestic and overseas, frequency, travel party, expenditure), Internet usage (time and frequency)

And the summary of data characteristics is shown in Table 3-1. It is expected that decisions on the above domains are interdependent. One can see that travel behavior such as driving license ownership, vehicle ownership (number of different types of vehicles), and

mainly daily travel mode is a cross-domain behavior. Furthermore, life satisfaction and happiness are also included to measure people's subjective QOL with respect to the whole life and each domain, together with household attributes (numbers of pre-school children, dependent students, and elderly members) and attributes of each member (age, gender, marital status, relationship with household head, ownership of mobile phones, personal computer), etc. Specifically, as for life satisfaction data, survey asked respondents how you are satisfied with your life as a whole and each life domain, showing the corresponding answers according to 1~5 point (1: very dissatisfied,..., 5: very satisfied). In terms of happiness data, survey asked respondents how happy you are currently, choosing the corresponding levels from 0 ~10 (0: very unhappy,..., 10: very happy). Regarding for the affective experience, survey required respondents show the answers (the percentages of bad mood, low mood, pleasant mood and very good mood respectively, and the total percentage is 100%.) for the question what percentage of your feeling in these domains (job, social, family life, leisure and recreation domain). From the above survey data, I found that the happiness distribution in Japan follows a double-peak pattern, with one peak at the center of the scale, 5, and another at 7–8 (where 0: very unhappy, ..., 10: very happy), and the average happiness score was 6.37 points (Figure 3-2). And the life satisfaction distribution is shown in Figure 3-3.

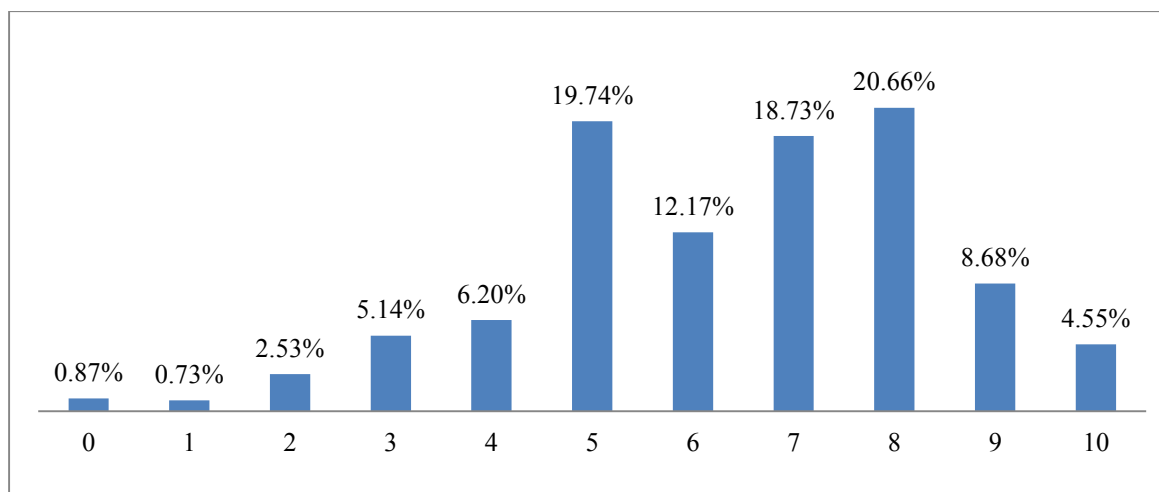


Figure 3-2 Happiness Score

Table 3-1 Summary of characteristics of life choices survey data in 2010

Individual Characteristics	Percentage		Percentage
		Household	
Gender		Composition	
Male	49.68%	1 member	10.84%
Female	50.32%	2 members	28.83%
Age		3 members	24.88%
< 15 years old	1.97%	>3 members	35.45%
15-17 years old	2.02%	Car Ownership	
18-34 years old	22.73%	Have more than one	
35-64 years old	61.48%	car	26.91%
> 64 years old	11.80%	Have a private car	53.44%
Occupation		Have no car	19.65%
Employed	49.36%	Main Travel Mode	
Part-time Job	11.02%	Cycling/Walking	35.67%
Housewife	20.71%	Public Transit	23.51%
Student	8.72%	Car	36.64%
Unemployed	10.19%	Others	4.18%
Education Level		Health Status	
Having a Bachelor degree	63.50%	Fine	77.55%
Having no Bachelor degree	36.50%	Not Fine	22.45%
Marital Status		Life Satisfaction	
Married	69.83%	Satisfied	57.07%
Single	30.17%	Neutral	32.87%
Household Income		Dissatisfied	10.06%
< 2 million yen/year	7.76%	Happiness	
2 - 6 million yen/year	46.46%	9 - 10 Score	13.22%
> 6 million yen/year	45.78%	6 - 8 Score	51.56%
		0 - 5 Score	35.22%

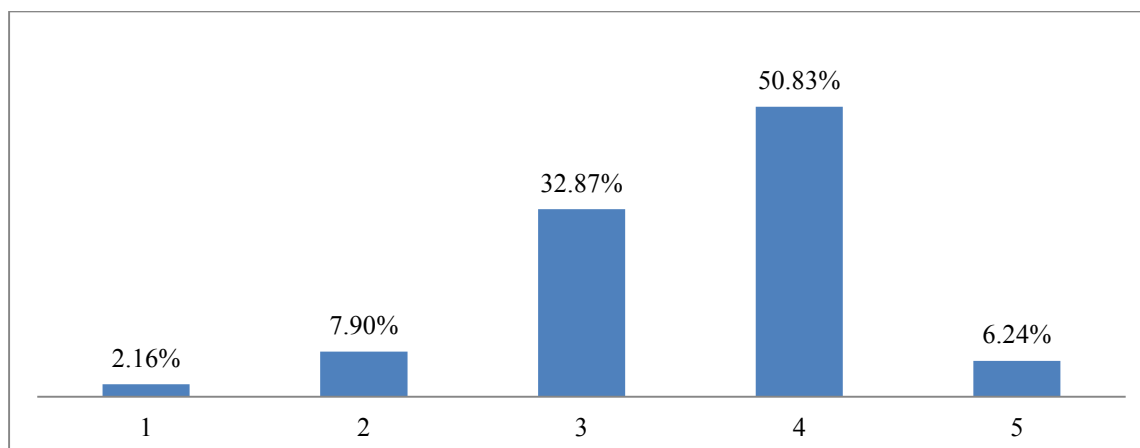


Figure 3-3 Life Satisfaction Score

3.2 A web-based life choice survey in 2014

For the purpose of panel data analysis and elderly mobility issue, I further conducted another life choice survey in January, 2014. Finally, 900 respondents aged between 15 and 88 years old participated in the survey. As a results, I obtained 422 panel data (in which 422 respondents participated both this survey in 2014 and the last life choice survey in 2010), 297 elderly persons (aged 65 years old or above) were from depopulated areas, 253 elderly persons and 350 non-elderly persons were from non-depopulated areas. The data characteristics of elderly persons from depopulated and non-depopulated areas are summarized in Table 3-4. And the change rate of main life events and QOL indicators are shown in Figure 3-3 based on panel data between 2010 and 2014.

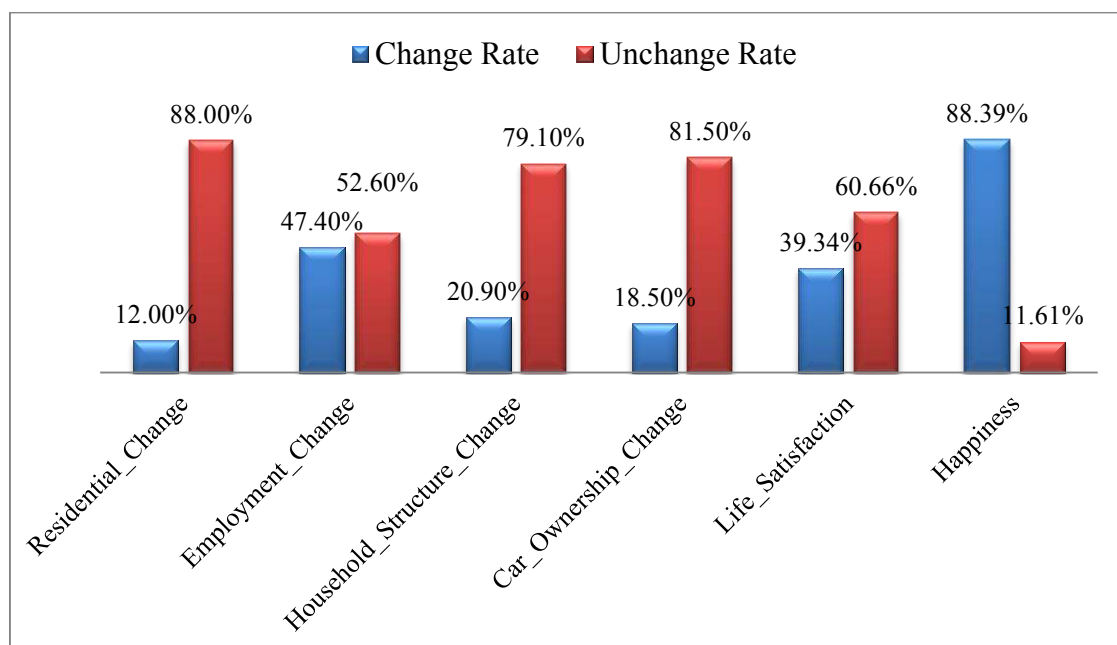


Figure 3-4 The Change Rate of Main Life Events based on Panel Data between 2010 and 2014

Table 3-2 Summary of Data Characteristics in 2014 between the elderly from Depopulated areas and Non-depopulated areas

Depopulated/ Non-depopulated Elderly	N=297	N=253	Depopulated/ Non-depopulated Elderly	N=297	N=253
Gender			Car Ownership		
Male	76.43	59.29	Have more than one car	36.70	18.58
Female	23.57	40.71	Have a private car	54.55	48.62
Education Level			Have no car	8.75	32.81
Having a Bachelor degree	36.03	34.39	Travel Purpose by Car		
Having no Bachelor degree	63.97	65.61	Shopping	37.37	27.27
Marital Status			Leisure	12.46	12.65
Married	85.52	79.05	Private affairs	20.54	11.07
Single	14.48	20.95	Others	29.63	49.01
Household Composition			Main Travel Mode		
1 member	10.77	15.02	Cycling/Walking	19.53	41.90
2 members	61.62	52.96	Public Transit	3.03	17.00
3 members	16.16	22.53	Car	7.71	39.92
>3 members	11.45	9.46	Others	0.34	1.19
Health Status			Life Satisfaction		
Fine	70.37	69.57	Satisfied	70.36	72.39
Not Fine	29.63	30.43	Neutral	22.53	21.89
Household Income			Dissatisfied	7.11	5.72
< 2 million yen/year	6.40	11.86	Happiness		
2 - 6 million yen/year	77.78	66.40	9 - 10 Score	13.56	17.51
> 6 million yen/year	15.82	21.74	6 - 8 Score	60.13	59.26
			0 - 5 Score	26.31	23.23

3.3 A life history survey

To disentangle the residential relocation decision making processes of young generation in Japan from a life course perspective in the second section of Chapter 6, longitudinal data are required. Instead of time-consuming panel survey, a retrospective approach is employed in this study that asks respondents to recall past mobility information. An Internet-based life story survey covering major cities in Japan was carried out in November 2010. This Internet-based survey was implemented with the help of a major Web survey company in Japan (having more than 1.4 million registered panels at the time of survey). As a result, 1,400 questionnaires were collected by contacting 6,940 registered panels, in which age, gender, and residential

distribution across the whole population in Japan are guaranteed. The response rate was 20.2%. The survey contents surround four life events over the life course: residential mobility, household structure mobility, employment/education mobility, and car ownership mobility. In the survey, before answering detailed information related to each type of mobility, respondents are first asked to report on the mobility (change) times and the exact timing of relevant events (their age when the event occurred), and a simplified matrix showing these timings is presented in a separate window for ease of reporting detailed information later on. Subsequently, detailed information about each episode in each mobility is reported as follows:

- 1) Residential mobility: relocation place, income, residence property, accessibility (here, refers to distance) to varied facilities (including railway; bus; primary, junior and high school; hospital; park; supermarket; city hall) in each episode.
- 2) Household structure mobility: household size, information for each household member in each episode (including age, gender, relation with householder).
- 3) Employment/education mobility: job category, commute time to job/school, accessibility to job/school, travel mode in each episode.
- 4) Car ownership mobility: car number, main user, car efficiency, purpose, and use frequency in each episode.

In addition to the above information, QOL related variables (happiness and life satisfaction) are also investigated, and respondents were asked to report on how confident (10-point scale) they felt about the answer to some major question items with continuous values (e.g., accessibility to facilities). Such confidence information can be used to reflect the reliability related to the reported information as well as the quality of the retrospective survey. The data show that the average confidence level is around 7–9 across different cohorts (a 10-point scale is set in which 0 means not confident at all and 10 means fully confident), suggesting an acceptable quality of the survey data. Figure 3-5 displays the mobility timing of residential

location, car ownership, household structure, and employment/education over the life course. Five years are grouped together. Obviously, there is a peak period of residential mobility lying between 20 and 35 years of age, and the similar curve can be seen from other three mobilities.

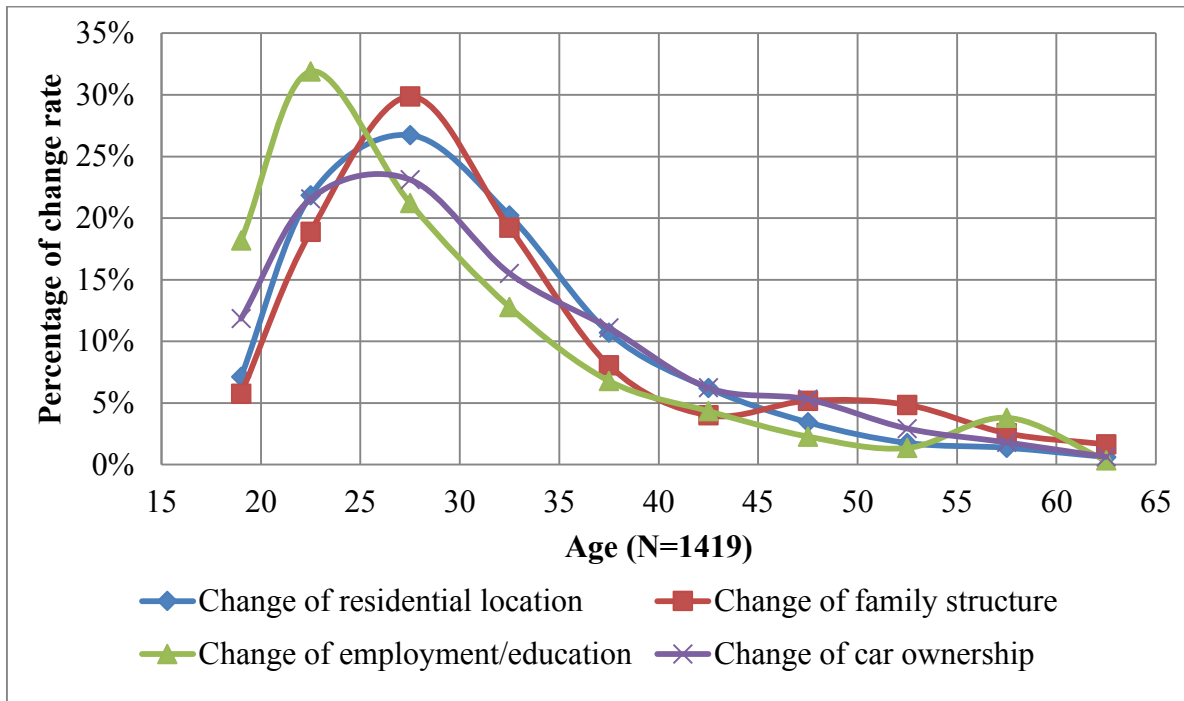


Figure 3-5 Timing of Mobilities in Residential, Household Structure, Employment/Education, and Car Ownership

4 Empirical Evidence of Behavioral Interdependencies across Life Choices in the Land Use and Transport Context

4.1 Cross-sectional Analysis

4.1.1 Introduction

One of the most important goals of land use and transport policies is to contribute to the improvement of people's quality of life (QOL). These days, more and more developed countries are trying to introduce QOL to supplement the role of GDP in representing people's wellbeing, such as France, UK, Japan, and USA, among others. Further, people's QOL, which can be roughly investigated from the life domains such as residence (Heal and Chadsey-Rusch, 1985; Werner, 2011), social (Honold et al., 2012; Delmelle et al., 2013), health (De Hollander and Staatsen, 2003; Sturm and Cohen, 2004), education (Frisvold and Golberstein, 2011; Winters, 2011), work (Huang and Sverke, 2007; Tefft, 2012), family life (Greenhaus et al., 2003; Huang and Sverke, 2007), leisure and recreation (Leung and Lee, 2005; Lin et al., 2013), finance (Kaplan et al., 2008), and travel behavior (Abou-Zeid et al., 2012; Cao, 2013; Delmelle et al., 2013). People's life choices (decisions) are closely linked with those life domains. Undoubtedly, these different life choices (decisions) are usually decided over different time scales under the influence of limited time and monetary constraints as well as the various needs of households and their members. Therefore, changes in one aspect of people's life choices may affect other choices. In other words, people's life choices (decisions) are interrelated. As residential choices and travel decisions are just a part of people's life choices (decisions), once the land use and transport policies are carried out, the policies irrefutably have directly impact on people's residential choices (e.g., where do they live) and travel behavior (e.g., what kind of mode choices do they choose), may further have influences on people's other various life aspects such as leisure life (e.g., frequency of going to the park), then on the people's QOL. Thus a comprehensive and interdisciplinary viewpoint of QOL is needed. Especially for urban

planners, to support the cross-sectoral urban policies making, which not only requires the efforts from land use and transport sectors, but also the endeavors from other sectors such as health and employment (Zhang, et al., 2011, 2012).

Links between transport and QOL at the individual level have been recognized for several decades. Existing transport studies have mainly focused on negative aspects (e.g., congestion, accidents, and air pollution) of transport activities. This is understandable because transport policies, as one type of urban policies, are required to clarify how to mitigate the negative impacts of externalities from transport activities. In reality, however, travelers usually experience both positive and negative feelings of travel activities (Zhang 2009; Ettema et al., 2010). Car drivers stuck in traffic jams can experience stress and impatience, but multitasking during the use of transport systems allows people to make efficient use of time, which generates positive utility (Zhang 2009). Travel may also increase people's QOL because people's daily activities tend to be distributed across space, then social bonds strengthened and personal goals realized (Ettema et al., 2010). Nordbakke et al. (2013) further supported that having access to convenient transport systems (e.g. living close to a public transit network) can generate feelings of freedom, competence and belonging. Greater motility (e.g. residential environment change) can also give people the passion and confidence that they are capable of realizing certain goals. Travel behavior is just a part of people's life choice. In this sense, travel behavior results from performing various human activities and the behavior itself also is a part of human mobility. People cannot survive without transport, which plays a vital role in meeting individuals' various needs (Vos, 2015). In terms of the residence, it provides a shelter for people, which is one of the most fundamental needs of people (Frank et al., 2003).

The above facts motivated us to re-examine the issues of residential choices and travel behavior from the positive perspective of people's QOL. Both residential choices and travel behavior are two important aspects in land use and transport policies making, which especially

requires cross-sectoral collaboration. Effects of both residential choices and travel behavior on QOL have been far-ranging examined in the literature; however, no study has been done based on such an extensive set of relevant life choices (decisions). In this context, trans-disciplinary and integrated approaches are required.

In this chapter, I employ the life-oriented approach, proposed by Zhang (2010, 2012, and 2014) and Zhang et al. (2011 and 2012), to explore and quantify the interdependencies among the residential choices (residence life), travel behavior and other life choices (decisions) concerning other seven life domains (finance, health, education and learning, social, employment, family life, leisure and recreation), as well as the people's QOL measured in the form of life satisfaction (satisfaction with each life domain and the whole life) and happiness (affection experiences of employment, social, family life, leisure and recreation life domains, as well as the whole life), based on a life choice survey data collected in Japan in 2010 (Zhang et al., 2011 and 2012). Different from the concept proposed by Knox (1975), the survey also captures the relevant travel behavior concerning each life domain in the form of travel mode choice, travel frequency, travel party and activity time. Also the residential choices are depicted by decisions on housing attributes and residential environment (distance to different facilities such as railway stations).

With the above considerations, the purposes of this study are: from a static viewpoint, (1) to statistically capture the interdependencies of life choices, after allowing for the effects of land use attributes; (2) to examine a two-way relationship between residential choice, travel behavior and other life choices; (3) to clarify what kind of life choices including residential choices and travel behavior affect people's QOL, as well as quantify the effect sizes after controlling for the effects of land use attributes; (4) to identify the necessities for joint representation of life choices on the way from the land use and transport planning to the higher level of QOL attainment.

4.1.2 Methodology

Methodologically, when there are too many life choice variables, as in this study, there are probably many correlations among these explanatory variables and more nonlinear relationships between these variables and QOL related variables, which must be properly treated. It is expected that this study could derive more consistent conclusions based on a more logical method. Moreover, Zhang (2014) stated that the interdependences across the above eight life domains. Therefore, it is needed to reflect and quantify such interdependences in this analysis. To this end, I proposed an integrated approach employing a data mining method called Exhaustive Chi-squared Automatic Interaction Detector (CHAID) to clarify what kind of life choice variables have impacts on the target decision (e.g., residence property, QOL indicators and so on), and further applying a Bayesian Belief Network (BBN) approach to quantify the influence of the various variables. The results from the Exhaustive CHAID approach are utilized to build the network structure between the QOL indicators and life choices variables in the BBN approach.

4.1.2.1 Exhaustive CHAID Approach

Data mining is defined as an analytical approach used to explore large datasets to achieve consistent interdependencies among the variables. Especially, CHAID (Chi-squared Automatic Interaction Detector), a type of decision tree technique, which is one of the most popular methods based on adjusted significance testing used in science and business for performing prediction, classification and detection (Kass, 1980). It uses given data to build automatically a series of “if-then” rules in the form of a decision tree. The tree begins with one root (parent) node for a target variable that contains all of the observations in the sample and grows to

accommodate subgroups segmented based on predictors at various branch levels until the tree converges based on stopping criteria. However, sometimes CHAID may not find the optimal split for a predictor variable. Accordingly, Exhaustive CHAID was developed to remedy this issue by continuing to merge categories of the predictor variables until only two super categories are left, which have the strongest associations with the target variable. Thus, once a set of predictors is given for a target variable, the Exhaustive CHAID approach will automatically derive the best combination of predictors for the target variable. As a result, any arbitrariness caused by analysts can be eliminated. However, the Exhaustive CHAID approach can only be used to clarify which life choice variables influence target variables (e.g., QOL indicators); it cannot quantify the degree/size of influence.

4.1.2.2 Bayesian Belief Network (BBN) approach

Bayesian Belief Network (Janssens, et al., 2006; Verhoeven, 2007; Takamiya, et al., 2010) is based on probabilistic causation (occurrence of a cause increasing the probability of an effect) and it is useful to analyze and observe the complex and unstable systems for decision making and reasoning with uncertainty. Moreover, it is suitable to analyze non-linear relationships and to evaluate the impacts of changes in the updating modeled situation.

Recently, some researchers have employed the BBN in transportation behavior research. A previous study by Janssens et al. (2004) confirmed and examined the availability of the potential value of BBN to cope with the complexity of travel mode choices problem. It is found that BBN is valuable for capturing and visualizing the multidimensional nature of complex decisions, potentially valuable for modeling complex decisions. Further, Takamiya et al. (2010) showed the effectiveness of using the BBN model to model travel behavior based on dependency zone and trip characteristics, where zones are characterized by the important

facilities for trip makers. Besides, Verhoeven et al. (2007) verified the feasibility of BBN to capture the direct and indirect effects of life trajectory events on the dynamics of activity travel patterns in general and travel mode choice in particular.

BBN structures are directed acyclic graph (DAG), there are no cycles, and it consists of a set of nodes and directed arcs. The nodes represent variables and the arcs represent the directed causal influences between linked nodes. The arc starts from the parent node (Y) to the child node (X). The child node is dependent on its parent node, but it is conditionally independent of others. The condition probability $P(Y|X)$, showing how a given parent node Y, can influence the probability distribution over its child node X, is calculated using Bayes' Theorem:

$$P(Y|X) = \frac{P(Y|X)P(Y)}{P(X)} \quad (4-1)$$

where, $P(X|Y)$ is the conditional probability of X given Y, and $P(X)$ and $P(Y)$ are the probabilities of nodes X and Y.

BBN is not a perfect approach and it still has some weaknesses (Mittal, 2007). First, it cannot differentiate between a causal relationship and a spurious relationship because causal relationships cannot be ascertained from statistical data alone. Therefore it is not capable to provide theoretical explanations about modeling results. Another limitation is that they do not differentiate between a latent construct and its measures (observed variables). Since this study has made clear assumptions about the interdependencies among residential choice variables, travel behavior variables and QOL related variables, and BBN is just applied to test those assumptions, the first weakness of BBN is not relevant in this study. As for the second weakness of BBN, our study can be done without the help of introducing any latent variables and

therefore the second weakness is not relevant, either. As for the application of BBN model, firstly, structure learning is performed to construct network structure based on causal relationships derived from observed data, and I obtained the model structure based on repeated trials and errors by checking the improvement of model accuracy in our case. Secondly, parameter learning is implemented to determine the prior conditional probability tables (CPT) of each node in the network. Fortunately, CPT can be calculated automatically by means of probabilistic inference algorithms that are included in the Bayesian network-enabled software. In our case, Netica Software is employed, which can handle continuous variables and discrete variables simultaneously. For the discrete variables, I can divide them into different states (i.e., high, medium, and low), and for the continuous ones, which can be converted to discrete quantities before any probabilistic inference automatically, the details of variables included in the analysis are briefly shown in Table 4-1. The resulting BBN structure was obtained after repeated testing, calibrating and validating.

The classification accuracy of BBN in Netica is evaluated based on standard scoring rules including logarithmic loss, quadratic loss, and spherical payoff (Morgan, et al., 1990). Values of spherical payoff, the most useful index, vary in the interval $[0, 1]$, with 1 being best model performance. The logarithmic loss values are calculated using the natural log, between 0 and infinity inclusive, close 0 indicating the best performance. Quadratic loss is between 0 and 2, with 0 being best.

4.1.3 Estimation results

For this study, the primary source of data comes from the internet-based life choice survey in 2010 by recruiting respondents residing in various cities across Japan (Zhang et al., 2011, 2012). It is expected that decisions on the above domains are interdependent. In the popular activity-

based approach, it is argued that travel demand is derived from activity participation. In the life-oriented approach, it is argued that travel demand is derived from life decisions. Such argument is also true for the residential behavior. Related to residential and travel behavior, they are interdependent with each other as well as with other life domains. Here, 99 (including 85 life choice variables and 14 land use attributes) explanatory variables were related to the analysis in this study, as shown in Table 4-1.

To obtain the best decision tree from the Exhaustive CHAID approach, I set the maximal level of the decision tree to 10 for each target variable (i.e., happiness indicator,

Table 4-1 Explanatory Variables

Land Use Attributes Distance to railway station (km) Distance to bus stop (km) Distance to city hall (km) Distance to community center (km) Distance to post office (km) Distance to hospital (km) Distance to supermarket (km) Distance to Kindergarten (km) Distance to Elementary school (km) Distance to Secondary school (km) Distance to High school (km) Distance to cinema/theatre (km) Distance to sports facility (km) Distance to park (km)	Employment domain Occupation ⁵⁾ Job type ⁶⁾ Commute mode ²⁾ Working hours per day (paid) Vacation actually taken (days/year) Duration of tenure (years) Monthly workdays (days)
Residence domain Residence duration (years) Living area (m ²) Housing type ¹⁾ Number of stories of residential building The floor where respondents lived Number of rooms Residence property (own=1; rent=0) Main travel mode ²⁾ Vehicle ownership (number of vehicles)	Health domain Sleep time Frequency of contact sports Frequency of non-contact sports Frequency of gentle sports Duration of contact sports (minutes) Duration of non-contact sports (minutes) Duration of gentle sports (minutes)
Finance domain Household annual income ³⁾ Percentage of food expenditure Percentage of housing expenditure Percentage of energy expenditure	Family life domain Indoor time use on weekday Outdoor time use on weekday Indoor time use on non-weekday Outdoor time use on non-weekday Household composition Frequency of having dinner with family Frequency of contact with relatives
	Leisure & recreation domain Frequency of going to cinema and theatre Frequency of going to sports facilities Frequency of going to amusement parks (e.g. park) Frequency of going to entertainment places (e.g. karaoke) Frequency of going to racing facilities

Percentage of furniture expenditure	Travel party ⁷⁾ to cinema and theatre
Percentage of clothes expenditure	Travel party ⁷⁾ to sports facilities
Percentage of healthcare expenditure	Travel party ⁷⁾ to amusement parks
Percentage of transport expenditure	Travel party ⁷⁾ to entertainment places
Percentage of education expenditure	Travel party ⁷⁾ to racing facilities
Percentage of leisure expenditure	Travel mode to cinema and theatre ²⁾
Percentage of saving	Travel mode to sports facilities ²⁾
Percentage of other expenditure	Travel mode to amusement parks ²⁾
Learning & education domain	Travel mode to entertainment places ²⁾
Education level (Bachelor=1,0)	Travel mode to racing facilities ²⁾
Frequency of language learning	Duration at cinema and theatre (minutes)
Frequency of knowledge learning	Duration at sports facilities (minutes)
Frequency of hobby learning	Duration at amusement parks (minutes)
Frequency of job training	Duration at entertainment places (minutes)
Duration of language learning (minutes)	Duration at racing facilities (minutes)
Duration of knowledge learning (minutes)	Leisure frequency
Duration of hobby learning (minutes)	Tourism frequency
Duration of job training (minutes)	Frequency of going home for a visit
Travel mode for language learning ²⁾	Leisure expenditure (Yen/year)
Travel mode for knowledge learning ²⁾	Tourism expenditure (Yen/year)
Travel mode for hobby learning ²⁾	Expenditure on going home for a visit (Yen/year)
Travel mode for job training ²⁾	Internet usage frequency (use every day=1,0)
Social domain	Internet usage time (minutes/day)
Frequency of neighborhood communication ⁴⁾	
Participation in community activities ⁴⁾	

Note:

- ¹⁾ Housing type: attached house; terrace house; apartment; others.
- ²⁾ Travel mode or main travel mode or commute mode: car; walking; public transit; others.
- ³⁾ Household annual income level: 1: <1.0, 2: 1.0 ~2.0, 3: 2.0 ~ 3.0, 4: 3.0 ~ 4.0, 5: 4.0 ~ 5.0, 6: 5.0 ~ 6.0, 7: 6.0 ~ 7.0, 8: 7.0 ~ 8.0, 9: 8.0 ~ 9.0, 10: 9.0 ~ 10.0, 11 :10.0 ~ 15.0, 12: >15.0 (unit: 1 million Yen).
- ⁴⁾ Frequency of neighborhood communication/ community activities: often; sometimes; rare.
- ⁵⁾ Occupation: officer; civil servant; merchant; part-time job; housewife; non-employee; others.
- ⁶⁾ Job type: technical professional; management; salesman; service staff; agriculture; others.
- ⁷⁾ Travel party: alone; family member; colleague /classmate; acquaintance; friend; others.

each life choice) and adopt all the above predictors. This part applies the Exhaustive CHAID approach using the Answer Tree software, which treats the 85 life choice variables as inputs (predictors) to each target choice variables. Further, to quantify the above influence on QOL indicators, this part further estimated the BBN model, for which the network structure between the target variables (QOL indicators) and its factors is built by utilizing the results from the

Exhaustive CHAID approach, after controlling for the effects of land use attributes. The results based on Exhaustive CHAID approach are shown in Table 4-2 ~ Table 4-8, and the results of BBN approach are shown in Table 4-9 and Table 4-10. The BBN estimation, where the predictors are derived from the Exhaustive CHAID approach and the value in parentheses after each predictor is the variance reduction (VR) calculated from the BBN model. Variance reduction is the expected reduction in the variance of a target node because of the introduction of an input node. In this sense, VR can be used to evaluate the degree of influence of each predictor on the target variable. In Table 4-2 ~ Table 4-8, the first column shows the indicators of travel behavior, residential choices and other life choices, while the second and the last column indicate the predictors for each indicator. The value in parentheses after each target variable in Table 4-2 ~ Table 4-8, is the accuracy of the decision tree split, ranging between 60% and 86%, suggesting that the Exhaustive CHAID approach achieves acceptable accuracy. The classification accuracy of the BBN estimated using Netica software is evaluated based on standard scoring rules including logarithmic loss, quadratic loss, and spherical payoff (Morgan and Henrion, 1990). Values of spherical payoff, the most useful index, vary in the interval [0, 1], with 1 indicating the best model performance. The logarithmic loss values are calculated using the natural log, between 0 and infinity (inclusive), where a smaller value suggests better performance. Quadratic loss values are between 0 and 2, with 0 being the best. For our model structure, the spherical payoff value is 0.9091, the logarithmic loss is 0.53, and the quadratic loss is 0.6842. All these values indicate that the BBN model performs well.

Given the results in Table 4-9, it confirms that income (i.e., household annual income) surely influences happiness, but it is only true with respect to happiness and the mildly pleasant mood produced by leisure activities; however, it is not the most influential factor. In the case of happiness, the greatest influence is the percentage of saving (i.e., income saved), with a VR of 30.80%, which is about three times higher than that of income (VR = 10.76%). As for the

mildly pleasant mood produced by leisure activities, duration at racing facilities is estimated to be the most influential factor (VR = 34.19%), followed by income (VR = 24.19%). In terms of land use attributes, distance to park (7.93%) plays a dominant role in happiness attainment. With regard to the other life choices variables, only occupation and the duration/frequency of job training are associated with several happiness indicators. Concretely speaking, occupation plays the most important role in explaining all three included types of mood when working on the job. The duration of job training affects the mildly pleasant mood produced by leisure activities, and the frequency of job training influences the good mood produced by leisure activities; however, both have less influence than do the consumption variables. For example, the VR values for the duration and frequency of job training are 2.32% and 2.03%, respectively, which are just 6.79% and 6.21% of the VR values of the most influential factors.

Education-related life choice variables are only associated with being in a bad mood during one's job, during family life, and during neighborhood communication. The percentage of income spent on education and a person's education level are ranked as the top factors influencing bad moods during family life and during neighborhood communication, while education level is the third greatest influence on bad moods during one's job. Thus, in this case study, education only contributes to negative affective experiences.

Turning to residence-related life choice variables, which are found to influence eight happiness indicators, of which six involve positive affect (i.e., a mildly pleasant mood during leisure activities and neighborhood communication, and a good mood during leisure activities, family life, one's job, and neighborhood communication) and two involve negative affect (i.e., a bad mood during one's job and neighborhood communication). Here, three residence-related life choice variables are found to be influential: residence property, living area, and residential duration. Residence property and residential duration produce mixed effects on a person's affective experience (i.e., their influences are observed with respect to experiences of both

positive and negative affect). By contrast, living area is only associated with positive affect (i.e., being in a good mood during family life). Unfortunately, none of the residence-related variables influences whole-of-life happiness.

Happiness indicators are influenced by various other life choice variables. Regarding happiness as a whole, as mentioned above, the most influential life choice variable is the percentage of saving (VR = 30.80%), while travel party to amusement parks is ranked in second place (VR = 12.78%), even before income. In other words, investment in one's future is most important to enhancing people's current overall happiness level. For the four targeted life domains (i.e., jobs, family life, the neighborhood, and leisure and recreation), saving is less relevant to happiness. For experiences of a mildly pleasant mood during leisure activities, income is ranked as the second most influential factor, and the third is the frequency of neighborhood communication.

Besides income and the percentage of saving, happiness is clearly influenced by spending money to maintain an active lifestyle, including tourism and leisure activities, sports and entertainment, contact with relatives, and communication with the neighborhood. Active lifestyle is related to experiences of positive affect in some life domains, but it is associated with negative affect in others. Thus, the effects of active life related choices on happiness are mixed.

Among the 13 happiness indicators, the frequency of neighborhood communication shows an influence on seven indicators (including positive and negative affective experiences), suggesting the importance of communicating with one's neighbors to happiness. Frequency of neighborhood communication is the greatest influence on experiences of positive moods during neighborhood communication (i.e., mildly pleasant and good moods).

Observing the influence of expenditure on happiness, besides bad and good moods during one's job and being in a good mood during neighborhood communication, expenditure

variables influence all the other happiness indicators in either a negative or positive way. Leisure expenditure influences happiness and the affective experience during leisure activities and family life, but with mixed effects. Transport expenditure is associated not only with being in a good mood during leisure activities but also with being in a bad mood during family life. Food expenditure is related to both positive and negative affective experience (good mood during neighborhood communication; bad mood during family life). Expenditure on clothes only leads to positive affect (a mildly pleasant mood during leisure activities). Expenditure on health care is associated with being in a good mood during family life. Among the expenditure variables, the three top-ranked influencing factors are: in equal first place, the effect of the percentage of saving on whole-of-life happiness, and the effect of the percentage of income spent on education on bad moods during family life; in equal second place, the effect of the percentage of income spent on leisure on bad moods during leisure activities, the effect of the percentage of income spent on transport on good moods during leisure activities, and the effect of the percentage of income spent on education on bad moods during neighborhood communication; and in equal third place, the effect of leisure expenditure on mildly pleasant moods during family life, and the effect of the percentage of income spent on health care on good moods during family life.

Looking at each type of life choice variable, sports contribute to positive affect, while Internet usage and visiting amusement parks, cinemas, and the theater have mixed effects on affective experience. Indoor time use on a weekday is only related to two negative experiences: bad moods during leisure activities and during one's job. However, indoor time use during a holiday influences only three types of experiences of positive affect: mildly pleasant moods during family life, and good moods during family life and during neighborhood communication. Considering that working hours and monthly working days do not significantly influence any of the 13 happiness indicators, whereas leisure- and tourism-related variables do, these results

may imply that one's current work–life balance does not matter to happiness, but the use of one's free time outside work absolutely matters.

Table 4-10 shows how the people's QOL in terms of life satisfaction affected by land use attributes, residential choices, travel behavior and other life choices. Firstly, the land use attributes such as accessibility measurement and travel behavior show the dominant role in life satisfaction. Specifically, vehicle ownership is the most influential factor (28.5%), followed by main travel mode (21.1%), and the distance to railway station play the prominent role in life satisfaction. Secondly, the satisfaction with residence domain is mainly affected by main travel mode (33.3%) and the distance to kindergarten (11.8%). This reveals that the great association between closeness to childcare facilities and life satisfaction. Additionally, accessibility to railway station has a significant effect on satisfaction with finance domain. And accessibility to community center is of importance for the satisfaction with education and learning domain. It suggests that the community centers (with museums, planetarium and so on) in Japan are beneficial for learners to pursue more diversity knowledge and generate higher learning enthusiasm. Moreover, closeness to park and railway station have impact on the life satisfaction with leisure and recreation domain. It reveals that transit/leisure oriented environment is essential to the leisure activities participation.

Table 4-2 Significant factors influencing the variables in Residence life

Target Variables	Predictors
Residence duration (82.6%)	Percentage of housing expenditure, Household Annual income, Distance to nearest Park , Duration at Amusement park, Distance to nearest Hospital , Percentage of furniture expenditure, Household composition, Frequency of going to cinema and theatre, Percentage of education expenditure, Residence property, Distance to City hall
Living area (66.4%)	Residence property, Number of rooms, Residence duration, Frequency of neighbor communication, Percentage of transport expenditure, House type, Tourism expenditure, Household composition, Travel party to amusement park, Percentage of clothes expenditure, Main travel mode, Job type, Vehicle ownership, Percentage of education expenditure, Travel mode to entertainment places

Housing type (84.6%)	Number of stories of residential building, Residence property, Number of rooms, Living area, Tourism frequency, Distance to nearest Kindergarten , Travel mode for language learning, Distance to nearest Secondary school , Travel party to cinema and theatre, Duration of gentle sports, Frequency of neighbor communication
Number of stories of residential building (91.70%)	The floor lived, House type, Distance to Railway station , Percentage of food expenditure, Percentage of furniture expenditure, Household Annual income, Percentage of transport expenditure, Household composition, Residence property, Distance to Supermarket , Distance to City hall , Distance to nearest Elementary school
The floor where lived (71.90%)	Number of stories of residential building, Residence property, Frequency of gentle sports, Percentage of furniture expenditure, Sleep time, Residence duration, Frequency of contact with relatives, Frequency of neighbor communication, Travel mode to entertainment places, Distance to nearest Kindergarten , Travel party to cinema and theatre, Frequency of going to sports facilities, Travel mode to cinema and theatre, Percentage of education expenditure, Distance to City hall , Distance to Supermarket
Number of rooms (75.70%)	Living area, Outdoor time use on non-weekday, Number of stories of residential building, Education level, Percentage of transport expenditure, Residence duration, Vehicle ownership, Distance to Supermarket , Percentage of education expenditure, House type, Frequency of contact with relatives, Percentage of energy expenditure, Household composition, Frequency of neighbor communication
Residence property (88.10%)	House type, Residence duration, Living area, Distance to Railway station , Number of rooms, Number of stories of residential building, Travel mode to amusement park, Percentage of transport expenditure, Distance to nearest Elementary school
Main travel mode (70.90%)	Commute mode, Indoor time use on weekday, Travel mode to sports facilities, Vehicle ownership, Frequency of having dinner with family, Education level, Occupation, Travel mode to cinema and theatre, Percentage of education expenditure, Travel mode to entertainment places, Household Annual income
Vehicle ownership (62.20%)	Household composition, Main travel mode, House type, Travel mode to amusement park, Living area, Percentage of furniture expenditure, Percentage of saving, Duration of tenure, Household Annual income, Number of rooms, Duration of non-contact sports, Expenditure on going home for a visit, Distance to nearest Post office , Frequency of neighbor communication, Number of stories of residential building, Percentage of transport expenditure

Table 4-3 Significant factors influencing the variables in Finance life

Dependent Variables	Predictors
Household Annual income (52.80%)	Household composition, Living area, Number of rooms, Percentage of saving, Percentage of furniture expenditure, Tourism expenditure, Percentage of housing expenditure, Residence duration, Travel party to cinema and theatre, Duration of tenure, Distance to nearest Kindergarten , Distance to nearest Post office , Tourism frequency

Percentage of food expenditure (34.30%)	Percentage of energy expenditure, Percentage of saving, Distance to nearest High school , Living area, Percentage of housing expenditure, Distance to City hall , Distance to Railway station , Percentage of clothes expenditure, Percentage of leisure expenditure, Frequency of neighbor communication, Household Annual income
Percentage of housing expenditure (28.20%)	Percentage of transport expenditure, Percentage of healthcare expenditure, Residence property, Vehicle ownership, Percentage of furniture expenditure, Distance to nearest Supermarket , House type, Frequency of contact with relatives, Percentage of clothes expenditure, Percentage of food
Percentage of energy expenditure (45.60%)	Percentage of transport expenditure, Percentage of furniture expenditure, Percentage of healthcare expenditure, House type, Distance to Railway station , Duration of tenure, Distance to Supermarket , Number of stories of residential building, Percentage of leisure expenditure, Household Annual income, Residence duration, Percentage of housing expenditure
Percentage of furniture expenditure (54.40%)	Percentage of clothes expenditure, Percentage of transport expenditure, Distance to nearest Hospital , Distance to nearest Kindergarten , Number of stories of residential building, Percentage of energy expenditure, Percentage of education expenditure, Percentage of food expenditure, Indoor time use on weekday, Distance to nearest Bus stop , The floor lived, Percentage of leisure expenditure, Residence property, Residence duration, Distance to nearest Post office
Percentage of clothes expenditure (52.80%)	Percentage of furniture expenditure, Percentage of transport expenditure, Distance to nearest Hospital , Vehicle ownership, Distance to nearest Secondary school , Percentage of housing expenditure, Percentage of healthcare expenditure, The floor lived, Occupation, Percentage of leisure expenditure, Percentage of food expenditure, Distance to nearest Park , Frequency of hobby learning, Number of Number of stories of residential building of residential building, Percentage of energy expenditure, Percentage of education expenditure
Percentage of healthcare expenditure (42.30%)	Percentage of transport expenditure, Percentage of clothes expenditure, Percentage of housing expenditure, Vehicle ownership, Percentage of food expenditure, Indoor time use on non-weekday, Household composition, Percentage of education expenditure, Leisure frequency
Percentage of transport expenditure (46.20%)	Percentage of healthcare expenditure, Percentage of energy expenditure, Education level, Percentage of clothes expenditure, Percentage of education expenditure, Travel party to cinema and theatre, Percentage of furniture expenditure, Frequency of contact with relatives, Distance to nearest Bus stop , Distance to nearest Park , Frequency of neighbor communication, Outdoor time use on non-weekday, Distance to nearest High school , Distance to nearest Kindergarten
Percentage of education expenditure (49.70%)	Percentage of transport expenditure, Household composition, Duration of hobby learning, Residence duration, Number of rooms, Percentage of food expenditure, Percentage of furniture expenditure, Residence property, Distance to nearest Bus stop , Frequency of neighbor communication
Percentage of leisure expenditure (43.70%)	Percentage of transport expenditure, Percentage of clothes expenditure, Percentage of food expenditure, Distance to nearest Park , Residence duration, Distance to nearest Kindergarten , Percentage of education expenditure, Distance to nearest Bus stop , Percentage of housing expenditure, Residence property, Commute mode

Percentage of saving (35.80%)	Percentage of leisure expenditure, Percentage of transport expenditure, Percentage of housing expenditure, Percentage of food expenditure, Percentage of furniture expenditure, Household Annual income, House type
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Table 4-4 Significant factors influencing the variables in Education/Learning life

Dependent Variables	Predictors
Education level (71.20%)	Commute mode, Household Annual income, Travel mode for hobby learning, Established holiday, Frequency of having dinner with family, Occupation, Number of rooms, Job type, Residence duration, Frequency of contact with relatives, Frequency of hobby learning, Health status, Sleep time
Frequency of language learning (98.40%)	Duration of language learning, Frequency knowledge learning, Percentage of healthcare expenditure, Duration of job training, Travel mode to racing facilities
Frequency knowledge learning (97.90%)	Duration of knowledge learning, Frequency of language learning, Percentage of transport expenditure, Travel mode to racing facilities, Frequency of going to sports facilities, Frequency of hobby learning, Frequency of job training
Frequency of hobby learning (96.60%)	Duration of hobby learning, Frequency of job training, Indoor time use on weekday, Duration at Amusement park, Distance to City hall , Working hours, Frequency of neighbor communication
Frequency of job training (96.80%)	Duration of job training, Travel mode for job training, Frequency of language learning, Commute mode, Education level, Duration of non-contact sports, Percentage of energy expenditure, Frequency of hobby learning, Sleep time, Frequency of neighbor communication, Health status
Travel mode for language learning (92.70%)	Travel mode for knowledge learning, Frequency of language learning, Distance to nearest Bus stop , Occupation, Travel mode to cinema and theatre, Duration of language learning
Travel mode for knowledge learning (91.60%)	Travel mode for language learning, Duration of knowledge learning, Travel mode for hobby learning
Travel mode for hobby learning (86.00%)	Travel mode for knowledge learning, Duration of hobby learning, Travel mode for job training, Vehicle ownership, Travel mode to cinema and theatre
Travel mode for job training (84.80%)	Duration of job training, Travel mode for knowledge learning, Residence duration, Duration of tenure, Duration of gentle sports, Main travel mode, Commute mode
Duration of language learning (94.20%)	Frequency of language learning, Duration of knowledge learning, Frequency of gentle sports, Frequency of having dinner with family
Duration of knowledge learning (92.60%)	Frequency knowledge learning, Duration of hobby learning, Percentage of healthcare expenditure

Duration of hobby learning (83.20%)	Frequency of hobby learning, Duration of knowledge learning, Travel mode for hobby learning, Duration of job training, Duration of contact sport, Distance to nearest Bus stop
Duration of job training (77.90%)	Frequency of job training, Travel mode for job training, Duration of hobby learning, Living area, Household Annual income, Working hours, Frequency knowledge learning, Occupation, Frequency of neighbor communication

Table 4-5 Significant factors influencing the variables in Employment life

Dependent Variables	Predictors
Occupation (69.90%)	Established holiday, workdays, Frequency of contact with relatives, House type, Living area, Working hours, Frequency of neighbor communication, Education level, Distance to nearest Secondary school , Duration of tenure
Job type (41.60%)	Occupation, Education level, Household Annual income, Established holiday, Expenditure on going home for a visit, Travel party to amusement park, Frequency of hobby learning, Frequency of neighbor communication, Commute mode
Commute mode (75.40%)	Main travel mode, Occupation, Travel mode for job training, Established holiday, Distance to nearest Park , Household Annual income
Duration of tenure (48.90%)	Occupation, Established holiday, Distance to nearest Hospital , Household Annual income, Vacation actually taken
Monthly workdays (60.00%)	Occupation, Vacation actually taken, Working hours, Frequency of hobby learning, Travel mode to cinema and theatre
Vacation actually taken (67.90%)	Established holiday, workdays, Frequency of going to cinema and theatre, Household composition, Residence property
Established Holiday (73.20%)	Vacation actually taken, Occupation, Distance to nearest Elementary school , Sleep time, Frequency of going to entertainment places, Duration of tenure, Internet usage frequency, Frequency of hobby learning
Working hours per day (51.10%)	Occupation, workdays, Frequency of having dinner with family

Table 4-6 Significant factors influencing the variables in Family and Social life

Dependent Variables	Predictors
Indoor time use on weekday (36.00%)	Indoor time use on non-weekday, Residence property, Frequency of having dinner with family, Frequency of neighbor communication, Working hours, Job type, Vacation actually taken, Outdoor time use on weekday, Residence duration, Occupation, Sleep time, workdays
Outdoor time use on weekday (72.50%)	Indoor time use on weekday, Outdoor time use on non-weekday, Travel mode to cinema and theatre, Duration of tenure, Frequency of neighbor communication, Sleep time, Indoor time use on non-weekday
Indoor time use on non-weekday (36.00%)	Indoor time use on weekday, Residence property, Outdoor time use on non-weekday, Education level, Distance to nearest Secondary school , Commute mode, workdays, Sleep time, Frequency of neighbor communication, Outdoor time use on weekday

Outdoor time use on non-weekday (46.30%)	Indoor time use on non-weekday, Outdoor time use on weekday, Leisure frequency, Duration at Amusement park, Residence duration, Frequency of going to amusement park, Percentage of housing expenditure
Frequency of having dinner with family (63.90%)	Indoor time use on weekday, Living area, Main travel mode, Established holiday, Sleep time, Frequency of contact with relatives, Frequency of neighbor communication, House type, Travel party to cinema and theatre, Education level, Number of rooms, Vehicle ownership, Travel party to sports facilities, Number of stories of residential building, Health status
Household composition (51.4%)	Indoor time use on non-weekday, Residence property, Health status, Percentage of education expenditure, Vehicle ownership, Frequency of neighbor communication, Number of rooms
Frequency of contact with relatives (25.80%)	Frequency of neighbor communication, Travel mode to amusement park, Living area, Tourism frequency, Commute mode, Leisure frequency, Number of rooms, Frequency of going home for a visit, Frequency of going to entertainment places, Education level, Frequency of going to amusement park, Percentage of leisure expenditure, Sleep time
Dependent Variables	Predictors
Frequency of neighborhood communication (77.50%)	Frequency of neighbor communication, Distance to nearest High school , Working hours, Occupation, Household composition, Sleep time, Percentage of saving, Residence duration, Commute mode, Duration of non-contact sports, Frequency of having dinner with family
Participation in community activities (79.00%)	Frequency of neighbor communication, Residence property, Duration at sports facilities, Frequency knowledge learning, Health status, Distance to Supermarket , Education level, Distance to nearest Hospital , Frequency of contact with relatives, Frequency of going to sports facilities, Percentage of education expenditure, Living area, Household composition, Percentage of energy expenditure, Number of stories of residential building, Travel party to amusement park

Table 4-7 Significant factors influencing the variables in Health life

Target Variables	Predictors
Sleep Time (61.20%)	Working hours, Occupation, Commute mode, Outdoor time use on weekday, Frequency of hobby learning, Frequency of gentle sports, Internet usage frequency, Education level
Frequency of contact sports (87.10%)	Duration of contact sport, Frequency of non-contact sports, Commute mode, Education level, Frequency of neighbor communication
Frequency of non-contact sports (78.80%)	Duration of non-contact sports, Frequency of contact sports, Frequency of going to amusement park, Frequency of going to sports facilities, Frequency of contact with relatives, Frequency of gentle sports, Frequency of job training
Frequency of gentle sports (62.60%)	Duration of gentle sports, Frequency of non-contact sports, Percentage of transport expenditure, Percentage of saving, Duration of contact sport, Sleep time, Travel party to entertainment places, Commute mode, Percentage of housing expenditure
Duration of contact sport (87.60%)	Frequency of contact sports, Duration at sports facilities, Duration at cinema and theatre, Travel mode for job training

Duration of non-contact sports (81.70%)	Frequency of non-contact sports, Duration at sports facilities, Duration at cinema and theatre
Duration of gentle sports (67.80%)	Frequency of gentle sports, Percentage of leisure expenditure, Duration of non-contact sports, Residence property, Percentage of energy expenditure

Table 4-8 Significant factors influencing the variables in Leisure/Recreation life

Target Variables	Predictors
Frequency of going to cinema and theatre (61.10%)	Travel party to cinema and theatre, Frequency of going to sports facilities, Travel party to amusement park, Travel mode to sports facilities, Distance to nearest Secondary school , Frequency of neighbor communication, Frequency of going to amusement park, Travel mode to cinema and theatre, Frequency of gentle sports, Travel party to racing facilities, Tourism expenditure
Frequency of going to sports facilities (75.80%)	Duration at sports facilities, Travel party to sports facilities, Travel mode to amusement park, Travel mode to amusement park, Frequency of going to entertainment places, Frequency of non-contact sports, Duration of non-contact sports, Frequency of going to amusement park
Frequency of going to amusement parks (61.80%)	Duration at Amusement park, Travel party to amusement park, Frequency of going to entertainment places, Duration of knowledge learning, Travel mode to cinema and theatre, Number of rooms, Frequency of going to cinema and theatre, Frequency of gentle sports, Travel mode to amusement park, Travel mode to amusement park, Frequency of neighbor communication
Frequency of going to entertainment places (72.50%)	Duration at entertainment places, Travel party to entertainment places, Travel party to amusement park, Frequency of going to sports facilities, Frequency of having dinner with family, Duration at Amusement park, Education level, Leisure expenditure, Duration of job training, Frequency of going to amusement park, Percentage of education expenditure
Frequency of going to racing facilities (93.60%)	Duration at racing facilities, Frequency of going to entertainment places, Frequency of having dinner with family, Travel mode to sports facilities
Travel mode to cinema and theatre (75.50%)	Travel party to cinema and theatre, Travel mode to entertainment places, Travel mode to amusement park, Residence property, Frequency of neighbor communication, Main travel mode, Vehicle ownership, Travel mode to sports facilities, Frequency of hobby learning, Frequency of going to cinema and theatre
Travel mode to sports facilities (82.70%)	Duration at sports facilities, Travel mode to racing facilities, Travel mode to amusement park, Travel party to amusement park, The floor lived, Travel mode to cinema and theatre, Main travel mode
Travel mode to amusement parks (82.10%)	Duration at Amusement park, Travel mode to entertainment places, Distance to nearest Secondary school , Travel party to amusement park, Travel party to sports facilities, Duration at cinema and theatre, Frequency of gentle sports, Travel mode to sports facilities, Travel mode to cinema and theatre, Commute mode
Travel mode to entertainment places (82.50%)	Travel party to entertainment places, Travel mode to cinema and theatre, Main travel mode, Travel mode to amusement park, Duration at entertainment places, Travel mode to racing facilities, Expenditure on going home for a visit
Travel mode to racing facilities (86.50%)	Frequency of going to racing facilities, Travel mode to sports facilities, Travel mode to entertainment places, Travel party to racing facilities, Duration at sports facilities, Frequency of neighbor communication

Duration at cinema and theatre (71.70%)	Frequency of going to cinema and theatre, Duration of non-contact sports, Travel mode to cinema and theatre, Travel party to cinema and theatre, Duration at sports facilities, Distance to Railway station , Distance to nearest Elementary school , Health status, Tourism expenditure
Duration at sports facilities (77.70%)	Frequency of going to sports facilities, Travel party to sports facilities, Duration at cinema and theatre, Travel mode to sports facilities, Duration at entertainment places, Vacation actually taken, Duration at Amusement park
Duration at amusement parks (76.70%)	Travel mode to amusement park, Frequency of going to amusement park, Distance to City hall , Frequency of going to cinema and theatre, Travel party to sports facilities, Residence duration, Travel party to amusement park, Duration at sports facilities, Occupation, Education level, Percentage of education expenditure, Travel mode to sports facilities
Duration at entertainment places (77.40%)	Frequency of going to entertainment places, Travel party to entertainment places, Duration of gentle sports, Travel mode to entertainment places, Occupation, Education level, Percentage of transport expenditure
Duration at racing facilities (98.30%)	Frequency of going to racing facilities, Travel mode to racing facilities, Duration at cinema and theatre, Number of stories of residential building, Distance to Railway station , Duration at entertainment places, Frequency of neighbor communication
Travel party to cinema and theatre (76.80%)	Frequency of going to cinema and theatre, Indoor time use on non-weekday, Travel party to amusement park, Living area, Travel mode to cinema and theatre, Duration of non-contact sports, Frequency of hobby learning, Travel party to entertainment places, Outdoor time use on non-weekday, Occupation
Travel party to sports facilities (80.70%)	Frequency of going to sports facilities, Travel party to racing facilities, Duration at sports facilities, Travel mode to sports facilities, Frequency of having dinner with family, Travel party to amusement park, Percentage of transport expenditure, Travel party to cinema and theatre
Travel party to amusement parks (81.60%)	Frequency of going to amusement park, Travel party to cinema and theatre, Travel mode to cinema and theatre, Travel party to racing facilities, Travel mode to amusement park, Frequency of going to entertainment places, Indoor time use on weekday, Travel mode to racing facilities, Travel party to entertainment places, Duration of tenure
Travel party to entertainment places (79.30%)	Frequency of going to entertainment places, Travel party to cinema and theatre, Outdoor time use on non-weekday, Travel party to amusement park, Travel party to racing facilities, Travel mode to entertainment places, Duration at sports facilities, Duration of gentle sports, Duration at entertainment places
Travel party to racing facilities (93.20%)	Frequency of going to racing facilities, Travel party to entertainment places, Travel party to sports facilities, Duration at entertainment places, Travel mode to sports facilities, Frequency of hobby learning, Travel mode to entertainment places, Duration of knowledge learning, Travel party to amusement park
Internet usage frequency (85.6%)	Internet usage time, Education level, Outdoor time use on weekday, Duration at Amusement park, Frequency of contact with relatives, Percentage of transport expenditure, Leisure frequency, Frequency of hobby learning, Frequency of going to entertainment places
Internet usage time (32.40%)	Internet usage frequency, Travel mode to entertainment places, Health status, Education level, Travel party to cinema and theatre, Indoor time use on weekday, Duration of job training, Duration at cinema and theatre, Percentage of education expenditure, Frequency of neighbor communication, Vehicle ownership, Frequency of neighbor communication, Frequency of contact with relatives, Percentage of clothes expenditure, Residence property
Leisure frequency (37.50%)	Tourism frequency, Travel mode to amusement park, Frequency of going to amusement park, Duration of job training, Percentage of leisure expenditure, Travel mode to amusement park, Indoor time use on non-weekday, Outdoor time use on non-weekday, Duration of non-contact sports, Sleep time

Tourism frequency (61.60%)	Tourism expenditure, Occupation, Frequency of having dinner with family, Outdoor time use on weekday, Frequency of hobby learning, Frequency of job training, Leisure frequency, Percentage of furniture expenditure
Frequency of going home for a visit (70.30%)	Expenditure on going home for a visit, Number of stories of residential building, Percentage of energy expenditure, Occupation, Distance to nearest Elementary school , Leisure frequency, Residence property, Sleep time, Distance to nearest Park
Leisure expenditure (78.40%)	Tourism expenditure, Duration at Amusement park, Percentage of leisure expenditure, Frequency of contact with relatives, Percentage of education expenditure, Travel mode to amusement park, Living area, Travel party to sports facilities, Household Annual income, Household composition, Frequency of neighbor communication, Outdoor time use on non-weekday, House type
Tourism expenditure (70.50%)	Travel party to amusement park, Education level, Duration of knowledge learning, Indoor time use on non-weekday, Frequency of gentle sports, Household Annual income, Frequency of contact with relatives, Household composition, Established holiday, Sleep time, Frequency of having dinner with family, Travel party to cinema and theatre, Frequency of going to amusement park
Expenditure on going home for a visit (68.50%)	Residence duration, Distance to City hall , Distance to nearest Park , Percentage of saving, Duration at Amusement park, Duration of gentle sports, Distance to nearest Elementary school , Travel mode to amusement park, Frequency of neighbor communication, Education level, Frequency of job training, Occupation, Frequency of contact with relatives, Percentage of furniture expenditure, Frequency of neighbor communication, Sleep time

Table 4-9 Significant factors influencing happiness

Target Variables	Predictors
Happiness (79.2%)	(1) percentage of saving (30.80%), (2) travel party to amusement parks (12.78%), (3) household annual income (10.76%), (4) tourism frequency (8.73%), (5) distance to park (7.93%), (6) duration of gentle sports (5.12%), (7) frequency of contact with relatives (0.11%), (8) frequency of neighborhood communication (0.07%), (9) percentage of leisure expenditure (0.02%)
Bad mood during leisure activities (71.3%)	(1) indoor time use on weekday (18.25%), (2) frequency of contact with relatives (11.92%), (3) percentage of leisure expenditure (10.61%)
Mildly pleasant mood during leisure activities (69.4%)	(1) duration at racing facilities (34.19%), (2) household annual income (24.19%), (3) frequency of neighborhood communication (14.19%), (4) main travel mode (11.76%), (5) leisure expenditure (8.99%), (6) residence property (7.93%), (7) outdoor time use on holiday (5.701%), (8) percentage of clothes expenditure (4.39%), (9) duration of job training (2.32%), (10) distance to bus stop (2.02%)
Good mood during leisure activities (86.2%)	(1) duration at cinema and theatre (32.68%), (2) percentage of transport expenditure (20.48%), (3) residence property (10.40%), (4) duration of language learning (8.30%), (5) internet usage time (5.08%), (6) frequency of job training (2.03%)
Bad mood during family life (75.5%)	(1) percentage of education expenditure (4.32%), (2) travel party to amusement parks (3.71%), (3) percentage of transport expenditure (2.25%), (4) percentage of food expenditure (1.16%), (5) distance to city hall (1.08%)

Mildly pleasant mood during family life (63.1%)	(1) indoor time use on holiday (12.75%), (2) leisure expenditure (12.50%), (3) duration of hobby learning (10.33%), (4) distance to railway station (9.87%), (5) frequency of contact with relatives (1.58%), (6) duration of contact sports (1.03%), (7) frequency of neighborhood communication (0.08%), (8) duration at cinema and theatre (0.03%)
Good mood during family life (66.3%)	(1) travel party to amusement parks (12.22%), (2) tourism frequency (12.01%), (3) percentage of healthcare expenditure (0.71%), (4) indoor time use on holiday (0.10%), (5) living area (0.004%)
Bad mood during job (63.5%)	(1) occupation (8.20%), (2) indoor time use on weekday (5.37%), (3) education level (1.93%), (4) vacation taken (1.13%), (5) residence property (0.10%), (6) distance to supermarket (0.08%), (6) frequency of going to cinema and theatre (0.003%)
Mildly pleasant mood during job (62.5%)	(1) occupation (7.60%), (2) frequency of gentle sports (4.47%), (3) duration at amusement parks (0.44%), (4) percentage of others expenditure (0.23%), (5) frequency of going to cinema and theatre (0.17%), (6) frequency of neighborhood communication (0.14%)
Good mood during job (61.1%)	(1) occupation (3.21%), (2) distance to city hall (3.00%), (3) distance to railway station (2.78%), (4) frequency of going to cinema and theatre (2.60%), (5) internet usage time (2.40%), (6) residence duration (0.17%), (7) vacation taken (0.14%)
Bad mood during social communication (63.3%)	(1) education level (30.34%), (2) percentage of education expenditure (15.20%), (3) outdoor time use on holiday (10.20%), (4) travel party to cinema and theatre (9.19%), (5) internet usage frequency (7.12%), (6) internet usage time (2.32%), (7) frequency of neighborhood communication (0.03%), (8) residence duration (0.002%)
Mildly pleasant mood during social communication (63.4%)	(1) frequency of neighborhood communication (18.98%), (2) tourism frequency (9.37%), (3) residence property (1.24%), (4) percentage of food expenditure (1.06%), (10) distance to bus stop (1.02%)
Good mood during social communication (60.4%)	(1) frequency of neighborhood communication (21.28%), (2) indoor time use on holiday (15.27%), (3) frequency of going to entertainment places (3.03%), (4) distance to high school (1.97%), (5) frequency of gentle sports (1.02%), (6) travel party to amusement parks (0.94%), (7) travel party to entertainment places (0.02%), (8) residence duration (0.009%)

Note:

1. The value in the parenthesis after each target variable shows the accuracy of decision tree split based on the Exhaustive CHAID approach, and the value in the parenthesis after each predictor is the variance reduction (VR) calculated from the BNN model.

2. The bold predictors are influential residential and travel behavior variables for the target variables.

Table 4-10 Significant factors influencing life satisfaction

Dependent Variables	Predictors
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Life Satisfaction (72.9%)	(1) vehicle ownership (28.5%), (2) main travel mode (21.1%), (3) occupation (19.13%), (4) outdoor time use on non-weekday (12.56%), (5) distance to bus stop (4.4%), (6) commute mode (2.7%), (7) frequency of going to cinema and theatre (1.92%), (8) distance to railway station (0.9%), (9) distance to sports facilities (0.551%), (10) distance to city hall (0.49%), (11) distance to park (0.389%)
Satisfaction with Residence (73.5%)	(1) main travel mode (33.3%), (2) distance to kindergarten (11.8%), (3) distance to secondary school (10.4%), (4) vehicle ownership (11.03%), (5) distance to station (1.27%), (6) distance to bus stop (0.82%), (7) travel mode to cinema and theatre (0.23%), (8) internet usage time (0.21%), (9) monthly workdays (0.18%), (10) distance to city hall (0.08%), (11) frequency of neighborhood communication (0.06%)
Satisfaction with Finance (68.9%)	(1) percentage of saving (30.9%), (2) frequency of going to cinema and theatre (15.4%), (3) vehicle ownership (9.74%), (4) occupation (8.95%), (5) main travel mode (2.11%), (6) distance to railway station (1.83%)
Satisfaction with Health (75.6)	(1) travel mode to sports facilities (23.8%), (2) frequency to sports facilities (19.4%), (3) commute mode (1.28%), (4) occupation (1.02%), (5) main travel mode (0.54%)
Satisfaction with Social (80.9%)	(1) frequency of neighborhood communication (28.1%), (2) travel mode to park (23.6%), (3) frequency to park (20.3%), (4) travel mode to sports facilities (18.7%), (5) distance to park (3.49%), (6) distance to sports facilities (2.34%), (7) occupation (1.12%)
Satisfaction with Education/Learning (71.2%)	(1) outdoor time use on non-weekday (20.34%), (2) distance to community center (10.44%), (3) percentage of education expenditure (9.12%), (4) monthly workdays (5.67%), (5) distance to high school (3.12%), (6) distance to kindergarten (1.63%), (7) vehicle ownership (1.11%)
Satisfaction with Job (82.1%)	(1) vehicle ownership (10.4%), (2) tourism frequency (7.61%), (3) commute mode (5.59%), (4) distance to station (4.32%), (5) distance to bus stop (4.20%), (6) job type (1.01%)
Satisfaction with Family Life (82.3%)	(1) indoor time use on weekday (26.8%), (2) main travel mode (12.90%), (3) frequency of going to cinema and theatre (1.92%), (4) vehicle ownership (0.78%); (5) frequency to park (0.51%), (6) frequency to sports center (0.045%)
Satisfaction with Leisure/Recreation (65.3%)	(1) outdoor time use on non-weekday (30.3%), (2) distance to park (15.04%), (3) distance to station (12.52%), (4) main travel mode (6.23%), (5) distance to sports facilities (5.01%), (6) frequency of contact with relatives (3.12%), (7) frequency to park (0.51%)

4.1.4 Conclusion

The relevance of people's life choice (i.e., the global decision) to their quality of life and limited studies suggest that previous research have just scratched the surface of the whole sphere and must make efforts for achieving more sound and robust conclusions to support actual policy decisions on the integration of land use and transportation systems. As an additional effort, this study proposed to develop a life-oriented approach to re-examine the land use and transport planning issues by explicitly and systematically incorporating various behavioral interdependencies across a broader set of life domains. Both Exhaustive CHAID approach and Bayesian belief network approach have been successfully confirmed to be the promising tools to capture and quantify complex behavioral interdependencies between residential choices, travel behavior, and quality of life, after controlling for the effects of other life choices linked with various life domains. This is done based on a life choice survey data collected from residents in various hierarchical Japanese cities in 2010, which was originally collected as one of fundamental surveys for the life-oriented approach. The life-oriented analysis provides a foundation for the purpose of this study. Findings are summarized below.

First, it is confirmed that the life choices (decisions) relevant to various life domains are interdependent with each other.

Second, the two-way relationship between residential choice, travel behavior and other life choices was examined. The results showed that the residential choices (residential environment, housing aspects) and travel behavior (travel frequency, mode choices, travel party, activity time) are influenced by other life choices related to each life domain conversely and to varying degrees. Accordingly, it is revealed that to consider the land use and transport policies that pursue higher people's QOL via residential and travel behavior in isolation is of importance. Therefore, considering the residential choices and travel behavior are just a part of people's life decisions (choices) and it is worth supporting transport and land use decisions from an integrative and holistic viewpoint. Thereby, after embedding relevant other life choices,

such as social and leisure related decisions, into the integrated land use and transport system, the effect of land use and transport on people's QOL should be re-considered and re-evaluated.

Thirdly, it is successfully identified the kind of life choices which affect people's quality of life, further quantified those effects. Some interesting findings are illustrated here:

- Income only influences happiness and experiences of mildly pleasant moods during leisure activities, but it is not the most influential factor for both.
- Saving is the most important factor for enhancing people's happiness, while vehicle ownership is the primary factor for improving people's life satisfaction.
- Usage of one's free time outside work improves happiness, however, the land use attributes and travel behavior play a vital role in life satisfaction attainment.
- Education only contributes to experiences of negative affect during one's job, family life, and social communication.
- The effects of different types of expenditure and residence-related life choice variables on happiness are mixed. However, most residence-related and leisure, social, family life related life choice variables are related to experiences of positive affect.
- Only the distance to the nearest park influence people's happiness, while distance to bus stop, railway station, sports facilities and city center have effect on people's life satisfaction.
- Engaging in more family life activities, leisure activities and social activities, which are important to happiness and life satisfaction improvement.

Finally, the results analyses provide valuable policy implications. It is revealed that people who choose to live closer to the daily facilities (public railway station, bus stop, city centre, school and so on) tend to have pleasant moods in each life domain. That is, geographic scales matter to levels of happiness, reflecting the strong positive association between closeness to city center and more employment chances, between convenient transit availability and more trips achievement, between closeness to school and higher education and learning enthusiasm.

People with higher leisure activity opportunities are having better social feelings and more satisfied with most life domains.

Therefore, it is concluded that impacts of land use and transport policies on quality of life can be properly captured by making better use of the ideas of life-oriented approach. In future, integrated behavior analysis covering various life domains should be developed to support evidence-based land use and transport policy decisions. Accordingly, it is expected that the life-oriented approach could pave a new way on further exploring the land use and transport issues.

4.2 Panel Analysis

4.2.1 Introduction

Achieving an improvement in people's QOL is identified as a goal of many contemporary planning endeavors and has become central to the formulation of land use and transport policies (Lotfi and Solaimani, 2009). Promoting urban people's QOL is also regarded as a meaningful way to evaluate urban development and social progress. People's QOL can be roughly captured from the essential life choices involving relevant travel behavior and the following life domains: residence, social, health, education, employment, family life, finance and leisure and recreation life (Knox, 1975; Zhang, 2014). The different life choices are usually decided over different time scales under the influence of time and monetary constraints and the various needs of households and their members (Zhang et al., 2012). Therefore, after embedding relevant other life choices, such as social- and leisure-related decisions, into the integrated land use and transport system, the effect of land use and transport on people's QOL should be reconsidered and re-evaluated. Particularly, over time, changes in residence/workplaces or vehicle ownership may have a significant impact on urban people's present/prospective QOL. Considering residential choices and travel behavior are just a part of people's life choices and the effects of land use and transport policies on people's QOL may not be significant after controlling for the intervention of other life choices. Based on the above considerations, a systematic investigation of various life choices, including residential choices and travel behavior, as well as QOL, especially from a dynamic viewpoint, is important. However, many links between essential life choices and QOL, embedded into land use and transport planning, are still scarce, particularly from a dynamic or long-term perspective.

This chapter aims to examine the changes of other life choices into the dynamic interdependencies among residential choices, travel behavior and QOL based on an analysis of panel data from Japan. To do this, this part examines 1) the effects of the determinant factors of people's QOL from a dynamic viewpoint and 2) the effects of changes in socio-demographics over time (individual attributes and changes of life events). Consistent with numerous other studies, this part examines gender and age, and changes in education level, annual income, employment status and household structure. Further, this part explores residential location choices and housing attribute choices, which are measured by distances to important public facilities, such as the nearest bus stop. Travel behavior is defined by vehicle ownership and the main travel modes for various activities. Other life choices are represented by the decisions made in the domains of health (i.e., time playing sports such as golf), social (i.e., frequency of participation in community activities), family life (i.e., time spent with family members), finance (i.e., household income allocation on the transport cost), education and learning (i.e., education level) and leisure and recreation life (i.e., time spent at entertainment facilities). Moreover, people's QOL is measured by life satisfaction and happiness as a whole. There are three main policy implications of this study. First, knowing the critical factors of life choices on people's QOL from a dynamic viewpoint helps understand people's prospective QOL, which can further guide and regulate their current life decisions to attain a higher level of QOL. Second, clarifying the influences of residential choices and travel behavior on other relevant life choices allows one to better evaluate the effects of land use and transport policies by explicitly incorporating policy outcomes into the evaluation process. Third, this study can inform policy makers about how people's QOL might be altered in response to new transport/urban strategies.

4.2.2 Methodology

A Structural Equation Model (SEM) was developed in this study. SEM is a very powerful tool and is increasingly being used in travel behavior research (Golob, 2003). A complete SEM consists of two components: the structural component and the measurement component. These components are defined by three sets of equations: structural equations, measurement equations for endogenous variables, and measurement equations for exogenous variables. This study includes both of the components and thus a full SEM model. There are several measures employed to assess the goodness-of-fit in SEM. However, in most cases the fit measures do not agree (Fabrigar et al., 2010). Some take parsimony into account and others do not. Based on that, fit indices can be divided into general goodness of fit indices and parsimony fit indices. The first category indices show, roughly speaking, whether the model fits the data better than any other model. Parsimony fit indices address the issue that the model may only be fitting the noise of the data and will not be representative for population-wide application. However chi-square is an essential statistic to report along with the Root Mean Square Error of Approximation (RMSEA) and associated p-value (Hooper et al., 2008). Given the sensitivity of chi-square to model misspecification, additionally Standardized Root Mean square Residual (SRMR) is reported. To represent a good fit the value of SRMR should be less than 0.05 although values up to 0.08 are considered acceptable (Hooper et al., 2008). RMSEA value should be less than 0.05 to indicate a good fit (Golob, 2003; Washington et al., 2009). Given the complexity of the model, I assessed the model fit on the aforementioned two indices.

4.2.3 Model estimation

4.2.3.1 Data description

Using the life-oriented approach discussed in the previous section, this chapter has two main purposes. First, from the static viewpoint, main purpose is to examine the determinant life choices and quantify the corresponding effects on people's QOL. Second, from the dynamic viewpoint, main purpose is to explore whether, and to what extent, the present QOL and present life choices are affected by life decisions made in the past. Accordingly, this part used web-based, two-wave panel survey data from a survey conducted in 2010 and 2014 of 422 respondents from different levels of cities in Japan. The survey contains numerous life choice variables covering relevant travel behavior and eight life domains: residence, health, social,

Table 4-11 The sample characteristics of the two-wave panel survey data in 2010 and 2014

Variables	Classes	N=422 (%)	
		2010	2014
Gender	Male	56.64	56.64
	Female	43.36	43.36
Age	0-17	0.95	0
	18-34	18.72	10.90
	35-54	56.87	56.16
	55-64	10.66	15.17
	>=65	12.8	17.77
Education Level	With Bachelor Degree, or over	52.13	71.33
	No Bachelor Degree	47.87	28.67
Household Annual Income (Unit: million Yen)	Low (<200)	6.40	7.11
	Medium (200-599)	49.05	47.39
	High (>=600)	44.55	45.50
Employment Status	With Full/Part-time Job	69.67	71.56
	Housewife/Students/No Job	30.33	28.44
Household Structure	Single	18.48	19.67
	Two People	27.01	26.54
	Three People	21.80	20.38
	Four People or Over	32.69	33.41

education and learning, employment, family life, leisure and recreation and finance. The selected socio-demographic variables include personal and household characteristics, as shown

in Table 4-11. Results indicate that in both samples, males are slightly overrepresented, and most respondents are middle-aged, from 35 to 54 years old. Additionally, the percentages of higher education attainment, high household annual income and job participation increased among samples in 2014 from 2010 to varying degrees.

4.2.3.2 Conceptual Framework and Explanatory variables

Further a structural equation model was employed to represent the dynamics of residential choices, travel behavior, other life choices and QOL, after controlling for the effects of changes in socio-demographics (in addition to age and gender, mainly including the changes in key life events) over time. The proposed structural model takes state dependence of all life choices into account. Overall, it is assumed that the present residential choices, travel behavior, other life choices and QOL are influenced by decisions made in the past. In particular, the current residential choices (travel behavior), in addition to the effects of changes in socio-demographics over time, are not only affected by the past corresponding residential choices, but are also influenced by the past travel behavior and past other life choices. Further, the present other life choices are not only influenced by the current residential choices, travel behavior and changes in socio-demographics, but also the past residential choices, travel behavior and the past corresponding choices. Most importantly, it is anticipated that the present QOL, and the effects of changes in socio-demographics, which is propelled by present and past life choices, are simultaneously boosted by the past QOL. The conceptual framework is presented in Figure 4-1.

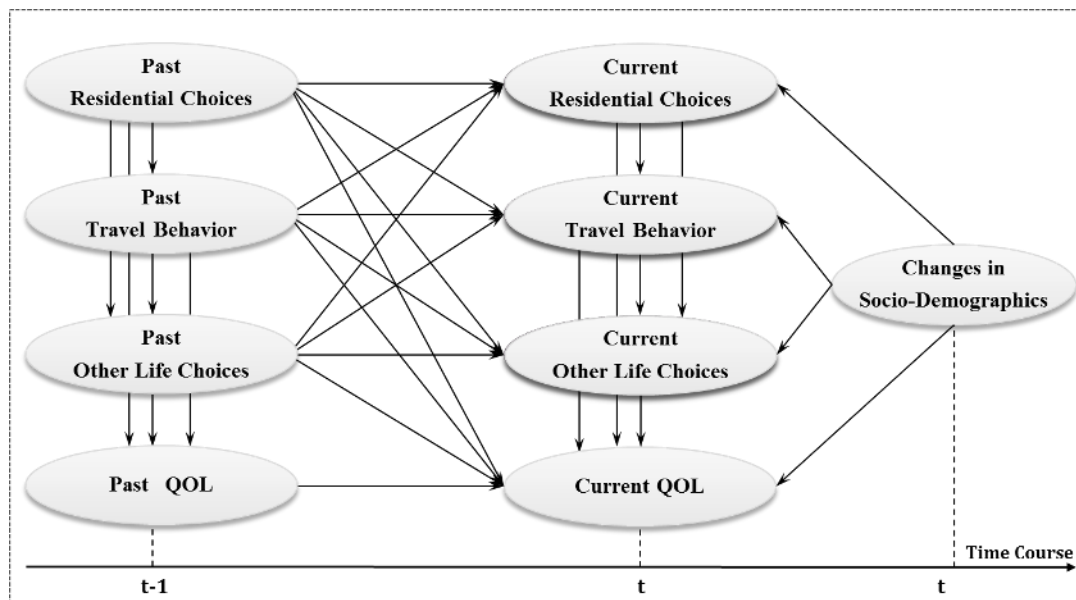


Figure 4-1 The Conceptual Framework of Panel Data Analysis between 2010 and 2014

The expected contribution of this study to the literature is to present and verify a conceptual framework of embedding the dynamics of other life choices into the dynamics of residential choices and travel behavior, which are essential to the representation of the higher QOL achievement as a whole. Specifically, questions related to life choices are addressed in the nine dimensions that are linked to the people's QOL: residence, health, social, education and learning, employment, family life, leisure and recreation, finance and relevant travel behavior. The residential choices include residence location choice and housing attribute choice, which were investigated by distances to different important public facilities, such as the city hall (city center) and the nearest bus stop, housing type, dwelling duration and tenure (ownership, rent). Travel behavior is defined by vehicle ownership and main travel mode choices to various facilities.

Particularly, as time goes on, the current QOL is expected to be shaped by the past QOL. Herein, the people's QOL is measured by life satisfaction and happiness, and therefore, it is essential to obtain the data represented for both of them. Specifically, for life satisfaction data, I asked respondents how satisfied they are with life as a whole and each life domain as well, showing the corresponding answers according to 1 to 5 points (1=very dissatisfied to

5=very satisfied). In terms of happiness data, survey asked respondents how happy they are currently, choosing the corresponding levels from 0-10 (0=very unhappy to 10= very happy). Therefore, I obtained more than 140 variables in total. Zhang et al. (2014) provides details of data content. As for the analysis method, a structural equation model with latent variables was built to capture the complicated interdependencies between QOL, residential choices and travel behavior by explicitly incorporating the influence of other life choices over time. Based on the Chi-square test results of life choice variables in 2010 and 2014, this study selected the significantly different variables for model analysis. The Chi-square test results are shown in Table 4-12, and only statistically significant variables are presented and described.

Table 4-12 The Chi-square test results of the two-wave panel life choices variables in 2010 and 2014

Variables	Pearson Chi-Square	Asymp. Sig. (2-sided)
<i>Socio-Demographics</i>		
Education Level (Bachelor=1,0)	32.906	***
Employment Status (With job=1,0 ¹)	0.365	**
Household Annual Income ²	4.372	***
Household Structure (No. of Family Members)	4.968	***
<i>Other Life Choices</i>		
Percentage of Household Transport Cost	18.254	**
Frequency of Family Meals Weekly	36.772	***
Frequency of Community Activity Participation	22.731	***
Time Use in Amusement Park Daily	12.787	**
Time Use in Doing Gentle Sports Daily (e.g. golf)	16.823	**
<i>Residential Choices</i>		
Distance from the City Hall (city center) within 1 km (Yes=1,0)	1.639	*
Distance from nearest Bus Stop within 0.5 km (Yes=1,0)	2.511	**
Distance from nearest Railway Station within 1 km (Yes=1,0)	0.484	*
Residence Duration (Years you lived in the current house)	51.235	**
Residence Type (Living in the Apartment=1, 0 ³)	0.801	*
Residence Property (Own=1,0)	1.708	**
<i>Travel Behavior</i>		
Household Vehicle Ownership	3.484	**
Main Travel Mode is Public Transit (Yes=1,0)	1.914	**
Main Travel Mode is Car (Yes=1,0)	0.324	*
Main Travel Mode is Walking/Cycling (Yes=1,0)	0.331	**

Note:

¹ The value of 'Zero' refers to the resident without job, housewives and students.

² Household annual income level: 1: <1, 2: 1 ~2, 3: 2 ~ 3, 4: 3 ~ 4, 5: 4 ~ 5, 6: 5 ~ 6, 7: 6 ~ 7, 8: 7 ~ 8, 9: 8 ~ 9, 10: 9 ~ 10, 11 :10 ~ 15, 12: >15 (unit: 1 million Yen).

³ The value of 'Zero' associate with 'residence type' refers to the resident live in the detached house or other types.

* Significant at the 90% level; ** significant at the 95% level; *** significant at the 99% level.

4.2.4 Estimation Results

Maximum likelihood estimation procedure based on the software AMOS 20.0 is used for the above structure equation model analysis. The estimated results are discussed in this section, where the direct, indirect and total effects of exogenous variables on endogenous variables are described, in the discussion on the effects of endogenous variables. Table 4-13 shows the results of the interdependencies of socio-demographics, residential choices, travel behavior, other life choices and quality of life (QOL) between 2010 and 2014. The goodness-of-fit measures reveal that the model is acceptable (GFI=0.699, AGFI=0.652, and RMSEA=0.016). The parsimony indicator (PNFI=0.556) also indicates that the models have a modest applicability (Sharmeen et al. 2014). In Figure 4-1, here assumed 29 direct effects among latent variables, 16 out of the 29 direct effects are statistically significant. Corresponding to those insignificant direct effects, 2 indirect effects are found to be significant. The estimated results consistently support our main assumed conceptual structure.

Firstly, from the static view, offering insights into the direct and indirect effects on the past QOL, the result found that the past other life choices (-0.276) has a prominent direct effect on it, compared with the past residential choices (0.158). Indirectly, the estimation results discovered that the past travel behavior (0.033) generates primary influence on the past QOL, which represented that the effect of travel behavior on QOL may mediated by other life choices. It is implied that ignorance of reflecting other life choices relevant to key life domains such as health and leisure, emphasizing the straightforward impacts of transport policies on QOL may not be fruitful as people's QOL is affected by other life choices rather than changes in transport situations. Secondly, from the dynamic view, as time goes on, looking at the significant direct and indirect effects on the current QOL, the results also successfully captured that the past QOL (0.826) directly contributes a dominant influence, followed by past other life choices (-0.409),

current other life choices (0.316), past travel behavior (-0.141), changes in socio-demographics (0.084), current residential choices (0.083), past residential choices (-0.045) and current travel behavior (0.031). Indirectly, it also obtained some statistically significant effects of past residential choices (0.148) and past travel behavior (0.105). It can be seen that current QOL is contributed to by the past QOL, and the results further found that the effects of other life choices play a prominent role in people's QOL both in the past and in the future. It is suggested that more and more residents are placing greater emphasis on the leisure, social, family, health oriented communications, on a pathway to their overall QOL enhancement. The result dynamically reflected that other life choices, besides residential choices, travel behavior and socio-demographics, contribute to the current QOL improvement. Therefore, not taking account of life choices comprehensively and longitudinally may lead to bias on the way from land use and transport policies to the QOL enhancement.

4.2.4.1 Changes in Socio-demographics and QOL

Offering the sights into the six indicators of the latent variable of changes in socio-demographics, the results depicted that the changes in socio-demographics are mainly featured by the life events change variables such as changes of the household annual income (0.717), followed by changes of household structure (0.61), changes of education level (0.233) and changes of employment status (0.207), as well as a current individual attribute such as age (-0.186). Further, from the total effects, the results showed that changes in socio-demographics has considerable influences on current residential choices (-0.271) and current QOL (0.05). Specifically, from the positive signs of changes in socio-demographics on current QOL and the above sample characteristics, the results show that the level of people's QOL could be enhanced if they improve their education level, dedicate themselves to one career, change their household

annual income and household structure, meaning that QOL oriented life style may trigger the occurrences of life events. However, due to the data and model limitations here, this paper may not offer specific details that how the residents change their household structure such as giving birth to a baby or changes in household annual income, could improve their level of QOL. Moreover, the results reflected that in response to the people's education level changes, household annual income changes, employment status changes and household structure changes, they prefer to locate in a rental apartment which is closeness to the city center with good accessibility to transit, instead of owning a detached house. This type of residential choices is good for the people's QOL improvement with life events changes. However, this trend will decrease with age. This is implied that to some extent changes of key life events have an impact to explain the QOL enhancement. Life domains and life events should be considered together, which is in line with the idea of Scheiner (2014).

4.2.4.2 Residential Choices and QOL

At a single time period, turning first to the six indicators of residential choices in the past, the residential choices are represented by people's decisions on the housing attributes and residential location/environment characteristics. Just in accordance with the idea of Chen et al. (2008), trade-offs between housing qualities and property, activity opportunities, and transport accessibility have long been recognized as fundamental considerations in both the decision to move and the selection of a residence. In details, residence property (0.767) is a prominent factor to characterize the people's residential choices, followed by the residence type (0.718) referring to apartment or detached house, as well as location/environment choices such as distance to the nearest bus stop within 0.5km (0.698), distance to the nearest railway station within 1km (0.275) and distance to the city center within 1km (0.165). It is implied that the

high-density and transit-oriented residential environment are crucial to the people's residential location choices. And the above findings are slight different with the results in 2014. Similarly, the present people's residential choices are also largely characterized by decisions on the housing attributes, compared with decisions on the residential location/environment. However, residence type (0.703) plays a dominant role, besides residence property (0.692), residence duration (0.442) also characterizes the people's residential choices, followed by distance to the nearest railway station within 1km (0.324) and distance to the city center within 1km (0.25). In contrast, distance to the nearest bus stop within 0.5km failed to represent the decision on the current people's residential choices. It is implied that currently compared with access to bus stop, the residents care more about the accessibility to the railway stations. Further looking at the magnitudes of effects from the latent variable of past residential choices, it generates significant direct impacts on past QOL (0.158) and significant indirect effects on past other life choices (0.006). Specifically, as for the considerable total impact of residential choices on other life choices, the result examined that residents living in their own apartment, closeness to the city center, railway stations and bus stops, the less transport expenditure, the more frequently for having dinner with their family members and going to the amusement park, the more engagement in the community activities, it is beneficial for their family, leisure and social life enhancement. It is depicted that the compact and diversity land use planning is good for the people's leisure, social and family life, so as to make residents more satisfied and happy. Therefore, the findings suggested that the land use policies aiming to directly improve people's QOL by changing housing situations or relocate the residence may not be fruitful due to the mediate effects of other life domains such as leisure. Next, providing the insights into the latent variable of current residential choices, it only partially captured the significant direct effects on the current QOL (0.083). It is illustrated that both in the past and current, living in the high-density or transit oriented land use pattern, especially with different kinds of facilities, the

residents feel more satisfied and happier with their different life domains. Surprisingly, neither past nor present, after controlling for the influence of other life choices over time, the consistently observed influence of residential choices on travel behavior in literature cannot be observed in this case study. This suggests that the observed influence of residential choices on travel behavior in literature may be spurious because of the ignorance of the other life choices and consequently re-confirms the necessity and importance of the life-oriented approach. Then, more detailed and comprehensively research is required.

Dynamically, switching to the impacts of the past residential choices on the current life choices and current QOL, it is depicted that the past residential choices only have a significant direct effect on current residential choices (0.114) and current QOL (0.045), significant indirect effects on current QOL (0.303), have no significant effect on the current travel behavior and other life choices. In details, as for the considerable total effect of past residential choices on current residential choices, the result demonstrated that with time goes on, the resident still prefer the similar housing attributes and residential environment, maybe due to the inertia. Most importantly, it is interestingly to note that the past residential choices exists the effect of future expectation on prospective QOL attainment. Living in the high-density or transit oriented land use pattern in the past, as time goes on, the residents still feel more satisfied and happy.

4.2.4.3 Travel Behavior and QOL

To inspect the four indicators of travel behavior in the past, main travel mode by walking/cycling (0.924) is playing a dominant role in characterizing the people's travel behavior, followed by main travel mode by car (0.678), main travel mode by public transit (0.39) and household vehicle ownership (0.382). It is in line with the finding at present, it is slightly different due to trivial effects of current household vehicle ownership. It is showed that

car acquisition played an important role in the people's travel mode choices in the past. Statically, looking at the total impacts of past travel behavior, it only has significant effect on past other life choices (0.12) and past QOL (0.078), has no effect on past residential choices. In details, it is found that the residents own more vehicles and take more trips by car, the more household income is allocated on transport costs. On the contrary, the residents choose to walk/cycle more, travelling more by public transit, the higher likelihood to engage in more community activities and health oriented sports activities, further beneficial for higher QOL attainment. That is consistent with the findings of current travel behavior, walking/cycling more, using public transit more particularly driving less make residents happier and more satisfied. Dynamically, the past travel behavior has significant and concordant influence on the current travel behavior (0.525), less influences on current residential choices (0.094) and current QOL (-0.036). Specifically, in terms of the effects of past travel behavior on current residential choices, it is indicated that the residents prefer car use to public transit or active transport (walking and cycling) use, they will feel more happy and satisfied if residing far away from the city center with disperse land use patterns for conveniently driving, as well as owning the detached houses. On the other hand, the residents who like walking/cycling out and travelling out by public transit, they will feel more satisfied and happy if living in the high-density and transit oriented neighborhoods, even renting an apartment. It is further confirmed that self-selection plays an impact on explaining people's QOL, which is in line with Cao's (2014) findings. Moreover, it is statically implied that the transport policies aiming to directly enhance people's QOL by reducing car use and promoting public transit and active transit may not be efficient as QOL may affected by other life choices rather than changes in transport conditions. Then, more deeply investigation is required.

4.2.4.4 Other Life Choices and QOL

Observing from the five indicators of other life choices in the past relevant to family life, social, health, leisure and recreation, finance domains, the distinguishing characteristics of this latent variable is mainly contributed by the social related choice such as frequency of community activity participation (0.754), which is varied with the current other life choices, that is dominantly characterized by the leisure related choice such as time use in amusement park (0.202). Providing the total effects of past other life choices, it plays a significant role in the current other life choice (0.917), current residential choices (0.426), current QOL (-0.309) and past QOL (-0.276). To be specific, in terms of the considerable total impact of past other life choices on the current responding ones, it is revealed that spending more time in different activities such as social, health, leisure related activities in the past, the more likelihood to do more corresponding activities in future and reduce the prospective transport expenditure, maybe due to inertia. Regarding to the total effect of past other life choices on the current residential choices, it is found that the more time spent in the different facilities of residents, and the less money on transport sector in the past, the higher likelihood to move closeness the city center and compact neighborhoods, with good transit accessibility and walking environment. It is suggested that as time goes on, the past life choices play a relevant role in the current life choices. Moreover, as for the impacts on the QOL indicators, it is confirmed that resident engaging in more health, leisure and social related activities, the past and current QOL would improve significantly. It is further reflected that resident spend more time in leisure, health and social related activities, the past and current QOL would boost greatly. The results show that the isolated land use and transport policies aiming to improve people's QOL by changing housing situation and transport conditions may not be fruitful and effective as QOL

is affected by other life choices comprehensively rather than changes in residential and travel situations.

4.2.5 Conclusion

Motivated by people's time-varying life choices, especially in response to residential location changes or employment changes over time, this study made an initial attempt to examine whether the influence of residential choices and travel behavior on people's quality of life can be observed and how much influence it has after controlling for the effects of other life choices and key life events over time. As such, I linked the dynamics of residential choices and travel behavior with other life choices involving health, social, education and learning, employment, family life, finance and leisure and recreation domains jointly to contribute to a shift in focus by moving from short-term behavioral analysis to mid-term dynamic analysis. I also extend the boundary of the dynamics of residential choices and travel behavior on quality of life by incorporating the influence of other life choices and key life events, which further provides insight into predicting people's prospective life decisions. A preliminary investigation of this complex system has done by estimating a structural equation model based on panel data.

Table 4-13 Estimation Results of Cause-Effect Relationships based on Structural Equation Model

Endogenous Variables	Exogenous Variables			Changes in Socio-Demographics			Past Residential Choices			Past Travel Behavior			Past Other Life Choices			Current Residential Choices			Current Travel Behavior			Current Other Life Choices			Past QOL			Current QOL					
	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect	Total Effect			
Latent Variables																																	
Past Travel Behavior							-0.051		-0.051																								
Past Other Life Choices							-0.004	0.006*	0.002*	0.12*		0.12*																					
Current Residential Choices	-0.271*		-0.271*				0.114*	-0.01	0.104*	0.039	0.055*	0.094*	0.403*	0.023	0.426*																		
Current Travel Behavior	0.1	0.015	0.115				0.029	-0.037	-0.008	0.534*	-0.009	0.525*	0.1	-0.016	0.084	-0.054		-0.054							0.03		0.03						
Current Other Life Choices	-0.088	0.042	-0.046				0.029	-0.012	0.018	0.036	-0.088	-0.051	0.98*	-0.063	0.917*	-0.142	-0.002	-0.144															
Past QOL							0.158*	-0.003	0.155*	0.044	0.033*	0.078*	-0.276*		-0.276*																		
Current QOL	0.084*	-0.034	0.05*				-0.045*	0.148*	0.104*	-0.141*	0.105*	-0.036*	-0.409*	0.1	-0.309*	0.083*	-0.047	0.036*	0.031*	0.009	0.04*	0.316*		0.316*	0.826*	0.002	0.829*						
Changes in Socio-Demographics																																	
Age in 2014	-0.186*		-0.186*																														
Gender in 2014	0.031		0.031																														
Changes of education level between 2010 and 2014 (Yes=1, 0)	0.233*		0.233*																														
Changes of household annual income between 2010 and 2014 (Yes=1, 0)	0.717*		0.717*																														
Changes of employment status between 2010 and 2014 (Yes=1, 0)	0.207*		0.207*																														
Changes of household structure between 2010 and 2014 (Yes=1, 0)	0.61*		0.61*																														
Past Residential Choices																																	
Distance from the City Hall (city center) within 1 km in 2010							0.165*		0.165*																								
Distance from nearest Bus Stop within 0.5 km in 2010							0.698*		0.698*																								
Distance from nearest Railway Station within 1 km in 2010							0.275*		0.275*																								
Residence Duration in 2010							0.024		0.024																								
Residence Type in 2010							0.718*		0.718*																								
Tenure in 2010							0.767*		0.767*																								
Past Travel Behavior																																	
Household Vehicle Ownership in 2010							-0.019	-0.019		0.382*		0.382*																					
Main travel mode is Walking / Cycling in 2010							0.047	0.047		-0.924*		-0.924*																					
Main travel mode is Public Transit in 2010							-0.02	-0.02		-0.39*		-0.39*																					
Main travel mode is Car in 2010							-0.034	-0.034		0.678*		0.678*																					
Past Other Life Choices																																	
Percentage of household transport cost in 2010							-0.016*	-0.016*		0.009*	0.009*		-0.075*		-0.075*																		
Frequency of family meals weekly in 2010							0.015*	0.015*		-0.027	-0.027		0.221*		0.221*																		
Time Use in amusement park daily in 2010							0.023*	0.023*		0.02	0.02		0.169*		0.169*																		
Time Use in doing sports daily in 2010							0.036	0.036		-0.007*	-0.007*		0.058		0.058																		
Frequency of community activity participation in 2010							0.001*	0.001*		-0.091*	-0.091*		0.754*		0.754*																		
Current Residential Choices																																	
Distance from the City Hall (city center) within 1 km in 2014	-0.068*	-0.068*					0.026*	0.026*		-0.024*	-0.024*		0.106*	0.106*		0.25*		0.25*															
Distance from nearest Bus Stop within 0.5 km in 2014	-0.024*	-0.024*					0.009*	0.009*		-0.008*	-0.008*		0.038*	0.038*		0.09		0.09															
Distance from nearest Railway Station within 1 km in 2014	-0.088*	-0.088*					0.034*	0.034*		-0.03*	-0.03*		0.138*	0.138*		0.324*		0.324*															
Residence Duration in 2014	0.12*	0.12*					-0.046	-0.046		0.042	0.042		0.188*	0.188*		0.442*		0.442*															
Residence Type in 2014	-0.191*	-0.191*					0.073*	0.073*		-0.066*	-0.066*		0.299*	0.299*		0.703*		0.703*															
Tenure in 2014	0.188*	0.188*					-0.072	-0.072		0.065*	0.065*		0.295*	0.295*		0.692*		0.692*															
Current Travel Behavior																																	
Household Vehicle Ownership in 2014	0.032	0.032					-0.002	-0.002		0.147*	0.147*		0.024	0.024		-0.015	-0.015		0.281		0.281												
Main travel mode is Car in 2014	0.071	0.071					-0.005	-0.005		0.325*	0.325*		0.052	0.052		-0.033	-0.033		0.619*		0.619*												
Main travel mode is Public Transit in 2014	0.048	0.048					-0.003	-0.003		-0.221*	-0.221*		0.035	0.035		-0.023	-0.023		-0.421*		-0.421*												
Main travel mode is Walking / Cycling in 2014	-0.107	-0.107					0.007	0.007		-0.488*	-0.488*		-0.078	-0.078		0.05	0.05		-0.93*		-0.93*												
Current Other Life Choices																																	
Percentage of household transport cost in 2014	0.005	0.005					-0.002	-0.002		0.005	0.005		-0.095*	-0.095*		0.015	0.015		-0.003	-0.003		-0.104		-0.104									
Frequency of family meals weekly in 2014	0.004	0.004					-0.002	-0.002		0.005	0.005		-0.089	-0.089		0.014	0.014		-0.003	-0.003		0.097*		0.097*									
Time Use in amusement park daily in 2014	0.009	0.009					-0.004	-0.004		0.01	0.01		0.186*	0.186*		0.029	0.029		-0.006	-0.006		0.202*		0.202*									
Time Use in doing sports daily in 2014	0.007	0.007					-0.003	-0.003		0.02	0.02		0.239	0.239		0.025	0.025		-0.002	-0.002		0.001*		0.001*									
Frequency of community activity participation in 2014	-0.04	-0.04					0.015	0.015		-0.045	-0.045		0.807*	0.807*		-0.126	-0.126		0.026	0.026		0.88		0.88									
Past QOL																																	
Life Satisfaction in 2010							0.128*	0.128*		0.064*	0.064*		-0.229*	-0.229*								0.828*		0.828*									
Happiness in 2010							0.122*	0.122*		0.061*	0.061*		-0.218*	-0.218*								0.791*		0.791*									
Current QOL																																	
Life Satisfaction in 2014	0.038*	0.038*					0.078*	0.078*		-0.027*	-0.027*		-0.233*	-0.233*		0.027*	0.027*		-0.03*	-0.03*		0.238*	0.238*		0.624*	0.624*		0.753*		0.753*			
Happiness in 2014	0.041*	0.041*					0.084*	0.084*		-0.029*	-0.029*		-0.249*	-0.249*		0.029*	0.029*		-0.032*	-0.032*		0.255*	0.255*		0.668*	0.668*		0.806*		0.806*			

First, from a static viewpoint, other life choices have considerable effects on people's quality of life compared with the minor effects of residential choices and travel behavior. Especially as time passes, from a dynamic viewpoint, the results further show that current other life choices and past other life choices play a dominant role in current quality of life achievement, compared with the slight influences of current and past residential choices, key life events, and the slight effect of current and past travel behavior. As such, ignoring other life choices relevant to people's key life domains, such as health and leisure, and key life events, such as household structure changes, and only emphasizing the straightforward impacts of land use and transport policies on quality of life may not be fruitful because people's QOL is greatly affected by other life choices more than changes in residential and transport situations. Second, I found that residents living in a high-density land use pattern, especially with diverse facilities, or in a transit-oriented neighborhood feel more satisfied and happier with their lives. This notably answers how land use patterns influence people's quality of life and provides insight into the worsening regional depopulation issue in Japan. Third, the consistently observed influence of residential choices on travel behavior in the literature cannot be observed in this case study neither in the static view nor in the dynamic view, after controlling for the influence of other life choices over time. This suggests that the observed influence of residential choices on travel behavior in the literature may be spurious because of the absence of considering other life choices and key life events.

The above analysis utilized the life-oriented approach (Zhang, 2014), and the results indicate that this approach provides a new method for capturing the effects of life choices on the prospective quality of life. The life-oriented approach offers an understanding of life choices, including residential choices and travel behavior, and should not be constrained by the boundary of any single discipline. The failure to capture travel behavior from the life choice perspective may lead to a failure of consensus building for policies to better support people's

lives. When people's quality of life is concerned, various life choice aspects should be simultaneously represented. In this regard, the structural equation model with latent variables is a flexible and powerful tool to incorporate various cause-effect relationships in a unified and consistent modeling framework. Meanwhile, behaviorally oriented modeling approaches that can accommodate a larger set of discrete and continuous choice variables should be developed.

Several important research issues should be noted. First, people's quality of life is highly different at specific stages of their life course, especially in response to residential location changes and employment changes. Further longitudinal data should be collected and a time series analysis should be conducted. Second, more advanced choice models should be built to jointly represent residential choices, travel behavior and other life choices, as well as quality of life for incorporating decision-making mechanisms into the analysis. Third, the effects of land use and transport policies on people's quality of life should be re-evaluated based on the conceptual framework proposed in this study and future development of better choice models. Finally, to arrive at more comprehensive conclusions, more case studies should be conducted, not only in developed countries, but also in developing countries, which are experiencing more dynamic changes economically, socially and culturally.

5 Capturing the Relationships between Women's Labor Participation, Other Life Choices, and QOL

5.1 Introduction

After experiencing a demographic dividend of a rapidly growing labor force and a falling birth rate from the 1960s to 1980s, Japan is now facing the consequences of a rapidly aging society (Kumagai, 2015). The consequence of this rapidly aging society is the sharpest labor force decline among advanced economies. The size of Japan's working-age population, ages 15–64, will fall from its peak of 87 million in 1995 to about 55 million in 2050 (IMF Report, 2012). This is approximately the size of the workforce at the end of World War II. Unless output per worker rises at a faster rate to offset the decline in the number of workers, Japan's GDP is likely to fall behind that of many of its neighbors. Japan has already ceded second place in global economic size to China, and India is not far behind. By some estimates Japan and Indonesia will be the same size by the middle of this century (Economist, 2010). In the near term, there is much Japan can do to encourage its highly educated female population¹ to participate more actively in the workforce. Getting more women in the workforce would mean not only a larger labor force, but possibly a more skilled labor force given that Japanese women on average have completed more years of education than their male counterparts. Japan's potential economic growth rate is steadily falling with the aging of its population. Raising female labor participation could provide an important boost to growth, but women face a huge hurdle in participating in the workforce in Japan. That is many women drop out of the workforce following childbirth. To increase women's attachment to work Japan should consider policies to provide better support for working mothers (IMF Report, 2012). According to the estimation from international organizations of WEO and IMF, it shows that raising female labor participation

¹ Japan's younger generation of women is more educated than their female peers elsewhere. In 2010, the cohort in their late 20s had on average 14.3 years of schooling, surpassed among advanced economies only by New Zealand.

rates in Japan to the level of northern Europe, GDP per capital would be permanently higher by approximately 8 percent.

Moreover, studies in transport field have mentioned that job accessibility can be another big obstacle for labor participation, and public transport represents a means to overcome employment accessibility and mobility problems. Antonio et al. (2014) claims that living in segregated areas that are poorly connected to employment centers has a negative effect on labor market outcomes. It analyzed the effect of job accessibility by public and private transport on labor market outcomes in metropolitan area of Barcelona, finding that job accessibility matters the intention to work especially for females. Another study examining Atlanta, Georgia, and Portland, Oregon, found that access to bus transit had positive employment effects in both cities (Sanchez, 1999a). For Los Angeles, Kawabata (2002b) found that improved accessibility, whether through auto or transit, had a positive effect on employment. Ong and Houston (2002) also found that single women on public assistance who did not have cars benefited from transit access. These women were more likely to be employed compared with those with lower levels of transit access. Other more recent research has discussed transport immobility as one of several barriers to employment encountered by welfare recipients (Blumenberg, 2002; Danziger, et al., 2000). Still other studies have simply ignored public transport as a meaningful work trip mode and have excluded it from employment accessibility estimates (see Gordon et al., 1989). Others, however, dismiss public transport, compared with cars, as a viable link between urban residents and employment locations. Studies in Dade County, Florida, and Alameda County, California, found little or no relationship between public transport access to employment locations and employment participation (Thompson, 1997; Cervero et al., 2002).

Research in the land use field mentioned that people who reside in low-density, with poor public transit, and isolated areas, have less enough job opportunities and lower quality of life. Matas et al. (2010) analyze the effect that the urban structure of Barcelona and Madrid has

on the probability of female employment. The author found that job proximity is significant for women, but small and insignificant for men. This study further shows that low job accessibility in public transport negatively affects the employment probability. Gobillon and Selod (2007) conclude that the locations where the unemployment rate is highest affect the people's job attainment. Meanwhile, Dujardin et al. (2008) find that the employment probability in Brussels is coherent with the spatial structure of the city.

Recently, in order to encourage more women to take up paid work, Prime Minister Shinzo Abe announced plans to extend childcare leave and expand public daycare facilities¹. This is a growth strategy with clear benefits to the economy and to those women who seek a career and sense of fulfillment it offers. In Japan, career and raising a family is too much of an either/or situation — and society as a whole pays a penalty. Japanese women's labor-force participation rate is 25% below men's, a gap that is about twice as high as in Germany and the UK, representing a significant reservoir of women power. Kathy Matsui, a Tokyo-based Goldman Sachs analyst known for her "Womenomics" reports, argues that this ongoing waste of women's human capital is shortsighted and is depressing the economy's growth potential. And, she maintains, it is unsustainable because, "... given the limited alternatives, Japan has no choice but to tap its most underutilized resource. It's hard to run a marathon with just one leg." Thus it is clear that if Japan seeks a better future (in terms of economic growth as well as social equity development) it needs to ensure that women are given opportunities for career. For example, 74% of college-educated women quit their jobs voluntarily — more than double the rate in the U.S. (31%) and Germany (35%). The percentage of women who drop out of the workforce in their 30s is also much higher than in the U.S. and Europe². However, whether the policies Prime Minister proposed can promote the women's labor participation is still

² The Japanese Times : http://www.japantimes.co.jp/opinion/2013/04/21/commentary/saving-japan-promoting-womens-role-in-the-workforce-would-help/#.VTRXfPSI_Id

controversial. It is possible that after women work out, work-family conflict would aggravate, time related work-leisure conflict could happen, stress relevant work-health conflict could come, and further women's quality of life could be suffered. With the above considerations, this chapter focuses on promoting women work out in Japan while simultaneously suggesting how to reduce the women's work-family conflict, then work-leisure conflict and work-health conflict, achieving their work-life balance, and promoting QOL. Specifically, the objectives of this chapter are 1) identify the barriers to female labor participation in Japan, after controlling for the effects of land use, transport and life cycle stages; 2) clarify the factors on women's good quality of family life, leisure life, health life and their QOL; 3) Provide cross-sectoral policies implications into women's job participation and QOL promotion, simultaneously balance women's work-life.

5.2 Methodology

To grasp the impacts of land use and transport on women's labor participation, this study uses a recursive multi-equation system, the structure of which is illustrated in Figure 5-1. This study focuses on five life outcomes – good family life, good leisure life, good health life, self-rated happiness and life satisfaction, all of which are expected to be affected, directly or indirectly, by women job participation. This life course causal model is analogous to a “pathways model” in life course epidemiology (Kuh et al. 2003).

It is hypothesized that women's job participation first directly affects their good family life attainment (high frequency of family-related activities engagement: such as contact with family member or relatives more than once a day), further due to time issues, women's job participation would have straightforward relationship on their good leisure life (high frequency

of leisure-related activities engagement- such as going to the cinema, amusement park and entertainment facilities more than twice a month), next due to work-related time and stress

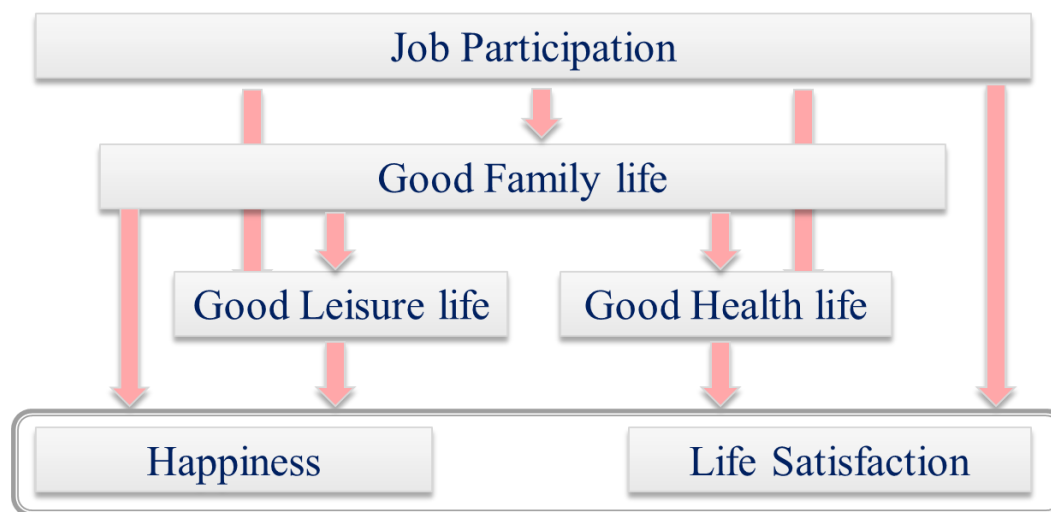


Figure 5-1 The causal model for work and life balance

issues, women's job participation also would have a direct impact on their good health life (high frequency of health life-related activities engagement - such as doing sports more than once a week). In line with foregoing discussion, good family life would promote the good leisure and health life as well. Finally, in line with our assumption to balance the women's work and life well, it is expected that women's job participation, good family life, good leisure life, good health life, which are all have positive influence on their happy (more than 8 score) and life satisfaction (more than 4 score) attainment. To make this recursive structure of life outcomes empirically tractable, this study first dichotomizes each outcome, as discussed later in more detail. And here considers six binary variables: "women's job participation," "good family life," "good leisure life," "good health life", "happiness-feel happy," and "life satisfaction-feel satisfy." Using the recursive multivariate probit model, a full version of which is expressed as:

$$\begin{aligned}
Y_1^* &= X_1\beta_1 + \varepsilon_1, \\
Y_2^* &= \alpha_{21}Y_1 + X_2\beta_2 + \varepsilon_2, \\
Y_3^* &= \alpha_{31}Y_1 + \alpha_{32}Y_2 + X_3\beta_3 + \varepsilon_3, \\
Y_4^* &= \alpha_{41}Y_1 + \alpha_{42}Y_2 + X_4\beta_4 + \varepsilon_4, \\
Y_5^* &= \alpha_{51}Y_1 + \alpha_{52}Y_2 + \alpha_{53}Y_3 + \alpha_{54}Y_4 + X_5\beta_5 + \varepsilon_5, \\
Y_6^* &= \alpha_{61}Y_1 + \alpha_{62}Y_2 + \alpha_{63}Y_3 + \alpha_{64}Y_4 + X_6\beta_6 + \varepsilon_6
\end{aligned} \tag{5-1}$$

and

$$Y_g = 1 \text{ if } Y_g^* > 0; \quad Y_g = 0 \text{ otherwise, for } g=1,2,\dots,6$$

Here, y_g^* is a latent variable for the binary variable y_g . X_g is a vector of exogenous variables to explain y_g , and $(\varepsilon_1; \dots; \varepsilon_6)$ is a vector of six-variate normally distributed error terms with $\text{var}(\varepsilon_g) = 1$ for $g = 1, 2, \dots, 6$. Fifteen covariances between a pair of six error terms, which are denoted as ρ_{gk} ($g, k = 1, 2, \dots, 6; g > k$), are also to be estimated. The estimation of the multivariate probit model is carried out using Stata software, which applies the simulated maximum likelihood estimation method (Cappellari and Jenkins, 2003). Two things should be noted regarding this six-variate probit model. First, it completely reflects the causal structure illustrated in Figure5-1. Second, estimation of a recursive multivariate probit model requires some considerations for the identification of the model parameters. Maddala (1983) proposed that at least one of the reduced-form exogenous variables is not included in the structural equations as explanatory variables. Following Maddala's approach, this study imposes exclusion restrictions: (1) to make X_1 include at least one exogenous variable that is not included in X_2 , (2) to make both X_1 and X_2 include at least one exogenous variable that is not included in X_3 and X_4 (3) to make all X_1, X_2, X_3 and X_4 include at least one exogenous variable that is not included in X_5 and X_6 .

5.3 Model estimation and results

5.3.1 Data description

Table 5-1 Summary of Dependent Data Characteristics

Sample Characteristics	Women (N=938 %)	Men (N=940 %)	Sample Characteristics	Women (N=938 %)	Men (N=940 %)
Age			Household Income		
15-34 years old	25.46	24.03	< 2 million yen/year	7.39	8.13
35-64 years old	74.54	75.97	2 - 6 million yen/year	47.63	45.29
Marital Status			> 6 million yen/year	44.98	46.58
Married	70.71	68.95	Car Ownership		
Single	29.29	31.05	Have more than one car	27.46	26.34
Occupation			Have a private car	51.92	54.99
Employed	24.72	74.32	Have no car	20.62	18.67
Part-time Job	18.80	3.14	Main Travel Mode		
Housewife	40.60	0.55	Cycling/Walking	43.34	27.91
Student	8.12	9.33	Public Transit	33.30	40.02
Unemployed	7.76	12.66	Car	19.89	27.17
Education Level			Others	3.47	0.49
Having a Bachelor degree	59.31	67.74	Health Status		
Having no Bachelor degree	40.69	32.26	Fine	78.65	76.43
Household Composition			Not Fine	21.35	23.57
No child	75.36	78.93	Life Satisfaction		
One child	11.77	9.43	Satisfy (more than 4 score)	60.22	53.88
Two children	9.31	8.32	Not Satisfy	39.78	46.12
Three children or more	3.56	3.32	Happiness		
No elderly	88.50	88.08	Happy (more than 8 score)	54.46	51.38
More than one elderly	11.50	11.92	Not Happy	45.54	48.62

The data used in this study was the life choice data collected in 2010, the labor force I mentioned here are the people aged from 15-64 years old³. As a result, 938 valid samples of women were obtained, including the data of individual characteristics, life cycle stages, land use and transport attributes. Individual characteristics include age, occupation, education level, etc. while life cycle stages attributes include no child home, one child home, two children home,

³ Ministry of The young adults in Japan, which refers to the people aged from 15 to 34 years old. Ministry of Health, Labor and Welfare. (In Japanese). <http://www.mhlw.go.jp/topics/2010/01/tp0127-2/12.html>.

child at school, child over 18 years old, no elderly home, one elderly home, two elderly home, etc. Land use attributes featured by the density of different infrastructure facilities, and travel behavior is the main travel mode to engage various activities. The data characteristics are summarized in Table 5-1.

In terms of data representation in the national level, the life index OECD¹ showed that women's well-being is higher than men's, especially for the life satisfaction indicator. Life satisfaction measures how people evaluate their life as a whole rather than their current feelings. When asked to rate their general satisfaction with life on a scale from 0 to 10, the Japanese gave it a 5.9 grade, lower than the OECD average of 6.6. However, women reported being somewhat happier than men, rating their lives at 6.1, compared with 5.7 for men⁴. And our survey data is match with the above evidence, women feel more satisfaction/happy compared with men, women without job feel more satisfaction/happy than the men with paid work. The details obtained from our survey data are showed in Figure 5-2 and 5-3.



Figure 5-3 The difference of Life Satisfaction by Gender

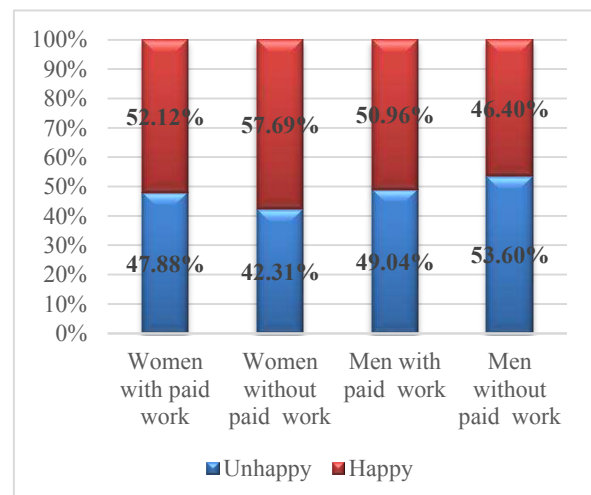


Figure 5-2 The difference of Happiness by Gender

The relationship between life cycle stage and women labor participation are showed in Figure 5-4. It is indicated that the more pre-school children and elderly persons (over 65 years old)

⁴ OECD better life index: <http://www.oecdbetterlifeindex.org/topics/life-satisfaction/>.

staying home, the higher likelihood women would not work out. The explanatory variables for modelling are showed in Table 5-2.

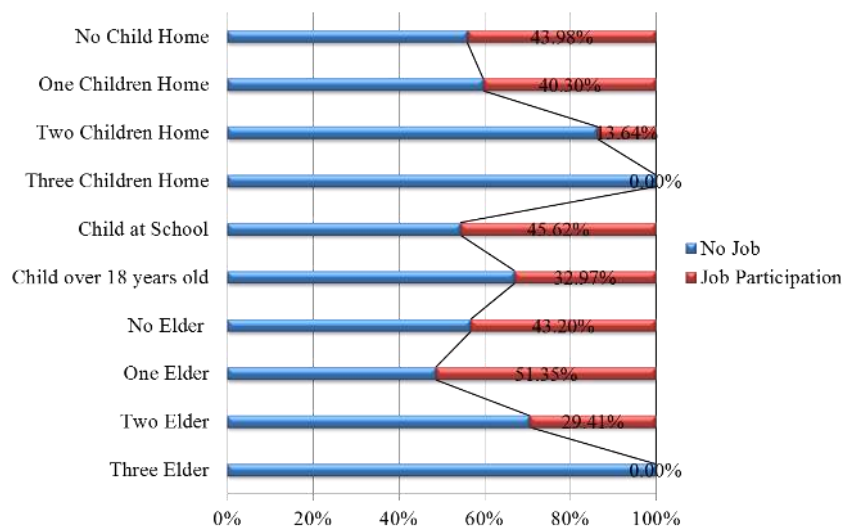


Figure 5-4 The relationship between life cycle stage and women job participation

Table 5-2 Explanatory variables for modelling

Socio-Demographics	Residence Choices
Age (15-64)	Living in the Megacities (Yes=1,0)
Family Status (Head=1,0)	Residence Duration
Marital Status (Married=1,0)	Residence Property (Own=1,0)
Driving License (Own=1,0)	Living Area (m ²)
Number of Children (pre-school child)	Neighborhood with Kindergarten (<= 1km)
Number of Elderly (>=65 years old)	Neighborhood with High School (<= 1km)
Health Status (Fine=1,0)	Neighborhood with Elementary School (<= 1km)
Education Level (Bachelor=1,0)	Neighborhood with Secondary School (<= 1km)
Household Composition	Travel Behavior
Household Annual Income	Vehicle Ownership
Land Use Attributes (Grid 1km*1km)	Main Travel Model is Walking/Cycling (Yes=1,0)
Density of Welfare Facilities	Main Travel Model is Public Transit (Yes=1,0)
Density of Local Government Facilities	Main Travel Model is Car (Yes=1,0)
Density of Public Facilities	Other Life Choices
Density of Railway Stations	Job Training Participation (Yes=1,0)
Density of Bus Stops	Part-time Job (Yes=1,0)
Density of Employment	Professional Job (Civil servant, officer=1,0)
Density of Medical Facilities	With Holiday System (Yes=1,0)
Life Cycle Stage	Vacation Taken last year (days)
Child Home (pre-school child)	Commute Distance (km)
Child at School (student)	Working Hours per day
Child over 18 years old	Work Days Monthly
Elderly Home (>= 65 years old)	

5.3.2 Estimation results

Table 5-3 summarizes the estimation results from the above recursive model. Based on the value of McFadden's Pseudo rho-square, it is demonstrated that the estimation results are mainly acceptable. In this study, I mainly focus on the ways to promote more women to take up paid work, and jointly balance their work and life. I first briefly comment on the estimates associated with the control variables significantly on women job participation, which are in line with the results previously obtained in the literature. In details, in terms of the attributes of life cycle stages, the results show that, as expected, more children in the family, especially the children under 6 years old, hinder women work out. However, more children in the school increases the propensity to have a paid job. The estimates associated to land use attributes indicate that higher density of transit facilities (e.g., railway station and bus stop) and public facilities have the expected effect on job acquirement for women, suggesting that these variables capture how land use patterns favors the accessibility and availability of jobs. Moreover, women who consider the accessibility of the public transport network in their place of residence to be high are more likely to have paid jobs. Finally, residents in areas with higher employment rates offer women more chances to get a job, which reflects the general idea that residential segregation is often accompanied by insufficient job accessibility by poor public transport. Besides, the results related to the neighborhood variables indicate that the residence with childcare facilities such kindergarten and elementary school have a beneficial impact on women returning to work. Particularly, this model considers the effect of job training program participation, it is showed the expected sign that providing job training program is good for women work out. Therefore, it appears that the probability among females of being regularly employed is especially sensitive to job accessibility and availability.

Table 5-3 Model Estimation Results

Explanatory Variables	Job Participation	High Family Life	High Leisure Life	High Health Life	Satisfy	Happy	
Contant	-0.84*	-0.14*	-0.577	-0.73*	-0.22*	-0.159	
Socio-demographics							
Age	-0.251*	0.30*	0.008*	-0.037	0.274*	0.173	
Family Status	0.608*	-0.82*	-0.145	0.087	0.231	0.181	
Marital Status	-0.255*	0.569*	0.065	-0.05*	0.245*	0.286*	
Driving license	0.602*	-0.03	0.096*	0.159*	-0.045	-0.115	
Household Annual Income	0.013*	-0.03*	0.050*	0.061*	0.077*	0.070*	
Health Status	0.233*	0.052	0.116*	0.209*	0.749*	0.615*	
Education Level	0.117	-0.22*	0.037*	-0.037	0.223*	0.031	
Household Composition	-0.14*	0.179*	0.021	-0.20*	-0.10*	-0.10*	
Number of children	-0.6*	0.320*	-0.02*	-0.11*	0.133*	0.278*	
Number of elderly	-0.222*	0.366*	0.4468	-0.20*	0.282	0.281	
Vehicle Ownership	0.153*	0.066*	0.035*	0.035*	0.026	0.048*	
Life Cylce Stages							
Child home	-0.537*	0.17	-0.44*	-0.25*	-0.01*	0.046*	
Child at school	0.068*	0.055*	0.22*	0.212*	0.003*	-0.077	
Child over 18 years old	0.001	0.002	0.001	0.003	0.006	0.123*	
Elderly home	0.156	-0.64	-0.367	0.466	-0.179	-0.229	
Land Use Attributes							
Density of Railway Stations	0.164*	0.055	0.398*	0.185	0.034*	0.004*	
Density of Bus Stops	0.088*	-0.05	0.01*	0.028*	0.103*	0.085*	
Density of Welfare Facilities	0.030	0.12*	0.078	0.115*	0.193*	-0.054	
Density of Local Government Facilities	0.109	--	--	--	0.032	-0.014	
Density of Medical Facilities	0.010	0.021*	-0.013	0.006	0.062*	0.083*	
Density of Public Facilities	0.021*	0.111*	0.027*	0.069*	0.007*	0.013*	
Density of Employment	0.344*	0.220	0.160*	0.132	0.52*	0.29*	
Travel Behavior							
Main travel model is Walking/Cycling	0.055	0.118	-0.09*	0.372*	0.225*	0.116*	
Main travel model is Public Transit	0.608*	-0.09	0.067*	0.371	-0.061	-0.092	
Main travel model is Car	0.203	0.168*	-0.049	0.142	0.002*	0.197*	
Residential Choices							
Megacities	0.125	-0.21*	0.025*	-0.12*	0.08*	0.145*	
Residence Duration	0.001	0.002	-0.008	--	0.007	0.010*	
Living Area	0.000	0.113*	--	0.003*	0.110*	0.004	
Residence Property	-0.079	-0.15	--	--	0.009*	-0.127	
Neighborhood with Kindergarten	0.023*	0.129	0.153*	0.148	0.159*	0.049*	
Neighborhood with High school	0.131	0.004	-0.136	0.024	0.117	-0.014	
Neighborhood with Elementary school	0.194*	0.05	0.032*	0.136	0.094*	0.161*	
Neighborhood with Secondary school	0.421*	-0.06	0.158*	0.155	0.219*	0.129	
Other Life Choices							
Job Training participation	0.200*	-0.01*	0.033*	0.038*	0.013	0.002*	
Commute distance	-	-0.01*	-0.013*	-0.001*	-0.19*	-0.12*	
Working hours per day	-	-0.04*	-0.02*	-0.01*	-0.01*	-0.03*	
With holiday system	-	0.007*	0.006*	0.010*	0.002*	0.013*	
Vacation taken last year	-	0.008*	0.004*	0.003*	0.020*	0.012*	
Work days monthly	-	-0.154*	-0.164*	-0.01*	-0.02*	-0.01*	
Professional job	-	-0.27*	0.178*	-0.76*	0.024*	-0.42*	
Part-time job	-	0.146*	0.137*	0.451*	-0.19*	-0.65*	
Women Job participation	-	-0.31*	-0.106*	-0.691*	0.722*	0.026*	
High Family Life Engagement	-	--	0.17*	0.133	0.227*	0.265*	
High Leisure Life Engagement	-	--	--	--	0.178*	0.287*	
High Health Life Engagement	-	--	--	--	0.272*	0.123*	
Number of Observation	943						
Wald Chi-square (223)	708.45						
LL0	-3251.3428						
LL1	-3130.4827						
Pseudo R-square (McFadden's)	0.1058						
P-value for Wald chi-square	0.0000						
	rho21	rho31	rho41	rho32	rho43	rho53	rho65
	-0.569*	-0.255*	-0.344*	0.002*	0.410*	0.131*	0.660*

Note: '--' the variables weren't put into estimation for the target dependent variables;
 '*' statistical significance at the 5% level.

Additionally, I focus in more details on the estimates associated to the variables beneficial to into balance women's work-life, not only in women's job participation also in their quality of life promotion. The results discovered that more children in the household, the women feel happier and more satisfied, but negatively affect women's job participation, as well as their health and leisure related activities engagement, while children in the school, it appears positive affect on women's work and life. Turning to the land use variables, it is indicated that the residence with higher density of transit facilities and public facilities, women have higher likelihood to feel happier and more satisfied, which are also beneficial to their leisure and health life pursuit. Especially, the higher probability to obtain a job, women feels more satisfied and happier for their life especially leisure life attainment. It is further showed that availability of childcare facilities such as kindergarten has a beneficial impact on women good quality of life attainment. Expectedly, based on the job characteristics, it is discovered that inflexible work time and long commute distance hinder women work out, as well as their quality of life improvement. While jobs with sound holiday system, long leave taken, flexible working time attracts women work out and improve their quality of life.

However, based on the recursive assumption, it is assumed that women job participation could affect their family life, leisure life and health life attainment, which all expected to have positive affect on their quality of life improvement. Consistently, it is verified that women job participation, higher family life, leisure life and health life engagement, which all beneficial to their quality of life enhancement. It also seems worth noting that the estimated correlations between the error terms of the five equations are always significant, which means that the interrelation between the unobservable elements that affect those five life outcomes should be taken into account in order to obtain a consistent estimate of the impact of women job participation on quality of life associated outcomes. In all, the estimation results reveal that women job participation has an expected persistent impact on subsequent life outcomes.

5.4 Conclusion

It is hypothesized in this study that promoting more women to take up paid work in Japan, it could cause work-family conflict, time related work-leisure conflict and stress concerned work-health conflict, further have detrimental effect on women's quality of life. Therefore, in order to balance women's work and family life, a recursive multi-equation system is used to firstly identify the barriers to women labor participation in Japan, after controlling for the effects of land use, transport and life cycle stages; secondly to clarify the factors on women's good quality of family life, leisure life, health life and their quality of life; thirdly to provide cross-sectoral policies implications into women's job participation and quality of life promotion, simultaneously balance women's work-life.

Our empirical analysis found that women job participation has a persistent impact on subsequent life outcomes. In line with conventional wisdom and the results from many previous studies, women labor participation is a hurdle for their good family life attainment. First, from a land use viewpoint, it is confirmed that job accessibility (density of employment and commute distance) and residence closeness to the childcare facilities (such as kindergarten) can promote women work out, which are beneficial for good leisure life engagement, further happy and satisfy attainment. Second, from transport side, it is verified that with more vehicle ownership, living in the environment with good public transit accessibility help women work out. However, allowing for good health life attainment (engaging more physical activities), walking/cycling rather than driving is more meaningful, and the result found that high health life attainment is good for high level of quality of life acquirement (more happy and satisfied). Thirdly, from other life choices behavior, it is discovered that job with fewer working hours, fewer working days, with holiday system, and more vacation days attract more women go for working, and those promote happy and satisfaction. Most interesting, job training program participation also

plays a prominent role in women's job life, health and leisure life, quality of life as well, but it is detrimental for family life enhancement. The results highlight that land use policy, transport policy, employment policy and leave policy should cooperate together to deal with women labor participation issue, jointly to balance their work and life.

6 Analysis of Young Adults' Residential and Travel Behavior

Linked with QOL

6.1 Influences of Young Adults' Residential and Travel Behavior on Other Life Choices and QOL based on the life oriented approach

6.1.1 Introduction

In Japan, a majority of young people have continued to migrate from local cities to the three major metropolitan areas¹ (Tokyo, Osaka and Nagoya regions) for a new job or new residence. These are centers where around half of the nation's population is now concentrated². Further, the proportion of elderly population (aged 65 years or over) in Japan was 12.1% in 1990, but rose to 25.0% in 2013 and it is estimated to increase to 33.4% in 2023³. Therefore, increasingly both academic and government agendas are focusing on the national depopulation issues (Wilson and Rees, 2003). Such depopulation is primarily driven by the out-migration of young adults (Stockdale, 2002a). Stockdale (2006) examined that migration out of the depopulating areas is related to the prospects for the economic regeneration of rural communities based on a study in Scotland. Moreover, Muilu and Rusanen (2003) claimed that the young people are in a key position as far as the future of the depopulated areas especially in the remote rural areas. In particular, without renewal of their population structure, these areas cannot remain viable or maintain their economic functions in the long term, based on an analysis of the 15~24-year age cohort in Finland. Therefore, it is further assumed that if the movement of young adults from rural areas to big cities would continue unabated, it could jeopardize the regional development in Japan. However, such kind of young labor force migration issue happened resulting in the formation of depopulated areas is not only a special issue in Japan, it has already been

¹ There are three metropolitan areas: Tokyo Area - Saitama, Chiba, Tokyo and Kanagawa; Osaka Area - Kyoto, Osaka, Hyogo and Nara; Nagoya Area - Gifu, Aichi and Mie.

² <http://www.nippon.com/en/column/g00189/>.

³ Statistics Japan. The Elderly Population, 2013 (in Japanese). (Downloadable from <http://www.stat.go.jp/data/topics/topi721.htm>; Accessed July 5, 2014).

confirmed in other developed nations such as England and Wales (Smith, et al., 2014), it is discovered that the long-distance movements of young adults is a leading constituent of demographic and population changes in society. It further has been observed in other Asian countries such as Nepal (Childs, et al., 2014). Communities that have thrived for centuries in Nepal's rugged mountain environments are facing rapid population declines caused by the outmigration of youths. It poses a potential long-term threats on agricultural production, family-based care for the elderly, socioeconomic inequalities, and human capital. Especially providing an insight into China, the total number of migrants from rural to urban areas has reached 153 million in 2010, accounting for about 30% of total rural labor⁴. The accelerating rural depopulating, driven by vast and increasing out-migration of young labors has imposed huge obstacles on improving land use efficiency and coordinating urban–rural development in China, such as low efficiency of rural residential land use, and lateral expansion of rural dwellings at the expense of farmland loss, decrease in the ability of rural inner development, and deterioration of rural residential environment (Li, et al., 2014 and Liu, et al., 2010). In Japan, such migration is in need of further exploration.

Young adults⁵ in Japan, aged from 15 to 34 year-old, when they leave school and establish independent households, must decide where to live and where to work. However, migration from a childhood home by young adults in search of job opportunities or marriage partners means forgoing the benefits of parents and relinquishing the economic and social value of hometown networks. Residing a new residential location can be a decisive life choice on the young adults' new lives, connecting with their main life domains of health, social, family life, finance, residence, job, education and learning, leisure and recreation, as well as travel behavior,

⁴ Ministry of Human Resources and Social Security. 2011. Human resources and social security undertakings statistical bulletin of 2010. (In Chinese). http://w1.mohrss.gov.cn/gb/zwx/2011-05/24/content_391125.htm.

⁵ The young adults in Japan, which means the people aged from 15 to 34 years old. Ministry of Health, Labor and Welfare. (In Japanese). <http://www.mhlw.go.jp/topics/2010/01/tp0127-2/12.html>.

and further on their quality of life, which is also assumed to be influenced by their socioeconomic characteristics and residential environment. Unfortunately, little research has been paying attention to the young population's migration issues from a comprehensive life choice view in Japan. How major regional cities can act to counter this trend will have a great bearing on the shape of nations' future. Therefore, it is time to shift the overwhelming focus on the three major metropolitan areas to the non-metropolises especially depopulated areas, and it comes a good time to establish a regional revitalization task force to direct efforts addressing regional depopulation and related issues. Therefore, this study aims to figure out and identify the migration reasons of such migration behavior of the young adults.

Motivated by the above considerations, the purpose of this study is to make an initial attempt to examine and quantify the effects of the land use on the young population's quality of life, compared with the impacts of their socioeconomic characteristics and essential life choices such as job related choices (decisions). Here, land use attributes, which are represented by the density of various facilities (i.e. public facilities, welfare facilities, transit facilities), as well as population and employment density. The socioeconomic characteristics contain individual attributes (i.e. age, marital status, education level) and household attributes (i.e. household composition, household vehicle ownership). While the life choices are represented by the decisions made in the domains of health (i.e. frequency of doing sports such as golf), social (i.e. frequency of participating the community activities), family life (i.e. time sharing with family members), finance (i.e. income allocation on the leisure cost), residence (i.e. reside closeness to the transit-oriented neighborhood or city center), job (i.e. job type, working hours per day), education and learning (i.e. frequency of learning activity participation such as hobby learning), leisure and recreation life (i.e. frequency of leisure activity participation such as going to the cinema), as well as travel behavior (i.e. main daily travel mode to different leisure facilities). Herein, the policy implications of this study are two-fold. First, this study could

inform policy makers how the young adults would improve their quality of life in respond to re-shaping of the spatial structure and the economic/urban strategies. Second, clarifying the influence of the land use on their relevant life choices could better evaluate the effects of land use policy by explicitly incorporating the policy outcomes into the evaluation process, which could better facilitate the outcomes of Japan.

6.1.2 Methodology

6.1.2.1 Data description

This study attempts to answer the following three questions within a unified analysis framework: (1) how do land use attributes affect the young adults' residential choices (location choice and housing attributes choices) and travel behavior, further affect their quality of life, after allowing for the job related decisions?; (2) is there geographically difference?; (3) what kinds of life choices influence the young adults' quality of life, controlling for their socioeconomic characteristics, and to what extent?. To this end, data were extracted from a life choices and quality of life survey including various aspects of life stretching major cities in Japan, which was implemented in 2010 with a sample size of 2,178 persons (Zhang et al. 2012; Zhang, 2014). This study focuses on the young adults aged between 15 and 34 years old. As a result, 539 (260 male and 279 female) respondents from the whole sample were extracted, where 171 and 171 were from the three metropolitan areas (Tokyo, Nagoya, and Osaka) and medium-sized cities, respectively, while 197 were from other local cities in Japan.

6.1.2.2 Conceptual Framework and Explanatory variables

As for the analysis method, a structural equation model with latent variables is built for exploring the complicated cause-effect relationships existing in the Japanese young adults' quality of life under the influence of land use attributes, socioeconomic characteristics and their essential life choices (decisions) in a comprehensive and systematic way, and the conceptual framework is presented in Figure 6-1.

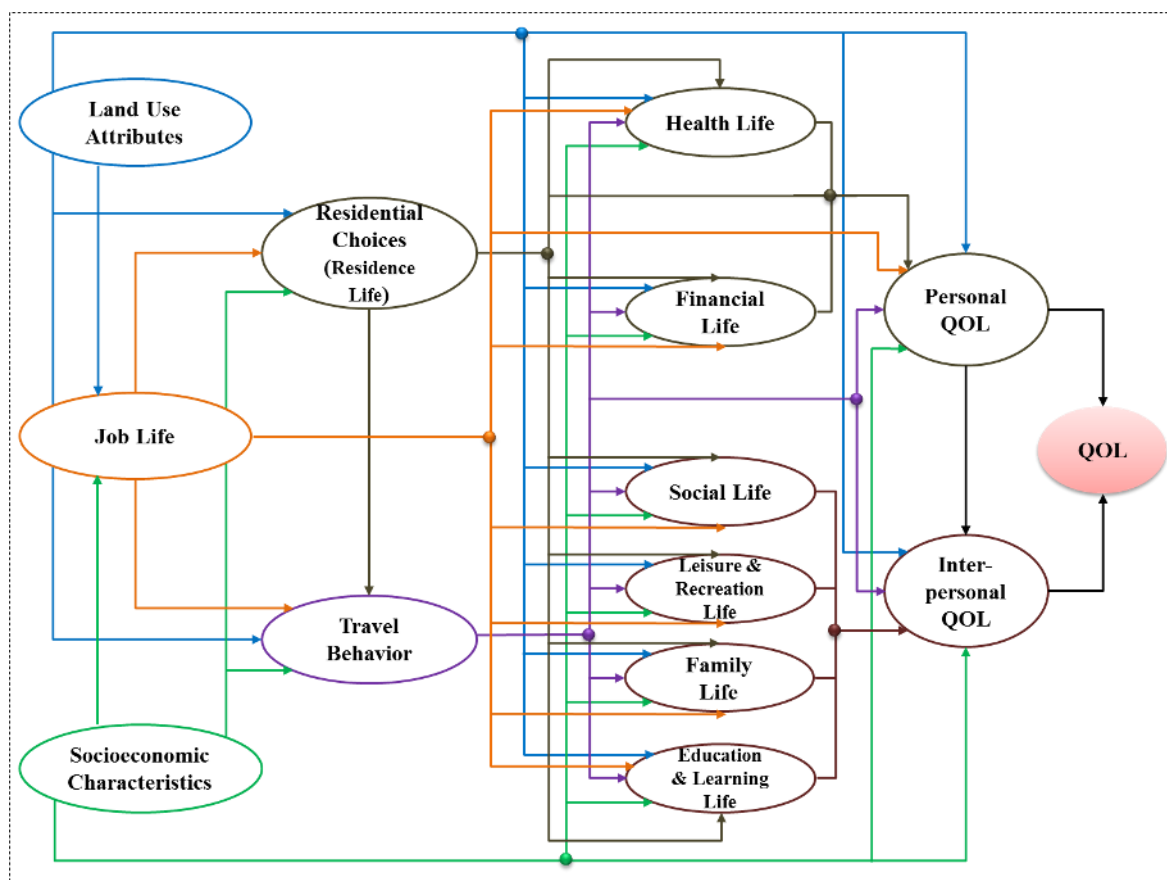


Figure 6-1 The Conceptual Framework of Analysis

Here, there are totally 14 latent variables. Data of land use attributes including population and employment density, as well as the density of various public infrastructure facilities such as welfare facilities and railway stations were selected. Socioeconomic characteristics included age, marital status, household composition, education level, vehicle

ownership, and annually household income level. And questions related to life choices were addressed nine dimensions that are considered relevant to the young adults' quality of life: health, social, family life, finance, residence, job, education and learning, leisure and recreation domains, as well as travel behavior. For example, the residential choices contain residence location choice and housing attributes choices, which were investigated by municipality jurisdiction and distances to different important facilities such as city hall and nearest bus stop, as well as dwelling size and tenure (ownership, rent). Therefore, totally 50 variables are extracted out for modelling estimation.

Additionally, the quality of life is measured by life satisfaction and happiness, it is therefore essential to obtain the data represented for both of them. Specifically, as for life satisfaction data, survey asked respondents how you are satisfied with your life as a whole and each life domain, showing the corresponding answers according to 1~5 point (1: very dissatisfied,..., 5: very satisfied). In terms of happiness data, survey asked respondents how happy you are currently, choosing the corresponding levels from 0~10 (0: very unhappy,..., 10: very happy). As influences on the young adults' quality of life, which is measured in terms of happiness and life satisfaction as a whole, and satisfaction with 8 specific life domains encompassing personal life sphere and interpersonal life sphere. Herein, personal life sphere, providing the basic life needs such as material desires, it contains health, job, residence and finance life domains, while interpersonal life sphere, offering the higher life needs such as spiritual concerns, it includes social, leisure and recreation, education and learning, family life domains. Presumably, it is assumed that the personal quality of life has a directly effect on the interpersonal quality of life, and both further contribute to the overall quality of life greatly. And the detailed descriptions for modeling on the construct of latent variables are shown in Table 6-1.

Table 6-1 The Explanatory Variables of the Latent Variables

Variables	Variables
<i>Socioeconomic Characteristics</i>	<i>Health Life (health-related activities decisions)</i>
Age (15~34 Years old)	Frequency of Sports Participation Yearly
Education Level (Bachelor and over =1, 0)	Average Duration of Doing Sports per Time
Annual Income ¹	<i>Education & Learning Life</i>
Marital Status (Yes=1,0)	Frequency of Learning Activity Participation Yearly (e.g., Language, Hobby, Job Training)
Household Composition	Average Duration of Learning Activity per Time
Household Vehicle Ownership	<i>Finance Life (income allocation decisions)</i>
<i>Land Use Attributes (Grid 1km*1km)</i>	Percentage of Household Housing Cost
Density of the Railway Stations	Percentage of Household Education Cost
Density of the Bus Stops	Percentage of Household Leisure Cost
Density of the Parks	<i>Family Life</i>
Density of the Welfare Facilities (e.g., childcare facility)	Frequency of Relatives Contact Yearly
Density of the Public Facilities (e.g., parking lot)	Frequency of Family Meals Weekly
Population Density	<i>Social Life</i>
Employment Density	Frequency of Neighbors Communication
<i>Residential Choices (Residence Life)</i>	Community Activity Participation
Living in Metropolitan Cities (Yes=1,0)	<i>Leisure & Recreation</i>
Distance from the City Hall (city center) within 1 km (Yes=1,0)	Frequency to leisure activity participation yearly (e.g., Cinema, Theater, Amusement park, Entertainment facilities)
Distance from the City Hall (city center) 1~5 km (Yes=1,0)	Average duration of leisure activity per time
Distance from nearest Bus Stop within 0.5 km (Yes=1,0)	<i>QOL Indicators</i>
Distance from nearest Railway Station within 1 km (Yes=1,0)	Life Satisfaction
Residence Duration (years you lived in the current house)	Happiness
Dwelling Size (m ²)	<i>Interpersonal QOL</i>
Tenure (Own=1,0)	Satisfy with Family Life
<i>Travel Behavior</i>	Satisfy with Leisure & Recreation Life
Main travel mode is Walking / Cycling (Yes=1, 0 ²)	Satisfy with Social Life
Main travel mode is Public Transit (Yes=1, 0)	Satisfy with Education & Learning Life
Main travel mode is Car (Yes=1, 0)	<i>Personal QOL</i>
<i>Job Life (work related decisions)</i>	Satisfy with Job Life
Occupation (officer, civil servant, staff =1, 0)	Satisfy with Residence Life
Working Hours per day	Satisfy with Finance Life
Commute Distance (km)	Satisfy with Health Life

¹ Household income level: 1<1, 2: 1~2, 3: 2~3, 4: 3~4, 5: 4~5, 6: 5~6, 7: 6~7, 8: 7~8, 9: 8~9, 10: 9~10, 11: 10~15, 12>15 (unit: 1 million Yen);

² The value Zero refers the people don't choose the corresponding travel mode and the people even don't join the activity.

6.1.3 Estimation results

The results of structure equation model analysis, based on the Maximum Likelihood Estimation, using the software AMOS, are discussed in this section, where the direct, indirect and total

effects of exogenous variables on endogenous variables are described, fully penetrated by the discussion on the effects of endogenous variables. Table 6-2 shows the results of the interdependencies of land use attributes, socioeconomic characteristics, residential choices, travel behavior, work related choices and other life choices connected with health, social, education and learning, family life, finance, and leisure and recreation life domains, as well as the quality of life. The goodness-of-fit measures reveal that the model is acceptable (GFI=0.694, AGFI=0.670, and RMSEA=0.019). The parsimony indicator (PNFI=0.655) also indicates that the models have a modest applicability (Sharmeen et al. 2014). In Figure 1, it assumed 56 direct effects among latent variables. In case of young adults, 27 out of the 56 direct effects are statistically significant. Corresponding to those insignificant direct effects, 9 indirect effects are found to be significant. The estimated results mainly support our assumed conceptual structure. Most importantly, the results answered the three above questions, firstly, it is successfully captured the directly effects of land use attributes on the young adults' residential choices, travel behavior, job life, leisure and recreation life, education and learning life, as well as the impacts on their personal quality of life. It is also examined the indirectly effects of land use pattern on their family life, finance life, social life, as well as interpersonal quality of life and their overall quality of life, however the effects on their health life showed insignificant. Secondly, it is confirmed that the young adults' quality of life exists a geographically difference between metropolises and non-metropolises, based on the finding that the young adults who reside and work/study in the metropolitan regions are more satisfied and happier than those who live in the non-metropolitan areas. Thirdly, the results answered that the young adults' choices in their family life, social life, leisure and recreation life, as well as residence life, which are playing a vital role in their overall quality of life enhancement. And the details of result description are showed below.

Table 6-2 Estimation Results of Cause-Effect Relationships based on Structural Equation Model

Exogeneous	Socioeconomics			Land Use Attributes			Job Life		Residential Choices			Travel Behavior		Health Life		Financial Life	
	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect	D-Effect	T-Effect	D-Effect	T-Effect
Latent Variables																	
Job Life	0.63*		0.63*	0.079*		0.079*											
Residential Choices (Residence Life)	0.233*		0.189*	0.242*		0.236*											
Travel Behavior	-0.275*		-0.369*	0.387*		0.382*											
Health Life	-0.472*	0.173*	-0.299*				0.222*	0.231*									
Financial Life	-0.55*		-0.633*		-0.085*				0.353*		0.353*						
Personal QOL				0.158*		0.112*					0.11*						
Family Life	0.329*	-0.286*			-0.322*	-0.231*	-0.68*	-0.575*	0.28*		0.298*	-0.528*	-0.528*				
Leisure & Recreation Life	-0.402*	0.188*	-0.214*	0.108*		0.063*	0.182*	0.208*									
Social Life	0.361*	-0.24*			-0.143*		-0.358*	-0.318*	0.304*		0.308*						
Education & Learning Life	-0.292*		-0.237*	-0.014*	-0.003*	-0.017*											
InterPersonal QOL	0.187*	-0.178*	0.01*		0.134*	0.116*											
Quality of Life (QOL)					0.112*	0.112*				0.107*	0.107*						
QOL Indicators																	
lifesatisfaction					0.103*	0.103*											
happiness					0.07*	0.07*											
InterPersonal QOL																	
Satisfy with Family Life					0.093*	0.093*											
Satisfy with Leisure/Recreation Life			0.006*		0.078*	0.078*											
Satisfy with Social Life					0.052*	0.052*											
Satisfy with Education/Learning Life			0.005*		0.055*	0.055*											
Personal QOL																	
Satisfy with Job Life					0.059*	0.059*				0.059*	0.059*						
Satisfy with Health Life					0.059*	0.059*				0.059*	0.059*						
Satisfy with Residence Life					0.062*	0.062*				0.061*	0.061*						
Satisfy with Financial Life					0.075*	0.075*				0.074*	0.074*						
Socioeconomic Characteristics																	
Age	0.908*		0.908*														
Education Level	0.388*		0.388*														
Marital Status	0.592*		0.592*														
Household Composition	-0.289*		-0.289*														
Annual Income																	
Vehicle Ownership																	
Land Use Attributes																	
Density of the Railway Stations				0.829*		0.829*											
Density of the Bus Stops				0.785*		0.785*											
Density of the Local Government Facilities				0.801*		0.801*											
Density of the Welfare Facilities				0.881*		0.881*											
Density of the Public Facilities				0.997*		0.997*											
Employment Density				0.52*		0.52*											
Population Density				0.652*		0.652*											

Continue:

Exogeneous Endogeneous	Socioeconomics			Land Use Attributes			Job Life			Residential Choices			Travel Behavior			Health Life		Financial Life	
	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect	D-Effect	T-Effect
Residential Choices (Residence Life)																			
Living in Metropolitan Cities				0.024*	0.024*					0.1*		0.1*							
Distance from the City Hall (city center) within 1 km										-0.074*		-0.074*							
Distance from the City Hall (city center) 1~5 km		0.018*	0.018*	0.023*	0.023*					0.098*		0.098*							
Distance from nearest Railway Station within 1km		0.038*	0.038*	0.048*	0.048*					-0.202*		-0.202*							
Distance from nearest Bus Stop within 0.5km																			
Dwelling Size		-0.052*	-0.052*	-0.065*	-0.065*					0.274*		0.274*							
Tenure		-0.118*	-0.118*	-0.148*	-0.148*					0.626*		0.626*							
Residence Duration		-0.081*	-0.081*	-0.101*	-0.101*					0.429*		0.429*							
Travel Behavior																			
Main travel mode is Walking / Cycling												-0.003*	-0.003*						
Main travel mode is Public Transit		-0.056*	-0.056*	0.058*	0.058*					-0.005*	-0.005*	0.152*		0.152*					
Main travel mode is Car		0.258*	0.258*	-0.268*	-0.268*					0.024*	0.024*	-0.701*		-0.701*					
Job Life																			
Occupation		0.55*	0.55*	0.069*	0.069*	0.873*		0.873*											
Working Hours per day		0.592*	0.592*	0.074*	0.074*	0.94*		0.94*											
Commute Distance		0.591*	0.591*	0.074*	0.074*	0.938*		0.938*											
Health Life																			
Frequency of Sports Participation Yearly		-0.047*	-0.047*													0.156*	0.156*		
Average Duration of Doing Sports per Time		-0.129*	-0.129*				0.099*	0.099*								0.431*	0.431*		
Financial Life																			
Percentage of Household Education Cost		-0.294*	-0.294*									0.164*	0.164*					0.464*	0.464*
Percentage of Household Leisure Cost		0.078*	0.078*									-0.043*	-0.043*					-0.123*	-0.123*
Percentage of Household Housing Cost		0.304*	0.304*									-0.17*	-0.17*					-0.48*	-0.48*
Family Life																			
Frequency of Relatives Contact Yearly				-0.079*	-0.079*	-0.197*	-0.197*			0.102*	0.102*			-0.181*	-0.181*				
Frequency of Family Meals Weekly				-0.122*	-0.122*	-0.304*	-0.304*			0.158*	0.158*			-0.279*	-0.279*				
Leisure & Recreation Life																			
Frequency to leisure activity participation yearly		-0.038*	-0.038*	0.011*	0.011*	0.037*	0.037*												
Average duration of leisure activity per time		-0.153*	-0.153*	0.045*	0.045*	0.149*	0.149*												
Social Life																			
Community Activity Participation				-0.056*	-0.056*	-0.23*	-0.23*			0.223*	0.223*								
Frequency of Neighbors Communication						0.248*	0.248*			-0.24*	-0.24*								
Education & Learning Life																			
Frequency of Learning Activity Participation Yearly		-0.205*	-0.205*	-0.015*	-0.015*														
Average Duration of Learning Activity per Time		-0.127*	-0.127*	-0.009*	-0.009*														

Continue:

Exogeneous Endogeneous	Family Life			Leisure & Recreation Life			Social Life			Education & Learning Life		Personal QOL			Inter-Personal Life			Quality of Life	
	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect
Latent Variables																			
Job Life																			
Residential Choices (Residence Life)																			
Travel Behavior																			
Health Life																			
Financial Life																			
Personal QOL																			
Family Life																			
Leisure & Recreation Life																			
Social Life																			
Education & Learning Life																			
InterPersonal QOL				0.16*		0.16*						0.849*		0.849*					
Quality of Life (QOL)		0.067*	0.067*		0.142*	0.142*		0.011*	0.011*				0.758*	0.83*	0.892*		0.892*		
QOL Indicators																			
lifesatisfaction					0.131*	0.131*							0.763*	0.763*		0.82*	0.82*	0.919*	0.919*
happiness					0.089*	0.089*							0.52*	0.52*		0.558*	0.558*	0.626*	0.626*
InterPersonal QOL																			
Satisfy with Family Life					0.128*	0.128*							0.682*	0.682*	0.803*		0.803*		
Satisfy with Leisure/Recreation Life					0.107*	0.107*							0.569*	0.569*	0.67*		0.67*		
Satisfy with Social Life					0.071*	0.071*							0.379*	0.379*	0.446*		0.446*		
Satisfy with Education/Learning Life					0.076*	0.076*							0.404*	0.404*	0.476*		0.476*		
Personal QOL																			
Satisfy with Job Life													0.53*		0.53*				
Satisfy with Health Life													0.533*		0.533*				
Satisfy with Residence Life													0.556*		0.556*				
Satisfy with Financial Life													0.673*		0.673*				
Socioeconomic Characteristics																			
Age																			
Education Level																			
Marital Status																			
Household Composition																			
Annual Income																			
Vehicle Ownership																			
Land Use Attributes																			
Density of the Railway Stations																			
Density of the Bus Stops																			
Density of the Local Government Facilities																			
Density of the Welfare Facilities																			
Density of the Public Facilities																			
Employment Density																			
Population Density																			

Continue:

Exogeneous Endogeneous	Family Life			Leisure & Recreation Life			Social Life			Education & Learning Life			Personal QOL		Inter-Personal Life		Quality of Life	
	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	I-Effect	T-Effect	D-Effect	T-Effect	D-Effect	T-Effect	D-Effect	T-Effect
Residential Choices (Residence Life)																		
Living in Metropolitan Cities																		
Distance from the City Hall (city center) within 1 km																		
Distance from the City Hall (city center) 1~5 km																		
Distance from nearest Railway Station within 1km																		
Distance from nearest Bus Stop within 0.5km																		
Dwelling Size																		
Tenure																		
Residence Duration																		
Travel Behavior																		
Main travel mode is Walking / Cycling																		
Main travel mode is Public Transit																		
Main travel mode is Car																		
Job Life																		
Occupation																		
Working Hours per day																		
Commute Distance																		
Health Life																		
Frequency of Sports Participation Yearly																		
Average Duration of Doing Sports per Time																		
Financial Life																		
Percentage of Household Education Cost																		
Percentage of Household Leisure Cost																		
Percentage of Household Housing Cost																		
Family Life																		
Frequency of Relatives Contact Yearly	0.343*		0.343*															
Frequency of Family Meals Weekly	0.529*		0.529*															
Leisure & Recreation Life																		
Frequency to leisure activity participation yearly				0.178*		0.178*												
Average duration of leisure activity per time				0.714*		0.714*												
Social Life																		
Community Activity Participation								0.725*		0.725*								
Frequency of Neighbors Communication								-0.779*		-0.779*								
Education & Learning Life																		
Frequency of Learning Activity Participation Yearly											0.864*		0.864*					
Average Duration of Learning Activity per Time											0.533*		0.533*					

Note: * significant at 95% level. "D-Effect" is "Direct effect", "I-Effect" is "Indirect effect", "T-Effect" is "Total effect".

6.1.3.1 Characterization of Land Use Attributes and Other Latent Variables

Turning first to seven land use variables, it is showed that the land use pattern for the young population is largely shaped by the non-population and non-employed attributes. Specifically, the density of the public facilities (0.997) such as parks and supermarkets is a prominent factor to characterize the land use pattern for the young adults, followed by the density of welfare facilities (0.881) such as kindergartens and schools, the density of railway stations (0.829), the density of local government facilities (0.801) such as city hall, and the density of bus stops (0.785). Observing to the socioeconomic characteristics latent variable, which is primary characterized by the individual attributes such as age (0.908), marital status (0.592) and education level (0.388), less featured by the household attributes such as household composition (0.289). Looking into the latent variable of job life, which is mainly characterized by the attributes of working hours (0.592), followed by commute distance (0.591) and occupation type (0.55). And the feature of residence life is mainly supported by the housing attributes such as tenure (0.118) or residence duration (0.081), and the residential environment attributes such as distance to the nearest railway station (0.038). Moreover, the distinguishing characteristics of travel behavior is mainly contributed by the young adults choose car (0.258) to go out. As for the latent variable of health life, it is major characterized by the intensity of doing sports (0.431) instead of frequency of sports participation (0.156), it is indicated that the young people prefer to engage more in those kind of sports activities for their health keeping. Switching to the finance life, which is primary featured by the income allocation on the housing cost (0.48) and education cost (0.464). In terms of family life variable, the time sharing with family members (0.529) shows more important compared with spending time on relative contacts (0.343). Regarding for the leisure and recreation variable, staying time (0.714) plays a prominent role in characterizing the young adults' leisure life. And in the social life,

communication with neighbors' (0.779) plays a more dominant role than participation in the community activities (0.725). As for the education and learning life variable, it is mainly supported by the attributes of the learning frequency (0.864). Most importantly, it is found that the personal quality of life is primary featured by the attributes of satisfaction with finance life (0.673) and residence life (0.556). It is further showed that the interpersonal quality of life is mainly characterized by the attributes of satisfaction with family life (0.803) and leisure life (0.67). Providing the insight into the quality of life variable, it is revealed that the life satisfaction attribute (0.919) is more essential than the happiness attribute (0.626). Those above results are mainly consistent with the young adults' daily life trajectories and needs.

6.1.3.2 Impacts of Land Use Attributes

First looking at the magnitudes of total effects among the latent variables, land use attributes generates significant impacts on the young adults' travel behavior (0.382) greatly, sequentially followed by residence life (0.236), family life (0.231), job life (0.079), social life (0.077), leisure and recreation life (0.063), as well as education and learning life (0.017). Specifically, as for the considerable impact of land use attributes on the young adults' travel behavior, the result found that living in the compact and high population/employment density cities, the better accessibility and availability of diversity facilities such as the public facilities and public transit facilities, the young adults prefer less car use, and the higher probability to walking or cycling to the entertainment places such as game centers, amusement parks as well as cinemas/theaters, the more propensity to choose public transit go for working. It is indicated that the compact and diversity neighborhoods encourage the young adults' walk more and cycling more for the leisure activities participation, and go for working by public transit, which are beneficial for the young population health improvement, energy conservation and pollution

emission reduction. Particularly in the residential choices including the residence location choice and housing attributes choices, the results reveal that the more compact land use pattern will attract more and more young adults to reside and work/study in the metropolitan regions, compared with the non-metropolitan cities, which has a negative and insignificant sign. However, the young adults prefer to live a bit far away (over 1km) from the city center maybe due to the high land and housing price surrounding the city center, and they more willing to locate the residence proximity to the railway stations so that access to the city center and anywhere else more easier and convenient. In terms of housing attributes choices, the young adults choosing to reside in the high compact neighborhood are more incline to rent an apartment instead of a detached house or owning a house, with smaller dwelling size and not live even longer. The results are mainly in accordance with the young adults' life style in Japan. Besides, the effect of residential choices on travel behavior are also significantly captured from the results, it is depicted that the young live away from the city center more than 1 km, are more incline to use car instead of public transit and walking/cycling. It is further supported that the young adults reside in the neighborhood with high mixed land use are high probability to work out and trip out by public transit and active transit (walking/cycling), compared with car use.

Providing insights into the job domain, it is reflected that the compact city with high employment opportunities and high population density, which promotes the young population to involve in more professional jobs such as officers and staff, and makes them work more and longer maybe due to the fierce competitions. Regarding for the leisure and recreation life, results demonstrated that the diversity and mixed built environment is a positive incentive on the young adults' decisions to engage in leisure activities more frequently, spend more time that is beneficial for the social network consolidation and extension. It is can fully explain the reason, it is expected that residential environment could have a direct effect on the young adults'

social life, an indirect effect is captured instead of an expected one. But it is further confirmed the positive impact on the young adults' family life, it is depicted that the compact land use planning is good for keeping touch with family members/relatives and sharing time together. Observing the education and learning life, it is discovered that living in the compact neighborhood with high density of public facilities such as schools and community centers, the young adults are more willing to attend the learning activities such as language learning and job skill training, so as to make them more competitive.

Last but not least, switching to the impacts on the quality of life, it is further verified that land use attributes have a significant impact both on the personal quality of life (0.112) and the interpersonal quality of life (0.116), as well as significant effect on the overall quality of life (0.112). It is illustrated that living under the compact land use pattern with high density of diversity facilities and high population/employment density, the young adults feel more satisfied and happiness with their different life domains particularly in their residence life, family life, social life, job life, leisure and recreation life. Expectedly, that is in line with our prior assumption that the young adults seem more satisfied and happier than those who live in the non-metropolitan areas, that's the reason why the majority of young adults are willing to migrate in the metropolitan regions in Japan, especially after their graduation from universities.

6.1.3.3 Impacts of Socioeconomic Characteristics

To inspect the significant total effects of socioeconomic characteristics on the other latent variables, it is found that the young adults' socioeconomic characteristics have an essential role in their finance life (0.633), sequentially followed by job life (0.63), travel behavior (0.369), health life (0.299), education and learning life (0.237), leisure and recreation life (0.214), and residence life (0.189), as well as the significant effect on the interpersonal quality of life (0.01).

Firstly, as for the finance life, it is showed that with the age increases, the young adults who were well-educated and married, the expenditure on education consumption will be gradually increased, but with the household composition becoming larger, the cost of leisure and housing consumption will be increased. Followed observing from the job life, it is found that the young adults who were well-educated always work longer and more than others, but with the family structure become larger, the young adults incline to work less maybe they share more time with family members.

In terms of the health life, it is discovered that the young adults who were well-educated and married, with the age increasing, they go for doing sports more frequently, compared with the young with more family members. Further on their education and learning life, it is showed that the household attributes also play a vital role in the young adults learning life, the more house members, the less frequently go for learning activities such as hobby, language learning and job skills training. In addition, the result also discovered that the young adults well-educated, they are engaging in more leisure and recreation activities. Both the learning activities and leisure activities engagement are beneficial for the interpersonal quality of life enhancement. These results are mainly consistent with our conceptual hypothesis, the household and individual attributes have a crucial role in the young adults' key life choices (decisions) such as work related behavior, learning behavior and leisure activities participation behavior.

6.1.3.4 Life Choices and QOL

According to the results, beside the land use attributes (0.112), it is clearly examined that the interpersonal quality of life has a dominant and direct effect (0.892) on the young adults overall quality of life, while the personal quality of life only showed an significantly indirect impact (0.758) on it, in which the residence life has an indirectly influence (0.107) on it. It is suggested that the interpersonal life spheres are more influential and essential to the young adults' overall quality of life. Specifically, the choices in the leisure and recreation life (0.142) show a dominant effect, followed by the family life (0.067) and social life (0.011). However, the socioeconomic characteristics have neither direct effect nor indirectly effect on the young adults' overall quality of life, as well as their job life. It is further implied that on the way to the higher quality of life attainment for the young adults, the choices (decisions) in the social, family, as well as leisure and recreation life spheres, such kinds of interpersonal activities are making them more satisfied and happier.

To be specific, observing from the residence life, it is depicted that the young adults who reside and work/study in the metropolitan regions are more satisfied and happier than those who live in the non-metropolitan areas. Further looking into family life, it is indicated that sharing more time with relatives and participation more family activities will improve the satisfaction and happiness with the young adults' life, further contribute to the young adults' overall quality of life enhancement. What's more, capturing from the social life, it is found that attending more community activities has a significant effect on the young adults' quality of life. Offering the insights into the leisure related choices, it is obviously showed that doing the leisure activities more frequently such as going to the entertainment facilities and spending more time on those entertain activities, the young adults would feel more satisfied and happier.

It is highly reflected that in the stressful society of Japan, more and more young adults are in the greater emphasis on the spiritual communications.

6.1.4 Conclusions

Motivated by the worsening regional depopulation issue in Japan, more and more young adults migrate from non-metropolitan cities to medium-sized cities or metropolises, with an increasing elderly population, the regional development may suffer from unprecedented losses. How we can help major regional cities to counter this trend is likely to have a great bearing on the shape of nations' future. This study made an initial attempt to investigate the intertwined interdependencies among land use attributes and quality of life, especially penetrating the relevant life choices linked with the quality of life into the classical relationship between residential choices and travel behavior, among a full population cohort of young adults aged from 15 to 34 year-old in Japan. This complicated system was preliminary done by estimating a structural equation model.

As a result, firstly it is examined that the compact land use pattern with high density of diversity infrastructure facilities really attracts the young population, but compared with living closeness to the city center, the young adults are more incline to reside in a transit-oriented neighborhood, maybe due to the high land and housing price surrounding the city center.

Secondly, it is showed that the young adults who reside and work/study in the metropolitan regions are more satisfied and happier than those who live in the non-metropolitan areas, were being a geographic difference of the young adults' quality of life in the metropolitan areas and non-metropolitan areas. This can explain why more and more young adults migrate to the metropolitan cities. Metropolitan cities can offer more diversity in the residential environment such as walkability community and various housing type options; second the

mixed land use and transit-oriented neighborhood can supply the young adults more choices for the life such as leisure activities engagement, learning activities participation, community activities involvement, as well as diversity mode choices; third the higher population and employment density can provide more work opportunities for the young adults, offering more chances to expand social networks. These findings show how the land use attributes influence the young adults' quality of life in Japan.

Thirdly, it is found that the young adults' socioeconomic characteristics including the individual attributes and household attributes have no impact on their quality of life, while the interpersonal life spheres especially family life, social life, leisure and recreation life, which are important to the young adults' higher quality of life attainment, in addition to the impacts of land use attributes. It is indicated that if the regional urban planners could pay more attention on the improvement of young populations' interpersonal life spheres such as offer more diversity in leisure facilities, it could be an effective measurement to keep the young labor force to dedicate in the regional economic development and community revitalization, and further alleviate the high concentration of the metropolitans.

The above analysis was done based on an idea of life-oriented approach (Zhang, 2014). The analysis results indicate that the life-oriented approach has successfully paved a new way to capture the effects of land use attributes on life choices and the resulting quality of life. The essential idea behind the life-oriented approach is that an understanding of life choices, including travel behavior, should not be constrained by the boundary of any single discipline. A failure to understand the travel behavior from the life choice perspective may lead to a failure of consensus building for policies to better support the young adults' life. As long as people's quality of life is concerned, various behavioral aspects should be simultaneously represented. In this regard, the structural equation model with latent variables is a flexible and powerful tool to incorporate various cause-effect relationships in a unified and consistent modeling

framework. Meanwhile, behaviorally-oriented modeling approaches that can accommodate a larger set of discrete and continuous choice variables should be developed.

In the end, having summarized the findings from this study, several important research issues should be mentioned. First, migration up and down the urban hierarchy is highly differentiated patterns for persons and households at specific stages of the life course, the further longitudinal data should be collected and a time series analysis should be conducted. Second, more advanced choice models should be built to joint represent residential and travel behavior as well as other life choices for incorporating decision-making mechanisms into the analysis. Third, effects of land use and transport policies should be re-evaluated based on the conceptual framework proposed in this study and future development of better choice models. Finally, for obtaining more convincing conclusions, more case studies should be done not only in developed countries, but also in developing countries, which are experiencing more dynamic changes economically, socially, and culturally.

6.2 Disentangling the Young Adults' Residential Relocation Choice: A life History Analysis

6.2.1 Introduction

The over-concentration of population in megacities is quite popular, which is not a special case of Japan, but also in a worldwide. In this sense, it is not unrealistic to assume that the population issues in Japan, it may also occur in many developing countries particularly in Asian countries in the future. Unfortunately, behavioral mechanisms behind young adults' residential relocation decisions have been under-researched, especially from a life course viewpoint.

Young adults in Japan, referring to the population aged from 15 to 34 year-old, need to decide where to live and where to work when they leave school or establish independent households. However, residing a new residential location is also an important life choice for the young adult's new life connecting with their other life domains of health, social, family life, finance, residence, job, education and learning, leisure and recreation, as well as travel behavior, which further affect their quality of life, as argued by the life-oriented approach (Zhang, 2014; Life-oriented Behavioral Studies Subcommittee, JSCE-IP, 2015). Unfortunately, little attention has been paid to the young population's residential relocation issues from such a comprehensive behavioral viewpoint. Motivated by the above considerations, the purpose of this study is to make an initial attempt to examine and quantify the effects of living environment attributes' changes and life events' changes on the young adults' residential relocation behavior over the life course, after controlling for their household attributes and socio-demographics, based on a discrete choice model. Furthermore, motivated by issues caused by massive out-migration to large-sized cities in Japan, here, only those young adults who relocated in the past are targeted. In this study, the residential relocation choice sets are three city types in Japan -

large-sized city, medium-sized city and small-sized city, defined based on the current population. Concretely, Tokyo, Yokohama, Osaka, and Nagoya (4 regions) are treated as the large-sized city, each of which has a population of more than 2.0 million inhabitants. Sapporo, Sendai, Saitama, Kawasaki, Kyoto, Kobe, Hiroshima, and Fukuoka cities are grouped into the medium-sized city, each of them has a population over 1.0 million. And the remaining cities (in this case study, 170 cities included in the survey) are classified into the small-sized city.

Herein, the policy implications of this study are three-fold. First, this study could inform policy makers about how the young adults would make the relocation decisions in response to re-shaping of the urban structure and the economic/urban development strategies. Second, clarifying the influence of residential environment changes on the young adult's life could better evaluate the effects of urban policies, especially land use policies. Explicitly incorporating such policy outcomes into the evaluation process could better facilitate the consensus building. Third, such implications derived from the Japanese case could provide useful insights into national, regional, and urban development plans, especially in developing countries experiencing over-concentration of population at their megacities.

6.2.2 Methodology

6.2.2.1 Data description

To disentangle the residential relocation decision making processes of young adults in Japan from a life course perspective, longitudinal data are required. Instead of time-consuming panel survey, a retrospective approach is employed in this study that asks respondents to recall past relocation information. An Internet-based life history survey covering major cities in Japan was carried out in November 2010. This Internet-based survey was implemented with the help of a

major Web survey company in Japan (having more than 1.4 million registered panels at the time of survey). As a result, 1,400 questionnaires were collected by contacting 6,940 registered panels, in which age, gender, and residential distribution across the whole population in Japan are guaranteed. And the response rate was 20.2%. The survey contents surround four life events over the life course: residential mobility, household structure mobility, employment/education mobility, and car ownership mobility. In the survey, before answering detailed information related to each type of mobility, respondents are first asked to report on the mobility (change) times and the exact timing of relevant events (their age when the event occurred), and a simplified matrix showing these timings is presented in a separate window for ease of reporting detailed information later on. Subsequently, detailed information about each episode in each mobility is reported as follows:

- Residential mobility: relocation place, income, residence property, accessibility (here, refers to distance) to varied facilities (including railway; bus; primary, junior and high school; hospital; park; supermarket; city hall) in each episode.
- Household structure mobility: household size, information for each household member in each episode (including age, gender, relation with householder).
- Employment/education mobility: job category, commute time to job/school, accessibility to job/school, travel mode in each episode.
- Car ownership mobility: car number, main user, car efficiency, purpose, and use frequency in each episode.

In addition to the above information, respondents were asked to report on how confident (10-point scale) they felt about the answer to some major question items with continuous values (e.g., accessibility to facilities). Such confidence information can be used to reflect the reliability related to the reported information as well as the quality of the retrospective survey. The data show that the average confidence type is around 7–9 across different cohorts (a 10-

point scale is set in which 0 means not confident at all and 10 means fully confident), suggesting an acceptable quality of the survey data. Zhang et al. (2014) shows the details of this collected data. It is confirmed that the selected sample has a wide distribution by age, gender, household annual income, household size, residential location, and occupation.

In line with our research purpose, i.e., disentangling the effects of life events and residential environment attributes linking with various life domains on young adults' (here, the young generations in 1980s, 1990s, and 2000s were considered) residential relocation choice in Japan, after controlling for their socio-demographics, I abstracted 1,770 mobility data of respondents who relocated their previous residence in their 15-34 years old from the above survey. Specifically, there are 393, 671, and 706 young adults in 1980s, 1990s, and 2000s residing new residences from their original residence places, respectively.

In this study, each relocation sample has three alternatives: small-sized, medium-sized, and large-sized city types. Because before moving, an individual resides in one type of the cities, as the whole sample, there are nine types of relocations: (1) moving from small-sized city to small-sized city; (2) moving from small-sized city to medium-sized city; (3) moving from small-sized city to large-sized city; (4) moving from medium-sized city to small-sized city; (5) moving from medium-sized city to medium-sized city; (6) moving from medium-sized city to large-sized city; (7) moving from large-sized city to small-sized city; (8) moving from large-sized city to medium-sized city; and (9) moving from large-sized city to large-sized city.

Before moving to the modeling analysis of young adults' residential relocation decisions, an aggregation analysis is conducted and results are shown in Figures 6-2 ~ 6-6.

The distribution of young adults' residential relocation choices by gender is shown in Figure 6-2, which reveals significant differences between female and male. As the whole sample, there were more female young adults migrated to small-sized cities: 5.99% from large-sized cities (male: 4.49%), 5.88% from medium-sized cities (male: 2.99%), and 26.53% from

small-sized cities (male: 22.21%). As for male adults, more migrations within large-sized cities (22.90%) and within medium-sized cities (24.97%) are observed. It is further shown that 10.65% of female moved from small-sized to large-sized cities, about 4 points higher than that of male adults. In total, there were more male adults preferring the relocation to medium-/large-sized cities (4.03 points higher in large-sized cities and 4.69 points higher in medium-sized cities than female), but more female moved to small-sized cities (about 8.71 points higher than male).

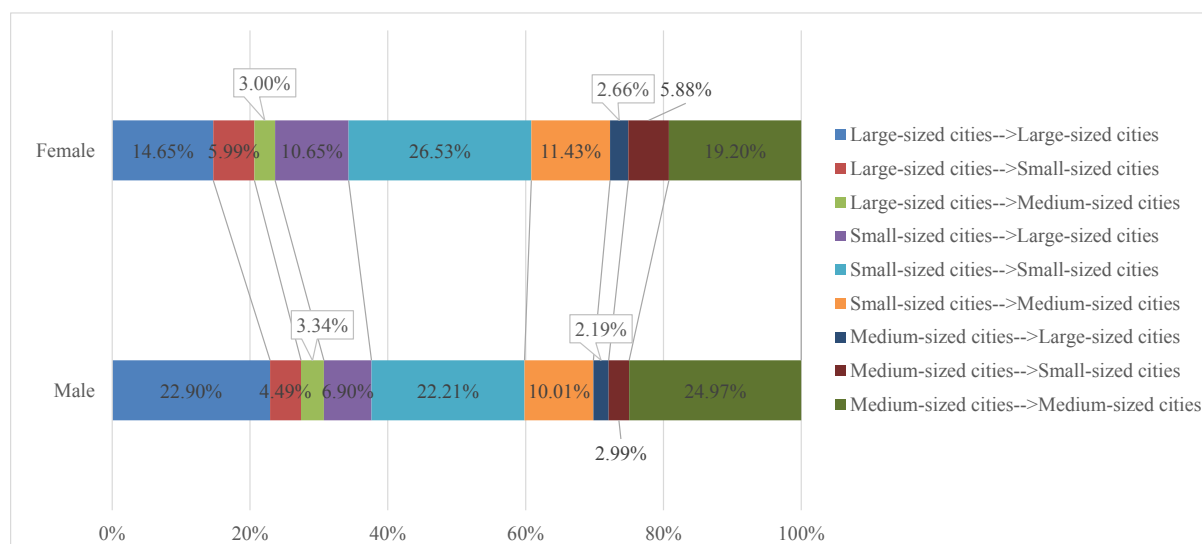


Figure 6-2 Distribution of young adults' residential relocation choices by gender

Figure 6-3 depicts the distribution of different young adults' residential relocation choices by generation. The 1990s generation more preferred the relocation within small-sized cities (26.68%) on one hand, while they less preferred the relocation within medium-sized cities (19.82%), compared with the 1980s and 2000s generations. The relocation to large-sized cities grew over time (27.47% in 1980s, 29.21% in 1990s, and 32.01% in 2000s). In contrast, the relocation to small-sized cities saw a peak in 1990s (35.36% in 1980s, 37.71% in 1990s, and 30.03% in 2000s), but the drop from 1990s to 2000s was much more remarkable than the increase from 1980s to 1990s. Conversely, I observed a valley of the relocation to medium-sized cities in 1990s, which however recovered almost to the same type in 1980s.

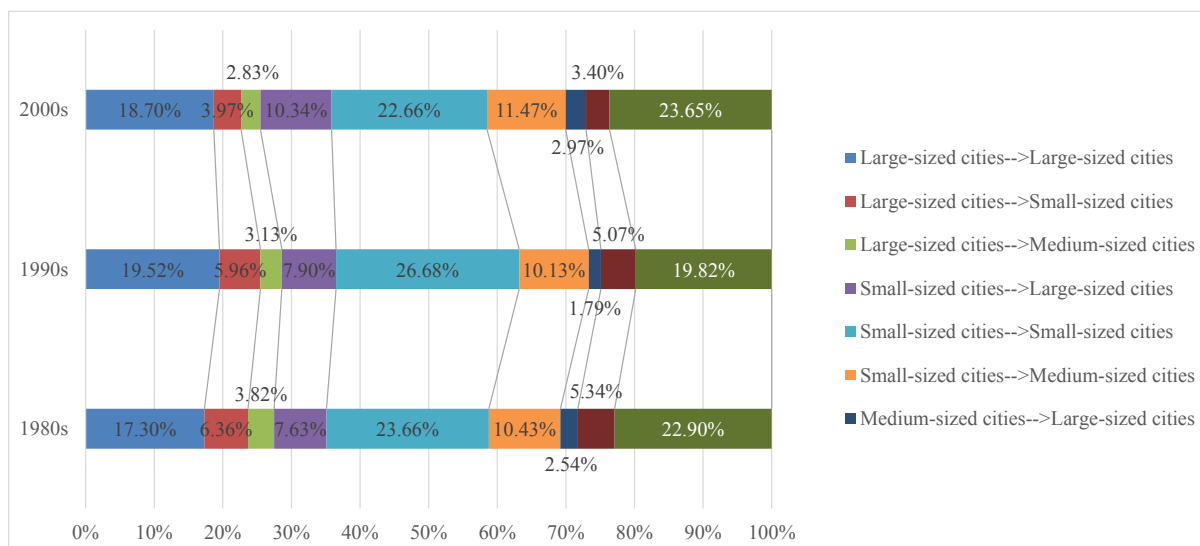


Figure 6-3 Distribution of young adults' residential relocation choices by generation

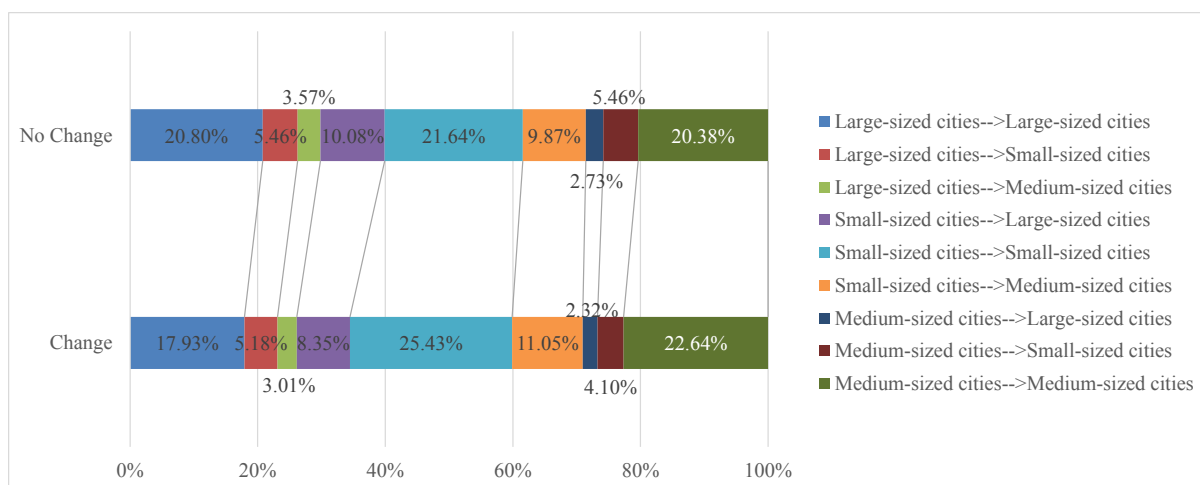


Figure 6-4 Distribution of young adults' residential relocation choices in response to household structure changes during previous or subsequent five years

Moreover, as we can see from Figures 6-4~6-6, in response to life events such as changes in household structure, work place, and car ownership within previous or subsequent five years, the young adults' residential relocation choices are significantly different. Specifically, if the household structure changed during previous or subsequent five years, the older young adults prefer to live in large-sized cities instead of medium-sized cities and small-sized cities. When they changed work places within previous or subsequent five years, more

and more younger adults relocated to large-sized cities. However, if the young adults changed their car ownership within previous or subsequent five years, they have a lower probability to relocate to large-sized cities.

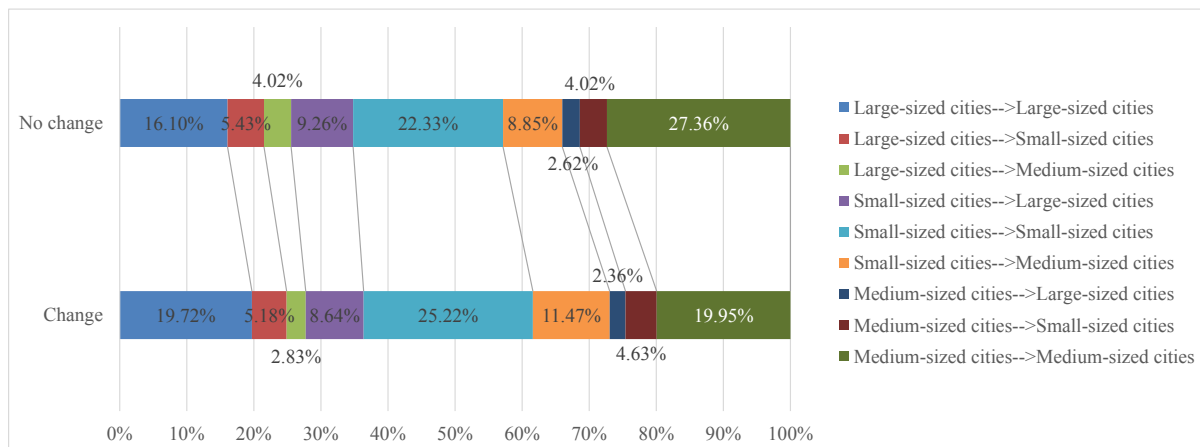


Figure 6-5 Distribution of young adults' residential relocation choices in response to work place changes during previous or subsequent five years

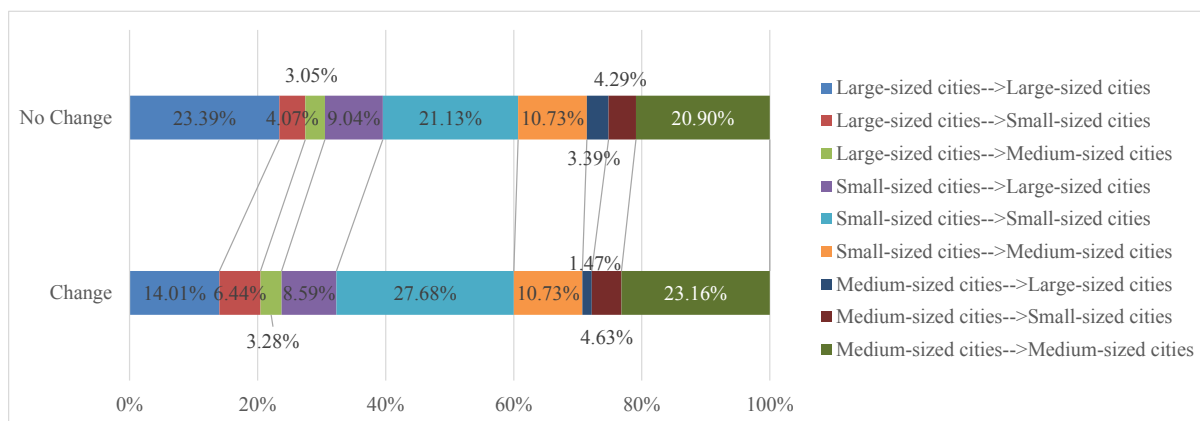


Figure 6-6 Distribution of young adults' residential relocation choices in response to car ownership changes during previous or subsequent five years

6.2.2.2 Model Specification and Explanatory variables

My analysis is based on a multinomial logit (MNL) model (McFadden, 1978). It is assumed in this study that a young adult n maximizes his/her utility in making the residential relocation decision. The choice set of relocation locations (cities) with j alternatives is denoted

by J . The utility U_{nj} that the young adult n obtains by choosing a relocation city j from the choice set J can be expressed as:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (1)$$

where, V_{nj} is the deterministic term of utility U_{nj} , and ε_{nj} is an error term representing the influence of unobserved factors on the relocation choice.

Assuming that the error term ε_{nj} follows an independent and identical Gumbel distribution across different choice alternatives, the following MNL model structure can be derived (details refer to McFadden, 1978), where P_{nj} denotes the probability that the young adult n chooses a relocation city j from the choice set J .

$$P_{nj} = \frac{\exp(V_{nj})}{\sum_{j'} \exp(V_{nj'})} \quad (2)$$

Generally speaking, a person chooses his/her residence location by comparing some specific cities (for example, Tokyo, Kyoto, Hiroshima, and/or Fukuoka). Even though there are more than 1,000 cities in Japan, it is even difficult to assume that a person chooses one city by comparing with several hundred cities, in reality. Because this study was motivated by the concern about issues caused by an increasing trend of young adults' massive out-migration from small-sized cities to medium-/large-sized cities in Japan, clarifying influential factors to residential changes across cities with different population sizes becomes important. Here, instead of focusing on specific cities in representing relocation choices, we capture such choices at three city types: large-sized, medium-sized, and small-sized city types, defined based on population. In other words, a young adult has three alternatives for his/her choice: large-

sized, medium-sized, and small-sized cities. Depending on which type of city the young adult is residing when making his/her relocation decision, the three alternatives are different. Details are shown below:

- In the case that the young adult is residing in one of small-sized cities: 1 = from small-sized city to small-sized city (treated as the baseline choice in model estimation), 2 = from small-sized city to medium-sized city, 3 = from small-sized city to large-sized city

- In the case that the young adult is residing in one of medium-sized cities: 4 = from medium-sized city to small-sized city (baseline choice), 5 = from medium-sized city to medium-sized city, 6 = from medium-sized city to large-sized city

- In the case that the young adult is residing in one of large-sized cities: 7 = from large-sized city to small-sized city (baseline choice), 8 = from large-sized city to medium-sized city, 9 = from large-sized city to large-sized city

In this study, I jointly estimate young adults' residential relocation choice no matter where they are residing. In other words, even though there are three types of choice models for the whole sample, but we estimate them at the same time. As shown later, there are many explanatory variables adopted in this study. Such joint estimation is made to obtain more reliable estimation results by using the 1,770 samples. One more motivation behind this consideration is that we attempt to derive more common factors affecting choices to relocate at the three city types.

To estimate any choice, usually, there are two types of attributes: one is specific to choice alternatives (some alternatives may have different attributes from others, and the others may share some common attributes, but the attribute values are different across alternatives) and the other is generic to alternatives, i.e., alternatives share both common attributes and same values. In case of residential relocation choice, alternative-specific attributes refer to different living environment at different city types and alternative-generic attributes indicate an

individual's socio-demographics and his/her household attributes etc., In this study, some life events are also introduced, which belong to alternative-generic attributes. Then, the deterministic term V_{nj} in equation (1) can be formulated as follows,

$$V_{nj} = \sum_k \beta_k X_{njk} + \sum_s \gamma_{sj} z_{ns} \quad (3)$$

where, X_{njk} refers to the k th alternative-specific attribute and z_{ns} indicates the s th alternative-generic attribute.

As stated previously, this study attempts to understand the competition between cities with different population types in the context of young adults' relocation choices. For this purpose, it is necessary to reflect the influences of relative advantages and disadvantages of an original city to the relocation city on young adults' relocation decisions. In this study, we selected living environment attributes at the city type as alternative-specific attributes (e.g., schools, industries, hospitals, and parks) and adopt the following difference-based formulation to define the above relative advantages and disadvantages.

$$X_{njk} = x_{njk} - x_{nj_0k} \quad (4)$$

Here, X_{njk} refers to the k th alternative-specific attribute of the relocation city j and to that of the original city j_0 .

Putting all the above treatments together, one can obtain the following probability equation for young adults' residential relocation choices.

$$P_{nj} = \frac{\exp(\sum_k \beta_k (x_{njk} - x_{nj_0k}) + \sum_s \gamma_{sj} z_{ns})}{\sum_{j'} \exp(\sum_k \beta_k (x_{n'jk} - x_{nj_0k}) + \sum_s \gamma_{sj'} z_{ns})} \quad (5)$$

One more logical feature of equation (5) is that, even though the traditional MNL formulation suffers from the so-called IIA (Independence of Irrelevant Alternatives) property, equation (5) does not hold such property because the probability ratio of alternatives j and j' also includes the information about other alternatives in choice set in the sense that the original city j_0 may belong to either of the three city types.

Here, it becomes a problem how to define alternative-specific attributes at three city types. In the survey, each respondent was asked to report the detailed name of residence city. As for the alternative-specific attributes of the chosen city type (large-sized, medium-sized, or small-sized city type), we adopted the living environment attributes at the chosen residence city (e.g., Tokyo or Hiroshima). Concerning a competing city type, we first randomly selected one specific city from all cities (4 in the large-sized city type, 8 in the medium-sized type, and 170 in the small-sized type) included in its corresponding city type and then treated the living environment attributes of that specific city as the alternative-specific attributes of the competing city type. In other words, all the living environment attributes in the model estimation are those values of the original city, the chosen relocation city, and the competing city randomly selected from the corresponding city type, where all the values are those in the relocation year.

Table 6-3 presents the explanatory variables included in the improved MNL model without the IIA property. To be clear, there are three groups of explanatory variables. The first group includes socio-demographics such as income and gender, the second group contains life events observed during previous and following five years. The third group includes living environment attributes at the city type. As for the living environment attributes, we further classify them into different categories that are associated with eight major life domains (residence, job, finance, health, leisure/recreation, education/learning, family life, and social life), as well as the transportation environment.

Table 6-3 Explanatory variables of residential relocation choice model

Explanatory variables	Descriptions
Socio-demographics:	
Gender	male = 1, memale = 0
Residential relocation age	the age of respondent in residential relocation year
Young adults in 1980s	1: if the respondent aged 15-34 years old during the period 1980 to 1989, 0: otherwise
Young adults in 1990s	1: if the respondent aged 15-34 years old during the period 1990 to 1999, 0: otherwise
Young adults in 2000s	1: if the respondent aged 15-34 years old during the period 2000 to 2010, 0: otherwise
Household income per year before residential relocation	1: <100; 2: 100-199; 3: 200-299; 4: 300-399; 5: 400-499; 6: 500-599; 7: 600-699; 8: 700-799; 9: 800-899; 10: 900-999; 11: 1000-1499; 12: >1500. (unit: 10,000 Yen)
Residence property before residential relocation	Own the house = 1, otherwise = 0
Commute distance before residence relocation	Distance from home to work place (1:<5; 2:[5, 10); 3:[10, 15); 4:[15, 20); 5: >=20 km)
Commute time before residence relocation	Travel time from home to work place (1:<15; 2:[15, 30); 3:[30, 45); 4:[45, 60); 5:[60, 90); 6:[90, 120); 5: >=120 minutes)
Life events:	
Household structure change before relocation	1: household structure changed in previous five years before residential relocation, 0: no change
Household structure change after relocation	1: household structure changed in subsequent five years after residential relocation, 0: no change
Work place change before relocation	1: work place changed in previous five years before residential relocation, 0: no change
Work place change after relocation	1: work place changed in subsequent five years after residential relocation, 0: no change
Car ownership change before relocation	1: car ownership changed in previous five years before residential relocation, 0: no change
Car ownership change after relocation	1: car ownership changed in subsequent five years after residential relocation, 0: no change
Attributes of living environments at the city level	
Residence life related attributes	
Density of residence	The number of living houses per area: number / km ²
Housing area	The average area of first floor: m ²
Rental house fee	Yen / month
Job life related attributes	
The employment rate of young adults	The employed young adults / the whole labor force in a specific area.
Tertiary industry companies	The number of companies in the tertiary industry
Financial life related attributes	
Average per capital income	1,000 Yen / year
Average per capital subsidy tax	The average financial subsidy per capital: 1,000 Yen / year
Average per capital inhabitant tax	The average income tax: 1,000 Yen / year
Health life related attributes	
Density of hospitals	The number of hospitals per area: number / km ²
Density of parks	The number of parks per area: number / km ²
Leisure & recreation life related attributes	
Density of restaurants	The number of restaurants per area: number / km ²
Density of shops	The number of shops per area: number / km ²
Density of supermarkets	The number of supermarkets per area: number / km ²
Education & learning life related attributes	
Density of primary schools	The number of primary schools per area: number / km ²
Density of junior schools	The number of junior schools per area: number / km ²
Density of high schools	The number of high schools per area: number / km ²
Family life related attributes	
Density of elderly care centers	The number of elderly care centers per area: number / km ²
Density of child care centers	The number of child care centers per area: number / km ²
Social life related attributes	
The population density of young adults	The population density aged from 15-34 years old: persons / km ²
Birth rate	The number of babies born divided by the whole population: %
Transportation environment	
Road Density	The total length of roads per area: km/km ²
Traffic accidents	The total number of traffic accidents per year

6.2.3 Model estimation and results

Table 6-4 depicts the model estimation results based on the standard maximum likelihood estimation method. In this study, an improved MNL model without IIA property was employed

to examine the effects of socio-demographics, life events, and living environment characteristics on residential relocation choices. As stated previously, there are three groups of young adults who resided in one of three city types and each group has three choice alternatives in relocation decisions. Here, the choice models of the three groups were estimated simultaneously. The baseline alternatives are the alternative “from large-sized city type to small-sized city type” for those who originally resided in the large-sized city type, “from medium-sized city type to small-sized city type” for those who originally resided in the medium-sized city type, and “from small-sized city type to small-sized city type” for those who originally resided in the small-sized city type. The model accuracy (both McFadden’s rho-squared and its adjusted value) is reasonably higher and most of the introduced explanatory variables are statistically significant. The model estimation results found varied factors affecting the relocation decisions of young adults originally living in different city types.

Effects of living environment

I mainly discuss results of statistically significant attributes, which all have expected parameter signs. As a comparison, we also look at some insignificant attributes.

First, advantageous job opportunities in large-/medium-sized cities surely increase the probability of relocating to these cities because of parameters of job life related attributes (the employment rate of young adults and the number of companies in the tertiary industry) are all positive. Relocation behavior of young adults originally residing in small-sized cities is not affected by job opportunities in the tertiary industry. This implies that revitalization policies from the tertiary industry would not attract young people’s relocation to small-sized cities. Instead, providing more employment opportunities in primary and secondary sectors may be effective, considering the significant parameter of the employment rate of young adults.

Second, currently, the Japanese government is making efforts to increase birth rates across the whole country. Because the parameters of birth rate in the three types of relocation choice models are all positive, this means that increasing birth rate in large-/medium-sized cities would significantly reduce the likelihood of relocating to small-sized cities. Statistically, it is said that cities with a lower type of population usually have a higher birth rate in Japan. If so, the decrease of birth rate in large-/medium-sized cities is beneficial to the relocation to small-sized cities. Many medium-/small-sized cities in Japan are also trying to provide more child care facilities for attracting more young people, the parameter of density of child care centers suggests that such a policy is statistically useful in medium-sized cities, but not effective at all in small-sized cities. Comparatively, increasing elderly care centers in small-sized cities may attract young people's relocation, probably because such an increase may mitigate their concerns about the after-retirement life.

Third, one more revitalization policy discussed in Japan is related to education. Our model estimation results suggest that effects of education-based revitalization policies are limited, which only affect the relocation choice from large-sized cities from the perspective of primary education and that from small-sized cities from the perspective of junior education. High school education policies are not influential to any relocation decisions.

Fourth, except density of parks in small-sized cities, all the other health life related living environment attributes are statistically influential to relocation decisions. The results indicate that increasing densities of health related facilities in large-/medium-sized cities remarkably contributes to the relocation within these cities, compared with those originally residing in small-sized cities (relevant parameters in original residence cities with large-/medium-sized population are 0.015/0.028, but the parameter in original residence cities with small population size is just 0.008).

Fifth, leisure and recreation related living environment is not influential at all to the relocation from small-sized cities. Restaurants contribute to the relocation from large-/medium-sized cities, shops to the relocation from medium-sized cities, and supermarkets to the relocation from large-sized cities.

Sixth, as for transportation environment, traffic accidents in large-/medium-sized cities lead to a lower likelihood of relocating to them. Considering that there are more transportation investments in these cities, which usually contribute to the realization of better transportation environment, our results show that even transportation investments in large-/medium-sized cities reduce the possibility of young people to move to small-sized cities. From the financial perspective, only parameters of subsidy tax are significant in explaining relocation decisions of young people originally residing in all three types of cities, suggesting the continuing importance of subsidy policies. Unfortunately, income and inhabitant tax are not relevant to relocation decisions.

Last, as for residence attributes, housing area is influential to relocation decisions from both large-sized and medium-sized cities and rental house fee is only significant in describing the relocation from large-sized cities. Due to the decreasing trend of land price in many cities, including large-sized and medium-sized cities, owning a larger house in these cities is becoming not so difficult. Such trend is however not a good news for small-sized cities who want to attract more young people.

Effects of socio-demographics and life events

Positive parameters of gender suggest that male more prefer the relocation to large-/medium-sized cities. Comparing the parameters between large-sized and medium-sized cities, it is found that male prefer the relocation to medium-sized cities more than large-sized cities. Looking at the age at the time of relocation, its parameters are statistically significant and negative, except

in the relocation alternative from medium-sized cities to large-sized cities. Negative parameters of the age imply that the younger adults are more likely to move to large-sized and medium-sized cities no matter where they originally resided. More concretely speaking, those who just graduated from universities in any types of cities all prefer the relocation to large-sized and medium-sized cities.

The young adults in 1980s (1990s as a reference) have a higher likelihood of relocating to small-sized cities from large-/medium-sized cities in the sense that most of the “Young adults in 1980s” parameters are negative. Unfortunately, such a trend is completely changed in 2000s: no matter where young adults resided, their relocation choices all give priority to large-/medium-sized cities, because all parameters of “Young adults in 2000s” are statistically positive. But depending on the original residence cities, such a changing trend show different pictures. In the case of originally residing in large-/small-sized cities, young adults more prefer the relocation to large-sized cities (the corresponding parameters are 0.237/0.888 in the relocation to large-sized cities and 0.052/0.678 to medium-sized cities). In contrast, those originally residing in medium-sized cities more prefer the relocation to the same type of medium-sized cities (0.865 in relocation to medium-sized cities > 0.526 to large-sized cities). Looking at the variable “residence property before relocation”, it is found that owning a house is only influential to the relocation to large-/medium-sized cities from large-sized cities. Household income before relocation is not relevant to relocation decisions. As for commute attributes, longer commute distance and time in large-/medium-sized cities reduce the relocation probability to large-/medium-sized cities, but a reverse effect is observed with respect to the relocation from small-sized cities. Such a differing trend might be caused by the larger gap of commute distance and time between small-sized cities and the other two cities.

Regarding life events occurring before and after relocation, they are not influential to the relocation from small-sized cities, but to that from large-/medium-sized cities. The

Table 6-4 Model Estimation Results

Explanatory Variables	Young adults originally residing in large-sized city level (Baseline: from large-sized city level to small-sized city level)		Young adults originally residing in medium-sized city level (Baseline: from medium-sized city level to small-sized city level)		Young adults originally residing in small-sized city level (Baseline: from small-sized city level to small-sized city level)	
	Large-sized City Level	Medium-sized City Level	Large-sized City Level	Medium-sized City Level	Large-sized City Level	Medium-sized City Level
Constant term	-2.589*	-2.728*	9.651*	11.359*	-0.153	-1.492
Socio-demographics:						
Gender	0.279*	0.617*	0.701*	1.289*	0.346*	0.017
Residential relocation age	-0.074*	-0.079*	-0.023	-0.100*	-0.069*	-0.022*
Young adults in 1980s	-0.535*	-0.165*	-0.164*	-0.163*	-1.197*	-1.052*
Young adults in 2000s	0.237*	0.052*	0.526*	0.865*	0.888*	0.678*
Household income before residence relocation	-0.420	-0.416	-0.214	-0.026	0.170	0.096
Residence property before residence relocation	0.725*	0.307*	0.195	0.019	0.195	-0.055
Commute distance before residence relocation	-0.406*	-0.311*	-0.410	-0.111	0.008*	0.113*
Commute time before residence relocation	-0.789*	-0.203*	-0.001	-0.003	0.109*	0.046*
Life Events:						
Household structure change before relocation	-0.698*	0.113	-0.636	-0.019	-0.150	-0.013
Household structure change after relocation	0.142	0.030	-0.140	-0.614*	-0.189	-0.093
Work place change before relocation	-0.366	-0.188	-0.218	0.172	-0.279	-0.032
Work place change after relocation	-0.640*	-0.570*	0.479	0.562*	-0.021	0.121
Car ownership change before relocation	0.439	0.956*	-0.209	-0.328	-0.203	-0.329
Car ownership change after relocation	0.507	0.603*	-0.988*	0.077	-0.116	-0.071
Attributes of Living Environment at the city level						
<i>Residence life related attributes</i>						
Density of residence		0.123		0.053		-0.007
Housing area		1.431*		4.063*		1.019
Rental house fee		-0.210*		0.040		-0.273
<i>Job life related attributes</i>						
The employment rate of young adults		4.220*		6.408*		1.624*
Tertiary industry companies		0.011*		0.135*		0.016
<i>Financial life related attributes</i>						
Average per capital income		0.009		0.137		0.022
Average per capital subsidy tax		1.060*		0.387*		0.064*
Average per capital inhabitant tax		0.833		0.199		0.093
<i>Health life related attributes</i>						
Density of hospitals		0.015*		0.028*		0.008*
Density of parks		0.120*		0.167*		0.016
<i>Leisure & recreation life related attributes</i>						
Density of restaurants		0.235*		0.123*		0.014
Density of shops		0.664		0.665*		-0.012
Density of supermarkets		1.513*		-0.775		1.214
<i>Education & learning life related attributes</i>						
Density of primary schools		5.034*		-2.054		0.007
Density of junior schools		3.832		3.794		0.262*
Density of high schools		1.379		-1.945		0.453
<i>Family life related attributes</i>						
Density of elderly care centers		0.058		0.023		0.091
Density of child care centers		0.573*		0.115*		0.267
<i>Social life related attributes</i>						
The population density of young adults		2.818*		-7.426		1.052*
Birth rate		0.063*		0.129*		0.306*
<i>Transportation environment</i>						
Road Density		0.521		-0.694		-0.149
Traffic accidents		-0.035*		-0.038*		-0.080
Sample size (N)				1,770		
Initial log-likelihood				-1944.544		
Final log-likelihood				-1310.467		
McFadden's rho-squared: ρ				0.326		
Adjusted McFadden's rho-squared: ρ'				0.252		

Note: Statistically significant (at the 5% type) parameters in bold type with “*” and insignificant in grey color.

household structure change during previous five years before relocation reduces the relocation within large-sized cities (-0.698), and that after relocation reduces the relocation within medium-sized cities (-0.614). Work place change after relocation results in a reduction of the

relocation from large-sized cities (-0.640 / -0.570), but leads to an increase in the relocation within medium-sized cities (0.562). Moreover, the result indicates that household car ownership change before/after relocation supports the young adults' residential relocation decisions on moving to medium-sized cities from large-sized cities (0.956 and 0.603), but the car ownership change after relocation mitigates the possibility of moving from medium-sized to large-sized cities. The above results suggest the existence of both state dependence and future expectation in young adults' residential relocation choices.

6.2.4 Conclusion

Motivated by the issues caused by historically massive out-migration of young people to large cities (especially, Tokyo, Osaka, and Nagoya regions) in Japan and generality of such issues in megacities of Asian developing countries in the future, this study has focused on the young adults' residential relocation choices among three city types (large-sized, medium-sized, small-sized cities defined by population) by implementing a retrospective life history survey in 2010 and building a discrete choice model without IIA property. Residential relocation data with 1,770 samples were collected from the young adults in 1980s, 1990s, and 2000s. Especially, effects of various living environment attributes related to different life domains are extensively examined over the life course, together with socio-demographics and life events, by incorporating both state dependence and future expectation into the modeling process. This study filled the research gap to better understand serious regional depopulation issues in Japan, mainly due to the rapidly aging population and the majority of young population out-migration from small-sized cities to medium-sized cities/large-sized cities, from the behavioral perspective. The key contribution is to develop an empirical framework to better understand

the different young adults' residential relocation tendencies from a life-course perspective, by allowing for the effects of state dependence and future expectation as well.

Various findings related to policy decisions have been derived from this study. First, it is found that the young adults in 1980s were more likely to relocate to small-sized cities; however, those in 2000s showed a higher preference over large-/medium-sized cities as relocation cities. On the other hand, the changing trend is more complicated considering migrations within large-sized and within medium-sized cities. Second, policies improving living environment for attracting young people should be made carefully because both significant and insignificant attributes are almost equally observed and significant living environment attributes also show diverse influences on residential relocation decisions of young adults in different types of cities. More policies increasing employment opportunities in small-sized cities in the primary and secondary sectors should be emphasized. If the central government wants to make policies (e.g., increasing child care facilities) for raising birth rate in both small-sized and medium-/large-sized cities, the policies may not be effective to the out-flow of young adults from large-sized cities to small-sized cities and sometimes may play a completely reverse role because our analysis results show that the decrease of birth rate in large-/medium-sized cities may increase the relocation possibility to small-sized cities. It seems that in small-sized cities, improving elderly care services may mitigate young people's worries about the after-retirement life and consequently result in more in-flow of young people. It is further revealed that effects of education-based revitalization policies are limited and effects of leisure and recreation related living environment are even limited. Furthermore, policies of improving the health-related living environment and increasing subsidy taxes may worsen the competition among cities to attract young people. Finally, a decreasing trend of land price in large-/medium-sized cities and relevant policies should be considered as a threat to small-sized cities in proposing revitalization policies. There are various issues caused by the population

over-concentration in megacities of Asian developing countries. The above findings at least suggest that policy maker should make more effort to support the development of medium-/small-sized cities.

Behaviorally, it is a valuable finding to re-confirm the existence of both state dependence and future expectation in the context of residential relocation decisions of those young adults originally residing in large-/medium-sized cities. Unfortunately similar observations cannot be found in the context of small-sized cities. Additionally, only a limited set of influential factors affecting the young adults originally living in small-sized cities are confirmed, suggesting that more factors should be explored in the future.

This study was partly done within the framework of the life-oriented approach (Zhang, 2014; Life-oriented Behavioral Studies Subcommittee, JSCE-IP, 2015), which suggests that decisions in various life domains are interdependent. The analysis results indicate that combining the life-oriented approach and retrospective survey approach could pave a new way to capture the effects of living environment attributes on people's residential relocation choices. The failure of understanding and capturing residential relocation behavior from the life choice perspective may lead to a failure of consensus building for policies to better support people's life. As long as people's quality of life is concerned, various behavioral aspects linked to essential life domains should be simultaneously represented. In this sense, migration studies based on the life-oriented approach should be further promoted. In addition, considering the influence of social interactions on general human decisions, those young adults who already decided to move might be influenced by those choosing to stay in the city. To clarify such influence, it is surely worth exploring how no-moving decisions affect moving decisions in the future. Finally, the existence of state dependence and future expectation suggests that more efforts should be made to develop behaviorally-oriented dynamic models over the life course.

**7 How Elderly's Travel Behavior Affects Other Life Choices
and QOL in Depopulated Areas under the Influence of Land
Use Patterns: A Comparative Study**

7.1 Introduction

In 1990 the older people (aged 60 years old or above) made up approximately 9.2% of the global population, but increased to 11.7% in 2013, and it is predicted to rocket to 21.1% in 2050 (World Population Ageing, 2013). In developed nations, the corresponding proportion was 12.0% in 1950 and rose to 23% in 2013. More seriously in Japan, a nation with an unprecedented rapidly aging and declining population. The National Institute of Population and Social Security Research (2013) announced that Japan's population in 2040 will stand at 107.276 million, a decline of about 20 million from 2010's 128.057 million. Essential in 2040 all prefectures where the percentage of elderly people (aged 65 years old or above) will be exceed 30%. The most aged prefecture will be Akita, where 43.8% of the population will be elderly persons while the youngest prefecture will be Okinawa (30.3%). In Hokkaido and 39 other prefectures, people aged 75 or older will account for more than 20% of the population. Particularly in the depopulated areas of Japan, the proportion of elderly population has already reached 33.2% in 2013 (that in the whole population was 22.8%) while from 1960 within 50 years the total population in the depopulated regions decreased by 45% (MIAC, 2014). There are many depopulated areas in Japan, in which the population has been decreasing while the elderly population has been increasing at a tremendous speed. Traffic consists mainly of privately owned vehicles, with poor environment on activities for living such as shopping or leisure due to lack of adequate transportation systems (Oeda et al., 2012). As the further population grays, however, more and more elderly people will be unable to drive, making it difficult for them to buy food and other essentials or to receive medical care. Moreover, the lower mobility of older people is also due in part to a history of land use and transport policy decisions. In 2002, the deregulation of bus services was enacted in Japan. With this deregulation law, private transport operators can not only more easily access to, but also more

easily withdraw from the bus market. In reality, many bus services by private operators have been withdrawn from unprofitable bus routes, especially in depopulated regions. Most public transport users in depopulated regions are, in fact, elderly persons who are inconvenient or cannot drive a car by themselves. The deregulation law has forced elderly persons who can somehow drive to re-rely on car use and those who cannot drive to lose many opportunities of participating in out-of-home activities. The inability to participate in daily life activities in the short term may influence other life decisions such as residential relocation and the elderly's quality of life in the long term. Unfortunately, little has been known clear about such quality of life related issues of the elderly mobility.

Various measures have been taken by Japanese government to revitalize the development of depopulated areas and to assist the elderly mobility, but these measures are little effective. As stated by Dax (2006), in sparsely populated areas the costs for basic services (i.e., accessibility to rural areas, post offices, phone services, Internet access, energy, sewage and waste disposal systems) tend to be considerably higher than in more densely populated regions. Once the community becomes compact spatially, it is expected that public services (including transit services) could be more easily provided. But any service involves a cost. The current problem in depopulated regions of Japan is that it is difficult to provide better public transport services because the elderly's residential locations are highly dispersed. In these fields, some NPOs or community groups have been actively involved in providing transport services with an attempt to replace the role of private transport operators (e.g. offer comparable para-transit). These services not only involve the cost of operating the transport services, but also social costs from NPO and community groups themselves. In future, the population of depopulated regions in Japan will further decrease. This trend will make the services of NPO and community groups more and more difficult because the population involved in the NPO and community services will also decrease, probably making such services unavailable and

insupportable. In this sense, supporting the elderly mobility partial from the perspective of public transport services is just a short-term measure and cannot resolve such elderly issues in a fundamental way. Recently, it has been gradually recognized that new mobility measures for resolving social exclusion issues caused by lower mobility are probably just temporal adaptation measures (Preston and Rajé, 2007). In this sense, the better land use and transport planning are required, developing the compact communities of depopulated regions so that promoting more walking mobility may be an alternative promising measure to better support the elderly life (Cao et al. 2010). Enhancing the elderly mobility, therefore, needs to be seen as an integral part of efforts to promote overall societal development especially in the transportation sector (Olawole and Aloba, 2014). Consistently in Japan, The local governments first plan to concentrate essential facilities such as medical institutions and administrative organizations in certain areas, then take administrative steps or offer financial and other incentives to relocate elderly people to higher-density and mixed-use communities, further to provide better public transit services to support the elderly mobility. However, whether or not it would be beneficial for the elderly's mobility and quality of life is still a riddle.

Motivated by the above considerations, the purpose of this study is to make an initial attempt to figure out how land use attributes affects the elderly's mobility behavior and how both of them further influence their quality of life, based on a comparison analysis between the elderly living in depopulated areas and non-depopulated areas of Japan. Here, land use attributes refer to residential environment characteristics, which are represented by density of establishment of each type such as railway station and supermarket. Mobility behavior of the elderly is characterized by travel mode choices, travel distance, travel cost and frequency. Quality of life is closely linked with the elderly's social, health, family and leisure life domains. The policy implications of this study are two-fold. First, this study could inform policy makers how the elderly people in the depopulated areas would respond to the compact and high-density

community design under the influence of their current socio-demographics. Second, clarifying the influence of the elderly's mobility behavior on their relevant life choices and quality of life could better evaluate the effects of land use policies by explicitly incorporating the policy outcomes into the evaluation process, which could better facilitate the consensus building.

7.2 Methodology

7.2.1 Data description

For the purpose of this study, data were extracted from a web-based life choice and quality of life (QOL) survey including various aspects of life stretching whole major cities in Japan (Zhang, 2014; Zhang et al., 2012). The survey was implemented in March 2014 with the assistance of a major Japanese Internet survey company having more than 1.4 million registered survey panels at the time of survey. Finally, 900 respondents aged between 15 and 88 years old participated in the survey, where 297 elderly persons (aged 65 years old or above) were from depopulated areas, 253 elderly persons and 350 non-elderly persons were from non-depopulated areas. Totally more than 140 variables across health, social, family life, finance, residence, job, education and learning, leisure and recreation domains, as well as travel behavior were obtained. Details of data contents refer to Zhang (2014). In this study, data from the two areas of the elderly persons are adopted for comparison. The details of data characteristics are shown in Table 7-1.

Table 7-1 The data sample characteristics of elderly persons between depopulated and non-depopulated areas

Data Characteristics (Elderly)	Depopulated (N=297)	Non-depopulated (N=253)	Data Characteristics (Elderly)	Depopulated (N=297)	Non-depopulated (N=253)
Gender			Car Ownership		
Male	76.43%	59.29%	Have more than one car	0.367	0.1858
Female	23.57%	40.71%	Have a private car	54.55%	48.62%
Education Level			Have no car	8.75%	32.81%
Having a Bachelor degree	36.03%	34.39%	Travel Purpose by Car		
Having no Bachelor degree	63.97%	65.61%	Shopping	37.37%	27.27%
Marital Status			Leisure	12.46%	12.65%
Married	85.52%	79.05%	Private affairs	20.54%	11.07%
Single	14.48%	20.95%	Others	29.63%	49.01%
Household Composition			Main Travel Mode		
1 member	10.77%	15.02%	Cycling/Walking	19.53%	41.90%
2 members	61.62%	52.96%	Public Transit	3.03%	17.00%
3 members	0.1616	0.2253	Car	77.10%	39.92%
>3 members	11.45%	9.46%	Others	0.34%	1.19%
Health Status			Life Satisfaction		
Fine	70.37%	69.57%	Satisfied	70.36%	72.39%
Not Fine	29.63%	30.43%	Neutral	22.53%	21.89%
Household Income			Dissatisfied	7.11%	5.72%
< 2 million yen/year	6.40%	11.86%	Happiness		
2 - 6 million yen/year	77.78%	66.40%	9 - 10 Score	13.56%	17.51%
> 6 million yen/year	15.82%	21.74%	6 - 8 Score	60.13%	59.26%
			0 - 5 Score	26.31%	23.23%

7.2.2 Conceptual Framework and Explanatory variables

As for the analysis method, a structural equation model with latent variables is built for capturing the complicated cause-effect relationships existing in the elderly's mobility behavior and their quality of life under the influence of land use attributes, after controlling for the mobility tools and the socio-demographics of elderly persons. SEM is a popular statistical method used to simultaneously capture and analyze the complex relationships among personal and household characteristics, activity participation, and travel behavior. This paper does not provide thorough conceptual explanations and mathematical details about SEM. For basic concepts and mathematics of SEM, refer to the works of Mueller (1996) and Byrne (2013). Typically, SEM consists of two model components: measurement models relating observed variables and latent (or unobserved) variables and structural models relating latent variables.

The strengths of SEM include the fact that it simultaneously performs a confirmatory factor analysis and path analysis and the fact that it tests hypothesized relationships among latent variables that are free from measurement errors. SEM also allows a user to have standardized parameters that show the relative influences of observed and latent variables.

Based on the Chi-square test results of variables between the two types of elderly, I picked out the significantly different observed variables for modelling, which are shown in Table 7-2. Specifically, there are totally 9 latent variables in the SEM structure, the latent variable of land use attributes is represented by the density of establishment for each type such as railway station, bus stop, park, medical facilities, welfare facilities and supermarket within a 1km² grid. The latent variable of socio-demographics include age, gender, marital status, household size, household income, number of adult children (18 years old and over) in the household, mobility constraint such as health status. The latent variable of elderly mobility tools contain the number of owned private/household vehicles and driving license. In terms of latent variable of elderly mobility behavior, it consists of main travel mode choice (walking, public transit and car), frequency of car use, travel distance and travel cost. It is assumed that the mobility behavior of elderly person is not only affected by their socio-demographics, also their mobility tools and residential land use attributes. As for the latent variables closely related to the elderly's life, the social life latent variable represents the frequency of communication with neighbors and community activity engagement; the health life latent variable depicts the gentle sports (i.e., golf) engagement; the leisure life latent variable contains the frequency to the various leisure facilities (i.e., cinema, theater, amusement park, entertainment facility); the latent variable of family life includes the

Table 7-2 The Chi-Square Test Results about the Elderly's Variables between Depopulated and Non-depopulated Areas

Variables	Pearson Chi-Square	Asymp. Sig. (2-sided)	Variables	Pearson Chi-Square	Asymp. Sig. (2-sided)
Land Use Attributes			Social Life		
Density of Public Facilities (Mesh 1km*1km)	52.146	***	Frequency of Neighbors Communication	13.021	***
Density of Park	73.58	***	Community Activity Participation	33.077	***
Density of Medical Facilities	54.566	***	Health Life		
Density of Local Government Facilities	5.386	**	Frequency of Gentle Sports Participation	11.768	***
Density of Welfare Facilities	51.386	***	Duration of Gentle Sports Activity	27.555	**
Density of Bus Stop	45.22	***	Leisure Life		
Density of Railway Station	1.043	***	Frequency to Cinema & Theater	15.897	**
Density of Supermarket	70.568	**	Frequency to Sports Facilities	12.321	**
Socio-Demographics			Frequency to Amusement Park	9.598	**
Household Size	12.201	**	Frequency to Entertainment Facilities	13.107	***
Number of Adult Children (>18 years old)	4.569	***	Frequency of Racing Activities	5.771	**
Marital Status (Married=1, 0)	3.97	**	Family Life		
Household Annual Income	24.717	***	Frequency of Relatives Contact	16.077	**
Gender (Male=1, 0)	18.621	***	Frequency of Family Meals	5.831	**
Age	36.848	**	Quality of Life (QOL)		
Health Status (Healthy=1, 0)	2.268	**	Satisfaction with Residence Life	3.022	***
Elderly Mobility Tools			Satisfaction with Finance Life	9.518	***
Private Vehicle Ownership	36.474	***	Satisfaction with Health Life	2.561	**
Household Vehicle Ownership	30.16	***	Satisfaction with Social Life	4.537	***
Driving License (Owned=1, 0)	30.82	***	Satisfaction with Education/Learning Life	1.102	**
Elderly Mobility Behavior			Satisfaction with Employment Life	3.389	***
Main Travel Mode is Walking (Yes=1, 0)	35.355	***	Satisfaction with Family Life	6.933	**
Main Travel Mode is Public Transit (Yes=1, 0)	31.127	***	Satisfaction with Leisure/Recreation Life	3.344	**
Main Travel Mode is Car (Yes=1, 0)	31.127	***	Overall Life Satisfaction	4.797	***
Frequency of Car Usage	76.045	***			
Travel Distance (Yearly)	1.07	***			
Travel Cost (Monthly)	83.776	**			

Note: ** significant at the 95% type; *** significant at the 99% type.

Household Annual Income type: 1<1, 2: 1~2, 3: 2~3, 4: 3~4, 5: 4~5, 6: 5~6, 7: 6~7, 8: 7~8, 9: 8~9, 10: 9~10, 11: 10~15, 12>15 (unit: 1 million Yen)

frequency of sharing time with family members and relatives. Since the elderly people are targeted in this study, job and education related life variables were excluded. Additionally, QOL latent variable here is measured by overall life satisfaction and satisfaction with each life domain such as health and residence. In the survey, survey asked respondents “how are you satisfied with your life as a whole and each life domain”, where the 5-point scaling method was adopted: 1 - very dissatisfied, ..., 5 - very satisfied.

Although numerous studies show that residential environment may facilitate or limit the elderly mobility (Rosenbloom, 2001), there is little consensus to be found. The prior researches suggest that the frequency and duration of engagement in leisure activities is an important objective determinant of QOL (Vemuri and Costanza, 2006), participation in physical activity and maintenance of an active lifestyle is an important strategy to promote QOL in older people (Cheng et al., 2009). It is indicated that the elderly’s social, health, leisure, and family life aspects could be the intermediate factors connecting the elderly’s mobility behavior with their higher QOL attainment. Based on the above contemplation, to examine and clarify how land use attributes affects the elderly’s mobility behavior and further how both of them affects their QOL, after controlling for the mobility tools and socio-demographics of elderly persons (aged 65 years old or above), a comparative study of the elderly in depopulated regions and non-depopulated regions will be done below, which conceptual framework is presented in Figure 7-1.

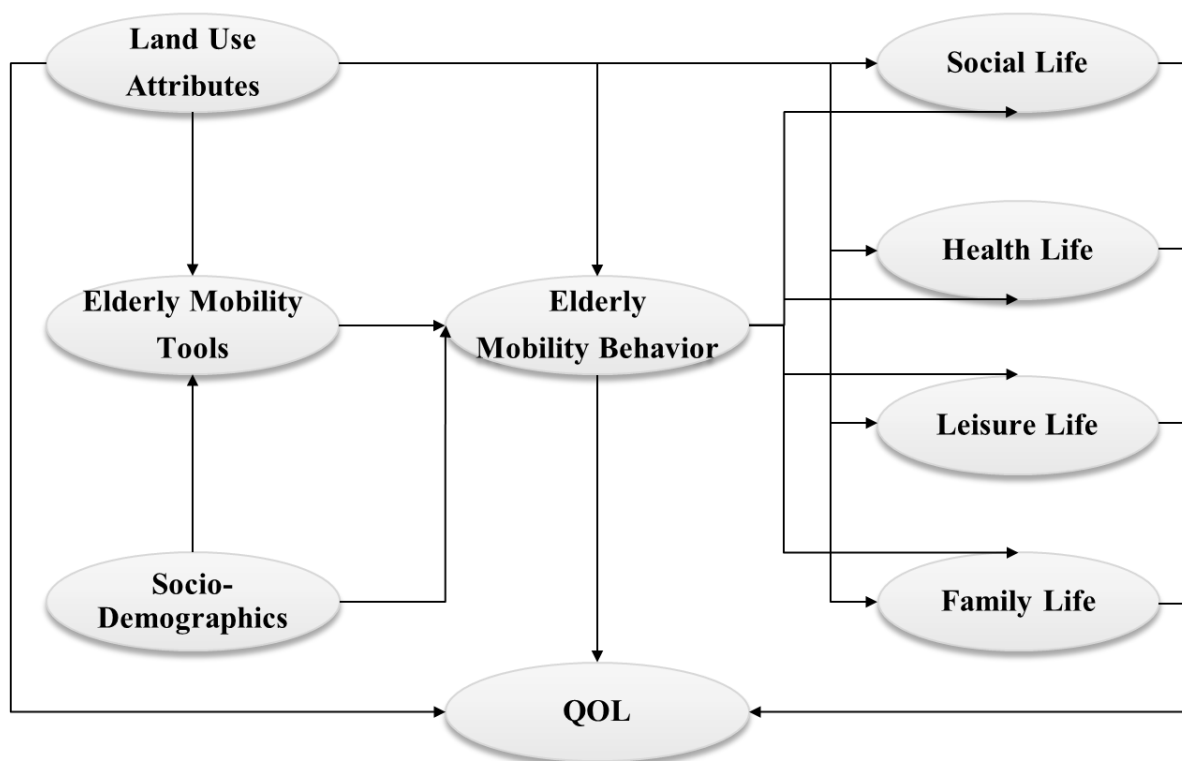


Figure 7-1 The Conceptual Framework of Analysis

7.3 Model estimation and results

The results of SEM analysis using the software AMOS based on Maximum Likelihood estimation are discussed in this section, and the direct, indirect and total effects of exogenous variables on endogenous variables are described, fully penetrated by the discussion on the effects of endogenous variables. Table 7-3 shows the comparative results between the elderly in depopulated areas and non-depopulated areas. Because this study emphasizes the elderly mobility issue in depopulated areas, I will pay more attention to the effects of decentralized land use design and the impacts on their QOL.

The goodness-of-fit measures reveal that the models are acceptable (Depopulated areas: GFI=0.852, AGFI=0.823, and RMSEA=0.017; Non-depopulated areas: GFI=0.843, AGFI=0.812, and RMSEA=0.015). Thus, the models seem to provide an acceptable fit to the corresponding data. The parsimony indices (Depopulated areas: PNFI=0.515; Non-

depopulated areas: $PNFI=0.503$) also indicate that the models have the modest applicability (Sharmeen et al., 2014). In Figure 1, I assumed 21 direct effects among latent variables. In case of depopulated areas, 13 out of the 21 direct effects are statistically significant while in case of non-depopulated areas, there are 10 significant direct effects. Corresponding to those insignificant direct effects, three indirect effects in depopulated areas and four in non-depopulated areas are found to be significant, respectively. The above results all support our assumed model structure.

7.3.1 Characterization of Land Use Patterns and its Impacts

The land use pattern for the elderly in depopulated areas is largely represented by the density of welfare facilities (0.829), medical facilities (0.768), and local government facilities (0.587) while in non-depopulated areas the land use pattern is mainly characterized by the density of welfare facilities (0.873), medical facilities (0.758), bus stop (0.635), and park (0.630). For both types of the elderly persons, the facilities for meeting elder persons' fundamental needs (i.e., welfare and medical facilities) are most relevant and essential. However, the density of public facilities is not a significant factor to characterize the land use pattern in both areas. What differentiate the two types of areas are that the density of bus stop and the density of park, both are relevant to represent the land use pattern of non-depopulated areas, but trivial in depopulated areas. On the contrary, the density of supermarket is an influential factor to define the land use pattern in depopulated areas, but not in non-populated areas.

Table 7-3 Estimation Results of Cause-Effect Relationships based on Structural Equation Model

Exogenous Variables	Land Use Attributes						Socio-Demographics						Elderly Mobility Tools					
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect	
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D
<i>Latent Variables</i>																		
Elderly Mobility Tools	0.257*	0.415*			0.257*	0.415*	0.49*	0.391*			0.49*	0.391*						
Elderly Mobility Behavior			-0.211*	-0.38*	-0.241*	-0.362*			-0.401*	-0.358*	-0.237*	-0.399*	-0.819*	-0.917*			-0.819*	-0.917*
Family Life			0.039*	0.135*	0.026*	0.065^			0.038*	0.149*	0.038*	0.149*			0.133*	0.342*	0.133*	0.342*
Leisure Life																		
Health Life	0.297^		-0.046	-0.275*	0.251^				-0.045	-0.302*		-0.302*				-0.696*		-0.696*
Social Life	-0.121^	-0.203*	-0.041*	-0.076*	-0.162*	-0.279*			-0.04*	-0.084*	-0.04*	-0.084*			-0.138*	-0.193*	-0.138*	-0.193*
Quality of Life (QOL)			-0.132^		-0.045^											-0.123^		-0.123^
<i>Land Use Attributes</i>																		
Density of Public Facilities																		
Density of Park	0.462*	0.63*			0.462*	0.63*												
Density of Medical Facilities	0.768*	0.758*			0.768*	0.758*												
Density of Local Government Facilities	0.587*	0.306*			0.587*	0.306*												
Density of Welfare Facilities	0.829*	0.873*			0.829*	0.873*												
Density of Bus Stop	0.187*	0.635*			0.187*	0.635*												
Density of Railway Station	0.23*	0.157*			0.23*	0.157*												
Density of Supermarket	0.213*				0.213*													
<i>Socio-Demographics</i>																		
Household Size							0.736*	0.596*			0.736*	0.596*						
Number of Adult Children							0.489*				0.489*							
Marital Status																		
Household Annual Income							0.593*	0.475*			0.593*	0.475*						
Gender							0.339*	0.262*			0.339*	0.262*						
Health Status							-0.087				-0.087							
Age							-0.183*	-0.14*			-0.183*	-0.14*						
<i>Elderly Mobility Behavior</i>																		
Main Travel Mode is Walking			-0.204*	-0.22*	-0.204*	-0.22*			-0.201*	-0.242*	-0.201*	-0.242*			-0.694*	-0.558*	-0.694*	-0.558*
Main Travel Mode is Public Transit			-0.071*	-0.101*	-0.071*	-0.101*			-0.07*	-0.111*	-0.07*	-0.111*			-0.241*	-0.256*	-0.241*	-0.256*
Main Travel Mode is Car			0.235*	0.304*	0.235*	0.304*			0.231*	0.335*	0.231*	0.335*			0.799*	0.77*	0.799*	0.77*
Frequency of Car Usage			0.145*	0.309*	0.145*	0.309*			0.143*	0.34*	0.143*	0.34*			0.494*	0.783*	0.494*	0.783*
Travel Distance (Yearly)			0.085*	0.172*	0.085*	0.172*			0.084*	0.19*	0.084*	0.19*			0.289*	0.436*	0.289*	0.436*
Travel Cost (Monthly)			0.056*	0.144*	0.056*	0.144*			0.055*	0.159*	0.055*	0.159*			0.191*	0.365*	0.191*	0.365*

Note:

* significant at the 99% type; ^ significant at the 95% type. "D": The Depopulated Area Elderly; "Non-D": The Non-Depopulated Area Elderly.

Table 7-3 (continued)

Exogenous Variables	Land Use Attributes						Socio-Demographics						Elderly Mobility Tools					
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect	
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D
<i>Elderly Mobility Tools</i>																		
Private Vehicle Ownership			0.142*	0.259*	0.142*	0.259*			0.271*	0.244*	0.271*	0.244*	0.553*	0.625*			0.553*	0.625*
Household Vehicle Ownership			0.154*	0.328*	0.154*	0.328*			0.293*	0.309*	0.293*	0.309*						
Driving License			0.177*	0.271*	0.177*	0.271*			0.337*	0.255*	0.337*	0.255*	0.688*	0.654*			0.688*	0.654*
<i>Social Life</i>																		
Frequency of Neighbors Communication			-0.107*	-0.163*	-0.107*	-0.163*			-0.026*	-0.049*	-0.026*	-0.049*			-0.091*	-0.113*	-0.091*	-0.113*
Community Activity Participation			-0.149*	-0.268*	-0.149*	-0.268*			-0.037*	-0.081*	-0.037*	-0.081*			-0.127*	-0.186*	-0.127*	-0.186*
<i>Health Life</i>																		
Frequency of Gentle Sports Participation										-0.036*		-0.036*				-0.082*		-0.082*
Duration of Gentle Sports Activity																		
<i>Leisure Life</i>																		
Frequency to Cinema & Theater																		
Frequency to Sports Facilities																		
Frequency to Amusement Park																		
Frequency to Entertainment Facilities																		
Frequency of Racing Activities																		
<i>Family Life</i>																		
Frequency of Relatives Contact			0.011*	0.035*	0.011*	0.035*			0.017*	0.081*	0.017*	0.081*				0.186*		0.186*
Frequency of Family Meals			0.025*	0.061*	0.025*	0.061*			0.037*	0.14*	0.037*	0.14*				0.323*		0.323*
<i>Quality of Life (QOL)</i>																		
Satisfaction with Residence Life			-0.025*		-0.025*													
Satisfaction with Financial Life			-0.027*		-0.027*													
Satisfaction with Health Life			-0.021*		-0.021*													
Satisfaction with Social Life			-0.023*		-0.023*													
Satisfaction with Education/Learning Life			-0.021^		-0.021^													
Satisfaction with Employment Life			-0.019^		-0.019^													
Satisfaction with Family Life			-0.031*		-0.031*													
Satisfaction with Leisure/Recreation Life			-0.029*		-0.029*													
Overall Life Satisfaction			-0.03*		-0.03*					0.071^		0.071^						

Table 7-3 (continued)

Exogenous Variables Endogenous Variables	Elderly Mobility Behavior						Family Life						Leisure Life						
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	
<i>Latent Variables</i>																			
Elderly Mobility Tools																			
Elderly Mobility Behavior																			
Family Life	-0.162*	-0.373*			-0.162*	-0.373*													
Leisure Life																			
Health Life		0.759*				0.759*													
Social Life	0.168*	0.211*			0.168*	0.211*													
Quality of Life (QOL)	-0.035^	0.183^			-0.061^	0.134^							-0.271*						-0.271*
<i>Land Use Attributes</i>																			
Density of Public Facilities																			
Density of Park																			
Density of Medical Facilities																			
Density of Local Government Facilities																			
Density of Welfare Facilities																			
Density of Bus Stop																			
Density of Railway Station																			
Density of Supermarket																			
<i>Socio-Demographics</i>																			
Household Size																			
Number of Adult Children																			
Marital Status																			
Household Annual Income																			
Gender																			
Health Status																			
Age																			
<i>Elderly Mobility Behavior</i>																			
Main Travel Mode is Walking																			
Main Travel Mode is Public Transit	0.295*	0.279*			0.295*	0.279*													
Main Travel Mode is Car	-0.976*	-0.84*			-0.976*	-0.84*													
Frequency of Car Usage	-0.603*	-0.854*			-0.603*	-0.854*													
Travel Distance (Yearly)	-0.353*	-0.476*			-0.353*	-0.476*													
Travel Cost (Monthly)	-0.234*	-0.399*			-0.234*	-0.399*													

Table 7-3 (continued)

Exogenous Variables Endogenous Variables	Elderly Mobility Behavior						Family Life						Leisure Life						
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	
<i>Elderly Mobility Tools</i>																			
Private Vehicle Ownership																			
Household Vehicle Ownership																			
Driving License																			
<i>Social Life</i>																			
Frequency of Neighbors Communication			0.111*	0.123*	0.111*	0.123*													
Community Activity Participation			0.155*	0.202*	0.155*	0.202*													
<i>Health Life</i>																			
Frequency of Gentle Sports Participation				0.089*		0.089*													
Duration of Gentle Sports Activity																			
<i>Leisure Life</i>																			
Frequency to Cinema & Theater																			
Frequency to Sports Facilities													0.232*	0.301*			0.232*	0.301*	
Frequency to Amusement Park													0.538*	0.431*			0.538*	0.431*	
Frequency to Entertainment Facilities													0.669*	0.622*			0.669*	0.622*	
Frequency of Racing Activities													0.474*				0.474*		
<i>Family Life</i>																			
Frequency of Relatives Contact			-0.072*	-0.203*	-0.072*	-0.203*	0.445*	0.544*					0.445*	0.544*					
Frequency of Family Meals			-0.158*	-0.352*	-0.158*	-0.352*	0.976*	0.944*					0.976*	0.944*					
<i>Quality of Life (QOL)</i>																			
Satisfaction with Residence Life			-0.019^		-0.019^														
Satisfaction with Financial Life			-0.021^		-0.021^														
Satisfaction with Health Life			-0.017^		-0.017^														
Satisfaction with Social Life			-0.018^		-0.018^														
Satisfaction with Education/Learning Life			-0.016^		-0.016^														
Satisfaction with Employment Life			-0.015^		-0.015^														
Satisfaction with Family Life			-0.024^		-0.024^														
Satisfaction with Leisure/Recreation Life			-0.022^		-0.022^														
<i>Overall Life Satisfaction</i>			-0.023^	-0.178^	-0.023^	-0.178^													

Table 7-3 (continued)

Exogenous Variables	Health Life						Social Life						Quality of Life						Overall Life Satisfaction						
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	
Endogenous Variables																									
<i>Latent Variables</i>																									
Elderly Mobility Tools																									
Elderly Mobility Behavior																									
Family Life																									
Leisure Life																									
Health Life																									
Social Life																									
Quality of Life (QOL)	-0.41*	-0.137			-0.41*	-0.137	0.182^	0.131^			0.182^	0.131^													
<i>Land Use Attributes</i>																									
Density of Public Facilities																									
Density of Park																									
Density of Medical Facilities																									
Density of Local Government Facilities																									
Density of Welfare Facilities																									
Density of Bus Stop																									
Density of Railway Station																									
Density of Supermarket																									
<i>Socio-Demographics</i>																									
Household Size																									
Number of Adult Children																									
Marital Status																									
Household Annual Income																									
Gender																									
Health Status																									
Age																									
<i>Elderly Mobility Behavior</i>																									
Main Travel Mode is Walking																									
Main Travel Mode is Public Transit																									
Main Travel Mode is Car																									
Frequency of Car Usage																									
Travel Distance (Yearly)																									
Travel Cost (Monthly)																									

Table 7-3 (continued)

Exogenous Variables	Health Life						Social Life						Quality of Life						Overall Life Satisfaction						
	Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		Direct Effect		Indirect Effect		Total Effect		
	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	D	Non-D	
Endogenous Variables																									
<i>Elderly Mobility Tools</i>																									
Private Vehicle Ownership																									
Household Vehicle Ownership																									
Driving License																									
<i>Social Life</i>																									
Frequency of Neighbors Communication							0.659*	0.585*				0.659*	0.585*												
Community Activity Participation																									
<i>Health Life</i>																									
Frequency of Gentle Sports Participation																									
Duration of Gentle Sports Activity	0.326*				0.326*									0.732*		0.732*									
<i>Leisure Life</i>																									
Frequency to Cinema & Theater																									
Frequency to Sports Facilities																									
Frequency to Amusement Park																									
Frequency to Entertainment Facilities																									
Frequency of Racing Activities																									
<i>Family Life</i>																									
Frequency of Relatives Contact																									
Frequency of Family Meals																									
<i>Quality of Life (QOL)</i>																									
Satisfaction with Residence Life			-0.226*		-0.226*				0.103^		0.103^			0.564*	0.692*		0.564*	0.692*		0.148*		0.182*		0.148*	0.182*
Satisfaction with Financial Life			-0.24*		-0.24*				0.109^		0.109^									0.27*		0.144^		0.27*	0.144^
Satisfaction with Health Life			-0.192*		-0.192*				0.087^		0.087^			0.479*	0.482*		0.479*	0.482*		0.099*				0.099*	
Satisfaction with Social Life			-0.207*		-0.207*				0.094^		0.094^			0.515*	0.487*		0.515*	0.487*							
Satisfaction with Education/Learning Life			-0.186*		-0.186*				0.085^		0.085^			0.464*	0.517*		0.464*	0.517*				0.14*			0.14*
Satisfaction with Employment Life			-0.173*		-0.173*				0.079^		0.079^			0.432*	0.425*		0.432*	0.425*							
Satisfaction with Family Life			-0.275*		-0.275*				0.125^		0.125^			0.685*	0.71*		0.685*	0.71*		0.242*		0.159*		0.242*	0.159*
Satisfaction with Leisure/Recreation Life			-0.26*		-0.26*				0.118^		0.118^			0.649*	0.741*		0.649*	0.741*		0.299*		0.408*		0.299*	0.408*
<i>Overall Life Satisfaction</i>			-0.235^		-0.269*		-0.235^		0.122^		0.122^			0.67*		0.67*									

The Depopulated Area Elderly

Chi square: 2623.310
 Degrees of freedoms: 1007
 Goodness of Fit (GFI): 0.852
 Adjusted Goodness of Fit (AGFI): 0.823
 Root mean square error of approximation (RMSEA): 0.017
 Normed fit index (NFI): 0.521
 Parsimony normed fit index (PNFI): 0.515

The Non-Depopulated Area Elderly

Chi square: 2492.293
 Degrees of freedoms: 1007
 Goodness of Fit (GFI): 0.843
 Adjusted Goodness of Fit (AGFI): 0.812
 Root mean square error of approximation (RMSEA): 0.015
 Normed fit index (NFI): 0.540
 Parsimony normed fit index (PNFI): 0.503

7.3.2 Impacts of Land Use Patterns

Even though land use attributes in both areas do not directly affect the elderly mobility behavior, they are surely influential via the ownership of mobility tools (vehicles and driving licenses). Looking at the magnitudes of total effects, the influence of land use attributes on the elderly' mobility tools and behavior in depopulated areas (0.257/-0.241) is smaller than that in non-depopulated areas (0.415/-0.362), suggesting that the reshaping of the spatial structure in depopulated areas is effective to the elderly mobility behavior, which is however not that large as in non-depopulated areas.

Most importantly, it was assumed that land use attributes could have a direct effect on the elderly's QOL. However, the direct effect is not statistically significant. Instead, an indirect effect is confirmed (-0.132). As we can see from the total effect from land use attributes to the elderly's QOL, only positively significant in depopulated areas (-0.045). Further due to the signs of parameters under the latent variable of QOL are all negative, it shows that the land use attributes positively affect the elderly's QOL. It is examined that the higher-density land use pattern, the higher QOL of the elderly. That's confirmed that the high-density and mixed-use community structure is beneficial for the elderly's QOL in the depopulated areas. Similarly, it was also assumed that land use attributes could have a direct effect on the elderly's life choices, which include family life, leisure life, health life, and social life. Except social life, other life choices are not directly, but indirectly affected by land use attributes. In either case, the model estimation results surely support the influence of land use attributes on life choices and QOL. This finding is consistent with the idea of life-oriented approach (Zhang, 2014).

Comparing all statistically significant total effects of latent variables on QOL, it is found that the most influential latent variable is the health life (-0.401), followed by the social life (0.182) for the elderly in depopulated areas. In contrast, the top two influential latent

variables for the elderly in non-depopulated areas are the leisure life (-0.271) and the social life (0.131). Comparing with these top two influential latent variables, the total effect of land use attributes is just -0.045 in depopulated areas, but it is not significant in non-depopulated areas. Such land use effects are also smaller than those of elderly mobility behavior, which are -0.061 in depopulated areas and 0.134 in non-depopulated areas. In case of non-depopulated areas, mobility tools are also more influential to QOL than land use attributes; however, in depopulated areas, QOL is not influenced by mobility tools.

As for QOL, all the included life satisfaction variables with respect to residential, finance, health, social, education and learning, employment, family, and leisure and recreation domains are statistically explained by QOL in a significant and positive way in both areas. In other words, QOL are well characterized by the domain-based life satisfaction variables. Looking at the top two life domains for QOL in depopulated areas, health life is characterized by duration of gentle sports activity (0.326) and social life by frequency of neighborhood communication (0.659). As we can see from total effects of the results, the land use attributes can significantly affect the elderly's social life (-0.162) and family life (0.026), further offering the sights into the parameters under the latent variables of social life (negative) and family life (positive), since density parameters to all daily facilities are positive and then the latent variable "land use attributes" is positively associated with health life and social life in depopulated areas, the more compact the residential neighborhood, the elderly has higher likelihood of performing gentle sports activity and the more frequent of communicating with their neighbors. This is an interesting finding, implying that the elderly would maintain their social network and health status if they could live in a more compact community.

7.3.3 The Elderly Mobility Behavior, Life Choices and QOL

For both types of elderly persons, direct effects of socio-demographics on elderly mobility behavior cannot be found; however, the indirect effects are confirmed through mobility tools. In terms of direct effects of mobility tools on the elderly mobility behavior, they are both statistically significant. It is obvious that either the depopulated elderly or the non-depopulated elderly, a higher type of vehicle ownership leads to more car use, less public transit use and walking, but longer travel distance and more trips by car. Also, the driving license is positively associated with the type of elderly mobility, suggesting that a travel reduction may be expected if the elderly's driving license becomes invalid. Household composition is positively associated with car use, negatively affects the public transit use and walking, but age shows an opposite effect. The gender gap in the elderly mobility is also evident. Older women make fewer trip, travel a shorter distance by car than older men. In addition, more adult children in a household is associated with the higher type of elderly mobility by car in depopulated areas, no statistical significance for the elderly in non-depopulated areas, maybe due to the inconvenient public transit and poor physical health for the elderly in the decentralized area, with the adult children's help, the more trips can make, the longer travel distance can obtain. That's one of the reasons why the Japanese government plans to motivate the elderly move live close to each other, after the community becomes compact spatially, it is expected that public services (including transport services) could be more easily provided. Unexpected, maybe due to the high life-expectancy, traditional and rigid lifestyles in Japan, and the physical health status has no significance to affect the type of elderly mobility.

Observing the influence of the elderly mobility behavior on life choices and QOL in depopulated areas, it does not affect leisure life and health life, but surely influences social life (0.168) and family life (-0.162). It is implied that the elderly mobility behavior affects QOL

mediated by the essential choices the elderly made in their social and family life. As for the positive/negative signs of the observed variables under the latent variables of elderly mobility behavior, social life (positive) and family life (negative), it is showed that engaging more often in the family and social activities by walking and public transit, it is beneficial to the higher type of QOL attainment. Looking at the parameter signs of the observed mobility behavior variables, one can see that walking and use of public transit increase the QOL type, but use of car in a more frequent way could detrimental to the improvement of QOL. Providing the insights into the parameter signs under the latent variables of land use attributes and mobility behavior, it is shown that land use attributes positively influence the elderly mobility behavior in both areas. This illustrates that a higher-density and compact land use pattern could result in more walk and more public transit use, but less use of car, shorter travel distance and less travel cost. Such changes in elderly mobility behavior caused by the compact and mixed-use land use development also contribute to the improvement of QOL type, mediated by the elderly's social life and family life activities engagement. Because the total effect of elderly mobility behavior is statistically positive on the QOL (-0.061, and the signs of parameters under the latent variable of QOL are all negative) in depopulated areas.

7.4 Conclusion

Motivated by the ever-increasing elderly persons in depopulated areas and the worsened transport environment caused by the bus deregulation law in Japan, this study made an initial attempt to investigate the intertwined relationships between land use attributes, elderly mobility behavior, elderly's essential life choice and quality of life in depopulated areas, after controlling for the elderly's mobility tools and socio-demographics. This was successfully done based on

a comparison analysis with the elderly in non-depopulated areas by estimating a structural equation model.

As a result, it is clearly clarified that either in depopulated areas or non-depopulated areas, the changes in elderly mobility behavior caused by the high-density land use development can contribute to the higher type of QOL attainment, mainly mediated by the elderly's social life and family life activities engagement. The effects would be larger especially when the local governments increases the density of welfare and medical facilities surrounding the elderly's residence areas. In terms of the effects of land use attributes (density of various establishments) on the elderly mobility behavior, is however not as large as in non-depopulated areas. Specifically, the analysis first estimates that building a high-density and mixed-use community in depopulated areas could result in more public transit use, more walking activity and less car use for the elderly. This is probably because the compact community design can provide the elderly a safe, comfortable, and convenient environment for their daily activity engagement, which allows them to reduce the car use, use public transit and walking more frequently. Such mobility behavior changes are beneficial for the elderly's social life, family life, and health life, further for their quality of life improvement in depopulated areas. Interestingly, in the more compact and higher-density of residential neighborhood, the elderly have a higher likelihood of performing gentle sports activity and the more frequent of communicating with their neighbors. Such engagement is an essential part of health-related quality of life, which consists of not only physical health, but also mental and social health (Zhang, 2013). These results comprehensively confirm that the local governments in Japan take administrative steps or offer finance and other incentives to offer elderly persons the higher-density and compact communities, not only contributes to more efficient provision of public services (i.e., public transit service), but also is beneficial to resolve the elderly's low mobility issues. However, land use design on its own may not ensure continued accessibility for the

elderly as their ability to drive declines with the aging, but it is an essential part of the cross-sectoral strategies for the elderly's sustainable life.

The above analysis was done based on an idea of life-oriented approach (Zhang, 2014). The analysis results indicate that the life-oriented approach has successfully paved a new way to capture the effects of land use pattern and mobility behavior on the elderly's important life choices and their resulting quality of life. The essential idea behind the life-oriented approach is that an understanding of life choices, including travel behavior, should not be constrained by the boundary of any single discipline. The ignorance and inability of understanding and capturing travel behavior from the life choice perspective may lead to a failure of consensus building for policies to better support the elderly life. As long as the life is concerned, various behavioral aspects should be simultaneously represented. In this regard, the structural equation model with latent variables is a flexible and powerful tool to incorporate various cause-effect relationships in a unified and consistent modeling framework. Meanwhile, behaviorally-oriented modeling approaches that can accommodate a larger set of discrete and continuous choice variables should be developed.

8 Conclusion, Limitation and Future Work

Achieving an improvement in people's quality of life is identified as a goal of many contemporary planning endeavors and has become important to the formulation of land use and transport policies (Lotfi and Solaimani, 2009). Promoting people's quality of life is also regarded as a meaningful way to evaluate urban development and social progress. Quality of life can be roughly captured from the essential life choices involving relevant travel behavior and the following life domains: residence, social, health, education, employment, family life, finance and leisure and recreation life (Knox, 1975; Zhang, 2014). The different life choices are usually decided over different time scales under the influence of time and monetary constraints and the various needs of households and their members. Therefore, after embedding relevant other life choices, such as social- and leisure-related decisions, into the integrated land use and transport system, the effect of land use and transport on people's quality of life should be reconsidered and re-evaluated. Particularly, over time, changes in residence/workplaces or vehicle ownership may have a significant impact on people's present/prospective quality of life, which may conversely affect the future life choices as well (Dolnicar et al., 2013). As residential choices and travel behavior are just a part of people's life choices and the effects of land use and transport on people's quality of life may not be significant after controlling for the intervention of other life choices. Based on the above considerations, a systematic investigation of various life choices, including residential choices and travel behavior, as well as quality of life, is important. However, understanding the links between essential life choices and quality of life, embedded into land use and transport planning, still has a long way to go, particularly from a dynamic or long-term perspective. Further, relationships between life choices and quality of life in the context of various urban studies have not satisfactorily examined. Especially in recent years, studies on subjective well-being have been advanced remarkably. It is important to clarify how to make better use of the insights from various studies on life choices

for supporting decisions on cross-sectoral urban policies making. Therefore, this study first made an initial attempt to examine the values of life-oriented approach from different time scales. Second, this study deals with three social issues from the stance of land use and transport aspects – women labor participation and childcare, young adults' lives (e.g., out-migration) and elderly mobility, based on the life-oriented approach, which is expected to provide the cross-sectoral policy implications and further contribute to the improvement of people's quality of life in a better way.

The findings of this thesis are first summarized below. Then limitations and directions for future research are discussed.

8.1 Findings

8.1.1 Values of life oriented approach

This study shows the importance of joint representation of life choices behavior both from a static view and a dynamic view, in the context of land use and transport planning. Further this study successfully examines the values of life-oriented approach by incorporating various life choice interdependencies across a broader set of life domains into analysis.

Firstly from a static viewpoint, the results, as a first step, showed the complex behavioral interdependencies between residential choices (residential environment, housing aspects), travel behavior (travel frequency, mode choices, travel party, activity time), and other life choices (e.g., frequency of neighbors communication), after controlling for the effects of land use attributes (distance to the nearest facilities) by using an Exhaustive CHAID approach. Further it quantified the effects of land use attributes, residential choices, travel behavior and other life choices on quality of life (measured by happiness and life satisfaction indicators)

based on a Bayesian belief network approach. As a result, first, it is confirmed that the life choices (decisions) relevant to various life domains are interdependent with each other. Second, it is examined that there is a two-way relationship between residential choice, travel behavior and other life choices. The results showed that the residential choices and travel behavior are influenced by other life choices related to each life domain conversely and to varying degrees. Thirdly, it is successfully identified which life choices affect people's quality of life and quantified those effects. Accordingly, showing the importance of linking land use and transport with other quality of life related aspects.

From a dynamic viewpoint, motivated by people's time-varying life choices, especially in response to residential location changes or employment changes over time, this study made an initial attempt to explore whether the influence of residential choices and travel behavior on people's quality of life can be observed and how much influence it has after controlling for the effects of other life choices and key life events over time. This complicated system was preliminarily done by estimating a structural equation model based on a panel data. As a result, it showed that both current other life choices and past other life choices play a dominant role in current quality of life achievement, compared with the slight influences of current and past residential choices, key life events, and the least effect of current and past travel behavior. Accordingly, ignoring other life choices relevant to people's key life domains, such as health and leisure, and key life events, such as household structure changes, and only emphasizing the straightforward impacts of land use and transport policies on quality of life may not be fruitful because people's quality of life is greatly affected by other life choices more than changes in residential and transport situations. Second, the consistently observed influence of residential choices on travel behavior in the literature cannot be observed in this case study neither in the static view nor in the dynamic view, after controlling for the influence of other life choices over time. This suggests that the observed influence of residential choices on travel behavior in the

literature may be spurious because of the absence of considering other life choices and key life events.

Therefore, it is concluded that the life-oriented approach offers an understanding of life choices, including residential choices and travel behavior, and should not be constrained by the boundary of any single discipline. The failure of understanding travel behavior from the life choice perspective may lead to a failure to better support people's lives. When people's quality of life is concerned, various important behavioral aspects should be represented jointly.

8.1.2 Women labor participation and life oriented approach

Aiming to promote more women to take up paid work in Japan, and mitigate their family responsibilities (e.g., childcare) associated work-family conflict, time related work-leisure conflict and stress concerned work-health conflict, in order to better balance their work and family life, further on their quality of life improvement, this study utilize the life oriented approach to achieve those above. A recursive multi-equation system is used to firstly identify the barriers to women labor participation in Japan, after controlling for the effects of land use, transport and life cycle stages; secondly to clarify the factors on women's good quality of family life, leisure life, health life and their quality of life; thirdly to provide cross-sectoral policies implications into women's job participation and quality of life promotion, and balance women's work and life.

Our empirical analysis found that women job participation has a persistent impact on subsequent life outcomes. In line with conventional wisdom and the results from many previous studies (Sandell, 1977; Macnaughtan, 2015), women labor participation is a hurdle for their good family life attainment. First, from a land use viewpoint, it is confirmed that job accessibility (density of employment and distance to workplace) and residence closeness to the

childcare facilities (e.g., kindergarten) can help more women work out, which is beneficial for good leisure life engagement, further happy and satisfy attainment. Second, from transport side, it is verified that with more vehicle ownership, living in the environment with good public transit accessibility help women work out. However, considering good health life attainment, walking/cycling more rather than driving are meaningful and beneficial, further make women feel more happy and satisfied. Thirdly, from other life choices behavior, it is discovered that the paid job with fewer working hours, fewer working days, with holiday system, and more vacation days attract more women who are looking for a job, and those life choices help women obtain more happiness and satisfaction. Most interesting, job training program participation also plays a prominent role in women's job life, health and leisure life, quality of life as well, but it is detrimental to family life enhancement. The results indicated that emphasizing the quality of life attainment, then land use policy, transport policy, employment policy and leave policy should cooperate together to deal with women labor participation issue.

8.1.3 Young adults' migration and life oriented approach

In Japan, more and more young adults migrate from non-metropolitan cities to medium-sized cities or metropolises, which has a detrimental effect on the regional development. This study employs the life oriented approach first to identify the reasons for such migration decision made by the young adults aged from 15 to 34 year-old in Japan from a static view, second to clarify their residential relocation decision making based on a life history data from a time course view.

This study made an initial attempt to investigate the intertwined interdependencies among land use attributes and quality of life, penetrating the relevant life choices linked with other life domains into the classical relationship between residential choices and travel behavior,

after allowing for the young adults' socio-demographics and job related choices. Using a structural equation model, it is found that the compact land use pattern with high density and diversity infrastructure facilities attracts the young population. However, compared with living closeness to the city center, young adults are more inclined to reside in a transit-oriented neighborhood, maybe due to the high land and housing price surrounding the city center. Secondly, young adults who reside and work/study in the metropolitan regions are more satisfied and happier than those who live in the non-metropolitan areas, which is shown that there is a geographic difference of the young adults' quality of life. Thirdly, in terms of the effects of land use and transport attributes on varied life choices, it was found that the mixed land use and transit-oriented neighborhood can offer the young adults more choices for their life such as leisure activities engagement, learning activities participation, community activities involvement, as well as diversity mode choices (walking / cycling more); the higher population and employment density can promote more young adults work out, engaging more social activities and leisure activities. It is indicated that if the regional urban planners could pay more attention on the improvement of young populations' quality of life such as offering more diversity leisure facilities and providing more housing choices (e.g., walking / mixed use neighborhood), it may be an effective measurement to keep the young labor force to dedicate in the regional economic development and community revitalization, and further alleviate the high concentration of the metropolitans.

Further, to develop an empirical framework to better understand the different young generations' residential relocation tendencies from a long-term perspective. This study focuses on their residential relocation choices among three hierarchical city types (megacities, medium-sized cities, local cities), by jointly considering different young generations (1980s, 1990s, and 2000s) moving when they were 15-34 years old, based on a retrospective life history survey data collected in Japan in 2010. It incorporated the effects of socio-demographics, life events

change features, and the quality of life oriented residential environment characteristics changes in the municipal type, by controlling for the young adults' original residential locations. It reached several findings. First, compared with young generation in 1990s, it is found that the young generation in 1980s prefer relocating to local cities to megacities/medium-sized cities, and the young generation in 2000s prefers megacities/medium-sized cities to local cities. The result shows the significantly different residential relocation tendencies between the varied eras of young generations. Secondly, in terms of life events change, the interesting findings are that the existence of both state dependence and future expectation plays significant role in residential relocation choices of the young adults originally living in megacities, while only future expectation has an impact on the residential relocation choices of the young adults originally living in medium-sized cities. However, neither state dependence nor future expectation shows an influence on the residential relocation choices of the young adults originally living in local cities. It is implied that the life events change features have a varying degree of effects on the residential relocation choices of young adults originally living in different city types. Thirdly, it is expected to observe that young adults prefer to live in the cities with more job opportunities, more subsidies from local government, higher density of public facilities such as hospital, park, supermarket, school, restaurant and child care center, as well as higher young population density. Those facilitate the young adults' residence life, job life, health life, finance life, health life, leisure life, education life, family life and social life, further contribute to their quality of life as a whole. Those notably further showed the reasons why the young population prefers to relocate to megacities/medium-sized cities instead of local cities in Japan.

8.1.4 Elderly mobility and life oriented approach

With an ever-increasing elderly population in depopulated areas and the worsened transport environment caused by the bus deregulation law enacted in 2002 in Japan, more and more elderly have difficulties for travelling. Facing such low elderly mobility issue, this study made a first attempt to investigate the life oriented intertwined relationships between land use attributes (density of various establishments), elderly mobility behavior, elderly's essential life choice and quality of life in depopulated areas, after controlling for the elderly's mobility tools and socio-demographics. This was successfully done based on a comparison analysis with the elderly in non-depopulated areas by estimating a structural equation model.

As a result, the analysis first showed that building a high-density and mixed-use community in depopulated areas could result in more public transit use, more walking activity and less car use for the elderly. This is probably because the compact community design can provide the elderly a safe, comfortable, and convenient environment for their daily activities, which allows them to reduce the car use, use available public transit and walking more frequently. Further, such active mobility behavior changes are beneficial for the elderly's social life, family life, and health life, further for their quality of life improvement in depopulated areas. Interestingly, it was also found that the more compact and higher-density of residential neighborhood, more elderly has a higher likelihood of performing gentle sports activity and more frequent communication with their neighbors and family members/relatives. Most importantly, it is clearly clarified that either in depopulated areas or non-depopulated areas, the changes in elderly mobility behavior as a result of living a high-density land use environment can contribute to the higher type of quality of life attainment, mainly mediated by the elderly's social life and family life activities engagement. The effects would be larger especially when the local governments increases the density of welfare and medical facilities surrounding the

elderly's residence areas. Therefore, these results comprehensively confirmed that the local governments in Japan take administrative steps or offer financial and other incentives to offer the elderly persons the higher-density and compact communities, not only contributes to more efficient provision of public services (i.e., public transit service), but also is beneficial to resolve the elderly's low mobility issues. However, land use design on its own may not only ensure continued accessibility for the elderly as their ability to drive declines with the aging, but it is an essential part of the cross-sectoral strategies for the elderly's sustainable life.

In conclusion, those above analyses were done based on the idea of life-oriented approach (Zhang, 2014). The analysis results indicate that the life-oriented approach has successfully paved a new way to capture the effects of land use and transport on the important life choices of women, young adults and elderly persons, further their resulting quality of life. The essential idea behind the life-oriented approach is that an understanding of life choices, including travel behavior, should not be constrained by the boundary of any single discipline. The ignorance and inability of understanding and capturing travel behavior from the life choice perspective may lead to a failure of consensus building for policies to better support the different cohorts' life. As long as the life is concerned, various behavioral aspects should be simultaneously represented.

8.1.5 Overall findings: Policy Implications

Aiming to improve people's quality of life from the perspective of land use and transport planning in a more comprehensive way, this research conducted by a life-oriented approach. Firstly, this study examined the values of life-oriented approach, by offering the empirical evidences of behavioral interdependencies across life choices in the land use and transport context. From different time scales, it is found that other life choices (e.g., leisure activity

engagement) play a dominant role in people's quality of life improvement, compared with the effects of land use attributes and travel behavior. Second, targeted on three important social issues in Japan: (1) women's labor participation and childcare, (2) young adults' lives (e.g., out-migration), and (3) elderly mobility, this study investigated the reasons of those issues' formation based on the life-oriented approach, particularly from land use and transport perspectives. As a result, some important policy implications are provided to deal with those serious issues. And details are showed in Table 8-1.

1. For the women labor participation and childcare issue, in order to balance their family and work, further improve their quality of life as well, this study found that the cross-sectoral policies would be efficient. Specifically, the Land Administration Department should take measurements to offer more public facilities such as childcare centers, transit facilities such as railway stations around the residential area with low women labor participation rate, it would facilitate more women to take up a paid work. Moreover, cooperating with Labor and Employment Ministry could be more effective, Japan should provide better support for working mothers. A more flexible work environment combined with better child care facilities and longer leave policies would help reduce the number of women who exit the workforce after childbirth.
2. For the young adults' out-migration issue, in order to keep more young adults in the local cities to revitalize the regional economic development, this study investigated their residential relocation behavior from different time scales. It informed the local governments that high density land use pattern with more public facilities, more job opportunities and more childcare facilities, as well as offering a vibrant environment such as more leisure activities provision, those would be useful to attract more young people.
3. For the elderly's lives, in order to facilitate them travel out and improve their quality of life, this study showed the local governments that the walkable community environment, more

gentle sports facilities, especially more medical facilities and welfare facilities, which are all beneficial for the old person's daily lives. It is implied that the local governments especially in the depopulated areas, should take administrative steps or offer financial and other incentives to offer the elderly persons better living environment such as compact communities, which is not only contributes to more efficient provision of public services (i.e., public transit service), but also is beneficial to resolve the elderly's low mobility issues.

Table 8-1 Policy implication based on the whole research

	Quality of Life			
	Women	Young adults		Elderly
		Short-term	Long-term	
Land Use Pattern	Density of transit facilities; Density of public facilities; Density of employment.	High-density land use pattern (Top three: Public facilities; Employment; Childcare facilities)	High-density land use pattern (Top three: Public facilities; Employment; Childcare facilities)	High-density land use pattern (Top one: Medical facilities and welfare facilities)
Transport	Job accessibility (short commute distance)		Low occurrence of traffic accidents.	Walking and public transit use; Less car use.
Residence Life	Closeness to kindergarten; Closeness to elementary school.	Megacities; Dwelling size; Own the house; Long residential duration		
Job Life	Part-time job; Sound holiday system; Longer vacation taken; Shorter working hours.		Employment rate of Young people; Number of Tertiary industry companies.	
Family Life		Sharing more time with family and relatives		
Health Life				Gentle sports activity engagement
Leisure/ Recreation Life		Leisure activities engagement		
Education/Learning Life	Job training program provision			
Finance Life			Average per capital subsidy tax	
Social Life		Community activity participation	The young adults population density; High birth rate	Frequency of neighbors communication; Community activity participation

8.2 Limitations

Life choice involves a range of decision making process and is influenced by a number of individual, household and environmental factors. In order to get a better understanding of the effects of land use and transport on varied life choices (including residential choices, travel decision and other life related choices), it is necessary to employ a dynamic simulation program based on a robust policy system to the people's quality of life improvement target. The dynamic collaborative effect of land use policy, transport policy, social policy, employment policy, health policy and so on should be evaluated in the simulation, which can contribute to assess the influence of some macro-type policies relevant to people's life aspects. However, this aspect remains unexplored in this study.

There are unexplored issues in representing dependencies and interactions in life choices in a more comprehensive way as well. It remains unclear how the dependencies and interactions vary in different contexts. As for the three urban issues I discussed above, it is still unclear the behavioral interactions among those phenomenon, such as whether the elderly mobility behavior affect the young adults migrate out, and whether young adults migrating out would promote more women work out. In terms of temporal dependence, the panel data analysis examined the influence of state dependence on life choice aspects, but failed in future expectation consideration. Moreover, in terms of young adults' migration issue based on a life history data, the dynamic models need to be further employed for representing the interdependencies of life choices.

Many relevant choice aspects involved in people's life are not included in this study, including group choice, route choice, household interaction related choice, etc. The developed model system should be extended to cover more decision aspects of people's life and incorporate more behavior mechanism in the future research.

This thesis adopted survey-oriented approach to analyze life choices. In other words, the model development is based on the available data derived from survey. Therefore, the results can only reflect the life choices in the study area. With such consideration, the generalization of the proposed model should be further tested by conducting comparative analysis between different countries (e.g., developing ones).

8.3 Future work

From an executive perspective, more in-depth analyses should be done to provide more convincing evidences to support the idea of life-oriented approach. To deepen excavate the ways to improve the quality of life of different population cohorts, more suitable entry points should be found, more details of life choices should be obtained, more specific studies are needed in the future.

From a theoretical viewpoint, more advanced choice models should be built to joint represent residential choices and travel behavior as well as other life choices for incorporating decision-making mechanisms into the analysis. And for obtaining more convincing conclusions, more case studies should be done not only in developed countries, but also in developing countries, which are experiencing more dynamic changes economically, socially, and culturally.

From the practical perspective, some simulations should be conducted to predict the changes in different life spheres due to the changes in land use and transport planning and socio-economic situations and to explore what kinds of policy packages could effectively support the people's quality of life improvement. Since life decisions making is a multi-dimensional process and decisions about different dimensions of behavior are interrelated with each other, changes in land use and transport planning and socio-economic situations will influence the whole process of people's choice. In future research, simulation can be conducted

under different scenarios by using the model estimation results derived from this study. Based on the simulation, policy packages could be proposed to support the improvement of quality of life.

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1. Zhang, J., Xiong, Y. (2015). Effects of multifaceted consumption on happiness in life: a case study in Japan based on an integrated approach. *International Review of Economics*, 1-20. (Chapter 4-1)
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8. Xiong Y., Zhang J. (2014). How residential environment and travel behavior influence people's life satisfaction? - A Bayesian network analysis. Compendium of Papers CD-ROM, *The 93rd Annual Meeting of Transportation Research Board*. Washington, D.C., January 12 - 16. (Chapter 4-1)
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