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:

Research on the Determinants of OlderPeople Living Arrangements in China

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Abstract

Aging problem in China is intensified by the huge population of older people.Low economic development level further exacerbates the aging problem in China. Nowadays, the Chinese government pays attention to the rapidly increasing number of older people through publication of a wide range of measures. Among all, living arrangements of older people is highly affecting demands of older people towards government and society. This thesis discusses theoretical research and develops empirical analysis model to reveal major factors on older people living arrangements decision. Older people with agricultural and non-agricultural Hukou are compared to better understand the influential mechanism.Then, this study, on the one hand, suggestsfactors of changing choicesof older people living arrangements based on the matched data.On the other hand, the current studycontrasts preference and actual choice of older people living arrangements in China for further exploration in potential variables on preference of older people.

National Censuses in 2000 and 2010 are introduced to statistically present the tendency of aging society in China. China Health and Retirement Longitudinal Study (CHARLS), conducted in 2010 and 2013, is employed in the empirical study. The first empirical analysis will start with major theoretical papersreview anda thorough discussion of China specific featuresto gain critical determinants of living arrangements. Logit regression analysis is aiming to find out factors of older people living arrangementsand differences in urban and rural areas in China. Personal characteristics, family features, financial conditions as well as policy legislation are proved to significantly affecting decision of older people. A robust test on investigating differences between urban and rural older people is also supporting theresult. Then, Logit regression is conducted to identify possible factors of changing living arrangements choice of older people. Furthermore, based on differences between preference and actual choice of living arrangements, another Logit regression on preference of older people is conducted for possible influential factors.

There are three main conclusions and respective policy remarks. First of all, personal characteristics,family structure, financial condition as well as policy legislation are significantly affecting choice of older people in China. Bequeath tendency is the

primary difference between urban and rural older people. As there are significantly effects of China specified factors on choice, it would be necessary for government to formulate policies based on China features but not indiscriminately adopt experiences from other countries. Secondly, changes of living arrangements are significantly influenced by medical affordability, housing structures as well as self-rated living standard of older people. Especially, person who is paying medical expenses of older people, existence of grandchildren, and self-rated living standard of older people are more likely to cause the change of current living arrangements. Therefore, government should focus on the sources of medical expense as well as living standard of older people. In order to encourage aging-in-place, Chinese government should promote community support network to ensure medical care accessibility. Thirdly,there is only a small part of older people who are able to live according to their preferences. Major constraint of living arrangements is health condition. Chinese government in this case should pursue adapted aging house which is able to raise living standard. In addition, government could encourage adult children to take responsibility in taking care of older people by introducing tax credit.

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Chapter 1 Introduction

1.1 Background and Significance

1.1.1 Background

Global population is aging rapidly due to low fertility and low mortality rates. This has been recognized for some time in the developed countries where it is estimated that there will be about 35 older people (65 years old and over) for every 100 workers by 2050[1]. Aging population has been acknowledged in China only recently, but with more urgency due to the tremendous population size and predicted growth; there will be 64 older people for every 100 workers by 2025 in China [1]. More data tell the truth that China is now waiting for a future trend of aging population in the coming few decades; by 2035 it is projected that those aged 65 and over in the China will account for 20% of the total populations, while the number of people aged 85 and over (oldest old) in China will be more than 3 times larger than that in 2010, accounting for 1.3% of the total China population [1].

Aging problem in China is not only intensified by the huge population of older people, but also exacerbated by the low economic development level of China. The half-baked economic development stage in China boosts economic pressure of older people. Apart from the economic plight, China is also facing the low consumption ratio puzzle that Chinese economy system is always known as investing too much, growing too fast, saving too much, and hence consuming too little. Consumption behavior of older people presents the most prominent puzzle in China. Consumption ratio of older people in China has been being at a low level for decades that the ratio is less than 5% before 1987 and still below 8% until 2012[2]. While the consumption ratio of the whole country is around 35%, average ratio in Asia is 55% and average ratio in OECD is 60%[3], it is still the lowest among all major economy. In addition, the sources of income are unitary that 50% of older people from urban area are depending on the pension. Furthermore, quite a number of older people cannot afford to survive by personal labor income or property income that more than 30% of older people from urban area are depending on the economic support from children[4]. In addition, due to their economic

dependency on family members and bequest tendency, most of the older people do not have economic and autonomous rights to deal with their income and wealth.

In fact, China has difficulties in facing aging population due to the following several reasons[5]. Social security or transfers for older people from society or government is far more than enough reaching the basic requirements of older people such as medical care and transportations. Also, community facilities for older people are limited due to the over-developed commercial residential buildings and over-crowded living environment. In addition, care and services provided by private or public sectors can barely meet the demand of older people. Last but not least, social inclusion of older people is always a concern and focus of the government as the value and involvement of older people into the society pose a positive impact on the society. Aging population adds pressure but also provides motivations for the improvement of the social system as well as the city development.

Older people is a vulnerable group which should be supported and helped by the government. Vulnerable group is defined as a group people who find it difficult to survive and lack of development opportunities due to being relatively disadvantaged in economic, physical, cultural and others. According to Justice of Fairness[6], vulnerable group should be helped and supported economically and socially in order to maintain the basic fairness in the society. Governments and NGOs are all giving very high propriety to the aging issues and also putting forward a series of methods to deal with them.

Nowadays, the Chinese government also pays attention to the rapidly increasing number of older people through publication of a wide range of measures. The government was apprehensive of aging demographic by making relevant law, rights protection law of the People's Republic of elderly people[7] which eventually performed on July of 2013, suggested since 1996. Since 2011, the General Office of the State Council of China has implemented a series of decision, notification and planning documents which are related to strengthening and speeding up works for older people as well as development of social care delivery model[8-12]. The measures call for every level of government to provide services to the older population in poverty. They also call for taking older people into account from economic planning to urban design.

However, China, as one of the typical developing countries with extremely rapid aging population, has no referencing country to learn and imitate about aging related

law implementation.It is obvious that some regulations, such as asking adult children to often go home for parents, can hardly be enforced in the reality. Pertinent legislation actions in developed countries are more sophisticated and enforceable but not suitable in China. Researches providing opinions based on reality situations as well as experience conclusion are important for the China government.

Starting from the 1980s, systematic studies in aging issues have already existed in Europe due to the early aging population that boomed just after Second World War. In the beginning, European scholars started to study the demographic influences that posing on society and government. Then, since baby boomers in foreign countries started to retire, more scholars from various research areas turn their eyes on the aging population issue. Meanwhile, the visual angle and depth of researches have been widening and increasing continually.Previous researches of aging population involve varies disciplines and majorly concentrates on western aging problem.They studiedaging population from different perspectives, including living arrangements, retirement consumption, physical and mental health problems, long-term care, corresponding policy implications and etc. Current research on aging population involves the above areas from different perspectives.

While all those aging related issue, living arrangements as the most important and crucial part of the aging issues have been the hot spots of scholars. They study living arrangements from different point of angles. Some study the factors affecting choice of living arrangements, some probe different types of living arrangements and aim to develop a new and adaptable living arrangement for a specific country or area. In addition, the relationships and mutual effects between living arrangements and other items, including physical and mental health, consumption patterns and etc. are also included in the related research area.

Above all, aging problems in China have become more and more prominent. This is because living arrangement of older people impacting a lot in different areas is a critical point of view to observe and tackle the problems.From the causes of to the impacts from different living arrangements, foreign scholars have studied through while it is still near the starting point in China. Therefore, living arrangements of older people would be the research object. Then, this study would emphatically analyze the choice differences as well as the reasons and causes of differences between older people in China and western countries. Finally, through comparing the differences between

preferences and actual choice of living arrangements, this study would be able to identify constraints of older people in making choices.

1.1.2 Significance

1.1.2.1 Theoretical Significance

(1)Identify major determinants of older people living arrangements in China

On one hand, existing theoretical studies of living arrangements of older people are still primarily supported by western studies. However, those studies on influential factors are not completely consistent and theoretical methods and models are still being proposed, improved and tested. On the other hand, living arrangements of older people in China is unique due to the cultural differences, traditional concepts of family and political environment. Almost all of the Chinese studies are based on the existing western theoretical theories, rarely tried to analyze the aging problem with consideration of Chinese characteristics. Therefore, this study would construct an analysis structure for analyzing living arrangements of older people in China based on the combing of western theories and analysis of current condition in China. Finally, current study would reveal the determinants of living arrangements decision of older people in China. Investigating living arrangements of older people could help to suggest a more useful and reality based advice as well as theoretical support for policymakers and would also theoretically ascend the research perspective through completing the whole theoretical study of living arrangements.

(2)Reveal major constrains of older people living arrangements in China

Living arrangements of older people can be divided into two kinds of choice, the actualchoice of older people, which is the existing condition of older people presenting to the database, and the living arrangements preference, which is the preferable status of living arrangements of older people. Actual choice maybe different from the preferences due to various limitations, which are also known as the constraints of choosing living arrangements. Most of the existing studies of living arrangements are concentrated on the actual choice of older people and only limited of them are paying attention to the preferences of older people.Furthermore, studies which are concentrating on the differences between actual living arrangements choice and preferences are still very limited. On one hand, the purpose of related legislation design is to affect or fulfill the preferences of older people but existing studies tacitly approve that the current living

arrangement choice is the best choice. The validity of existing studies is therefore still up for debate.On the other hand, data limitation is the other reason of not considering preference of older people. Most of the studies are adopting existing surveys on current living arrangements of older people due to the consideration of statistical convenience of data collection and also the assurance of data quality.From the perspective methodology, there is limited corresponding model for this type of comparison and therefore lack of theoretical support. This study thus, based on the comparison between preferences and actual choice of older people, would construct an appropriate analysis structure as well as an empirical model. Then, this study would be capable to reveal constraints of current choice of older people and a more effective and specific policy advice would be put forward for policy makers.

1.1.2.2 Practical Significance

(1)Deepen the understanding of aging problem in China

Aging problem started and developed in European countries, all basic and major theories, methodologies and practical studies are constructed and deepened by foreign scholars. However, the current condition, causes, as well as influences of aging problems are not so familiar with what have been done in foreign countriesdue to the cultural, legislation system and economic development level in China are with so much diverse and distinguish features. To continue adopting theoretical model developed by foreign scholars is not reliable so that this would undoubtedly necessarily to study the aging problems from the Chinese economic and social perspectives. As a result, this study could deepen the understanding to aging problem in China for the government and the society.

(2)Provide policy remarks for aging population

Through comparison of living arrangements choices between older people in China and those in western countries, this study aims at providing advice for policy makers to help older people have a more reasonable living arrangements choice. From the analysis of theoretical models developed by foreign scholars and the discussion of characteristics of aging problems in China, this study would be able to comprehensively elucidate living arrangements decision factors of older people in China. In addition, this study would identify the interaction strength and influential mechanisms of factors. This hence would help policy makers clarifythe thoughts of policy formulation and

implementation and as a result to be able to develop a more target-driven measure to lay a foundation of the regulatory function of policies.

On the other hand,through identifying the constraints of giving rise to preferences and actual choice of living arrangements choice, this study also aims at advising government for dislodging those constraints. Supported by research[13], older people in China would prefer aging-in-place without constraints. Supporting older people to age-in-place would significantly loosen the pressure of government taking care of older people from the perspective of economic and amount of formal care providing.Therefore, through similar advice, older people, regarding as vulnerable group of the society, would have more opportunity to choose and a more justice society would be constructed.

1.2 Research Objectives and Content

1.2.1 Research objectives

This thesis developsempirical analysis model to reveal the major influencing factors of living arrangements of older people in order to better understand the determinants and constraints of older people and the influential mechanisms of those determinants. This study will construct empirical analysis models, on one hand, suggest measures of changing living arrangements of older people based on the comparison between China and western countries, on the other hand, provide a problem solving path of improving current decision pattern through contrasting the preference and actual choice of living arrangements of older people in China.

1.2.2 Research content

(1)Identify major determinants of living arrangement

Theoretical analysis on western theories of living arrangements of older people revealing major influential factors and their influencing mechanisms of older people towards living arrangements will be carried out. A more persuasive and convincing suggestion of major determinants of older people can be made through deep analysis of Chinese characteristics and theoretically based model construction. From identifying those determinants make that possible to study the pathway of those determinants changing or affecting the choice of older people.

(2)Estimate determinants of living arrangements

Based on the result of theoretical study, empirical analysis of living arrangements choice of older people from the perspective of determinants of living arrangements in China will be carried out to obtain magnitude of each major factors impacting on the choice. Then, based on the result from the previous stage, factors influencing decision process will be analyzed. Through testing and adjustment of models and factors, this study gives out a determined empirical influential model for living arrangements of older people in China. Policy advice can hence be provided based on the identified significant influential factors.

(3)Identify major constrains of living arrangements decision

This study firstly combs the conclusions and problems of existing empirical studies on living arrangements of older people and analyses the current condition of living arrangements choices of older people in China. Then, a comprehensive view of actual choice of living arrangements in existing studies would be summed up. After that, this study would carry out data analysis on micro demographic data of older people in China and try to identify the actual choice of them. With all of the systematic data analysis and summary of existing studies, this study would construct an empirical analysis model for identification of constraint factors of living arrangement choice.

(4)Estimate constrains of living arrangements

Based on the previous analysis and model construction, the next section would start to empirically analyze the constraint factors of living arrangement choice as well as the influential strength and mechanisms of each factor. Through testing and adjustment of models and factors, this study gives out a determined empirical influential model of the constraints on living arrangements of older people in China. Policy advice is therefore provided based on the identified significant influential factors.

(5)Conclusion and policy remarks

Policy advice would be put forward on the conclusions of influential factors and constraints analyses. In addition, identifying constraints of choice could also assist the government in improving the freedom degree of choice of older people and hence to promote happiness of older people in China.

1.3 Research Methodology and Technical Route

1.3.1Research methodology

This report combines the theoretical and empirical way of research. It would give a solid and persuasive support for the final political advicefrom theoretical study to empirical analysis. The specific research methodologies are as follows:

(1)Literature review

Literatures accessing the determinants and influential mechanisms of living arrangements choice from different perspectives, such as importance of personal characteristics, comparison between characteristics of older parents and adults children, and relationships between living arrangements choice and health condition, will be studied and organized for preliminary investigation. Level of effect of each factor in every related literature will be collected and neaten for comparison of every factor in order to get the first concept of influential factors. Then, empirical studies of current choice of living arrangements and preference of choice, constraints and their influential mechanisms on actual choice and decision making are summarized and concluded.

(2)Data collection and processing

Data will be obtained from two major sources. The first on is the CHARLS data from 2011 and 2013, which is described in [14], was designed after the Health and Retirement Study in the US as a broad-purposed social science and health survey of the older in 28 provinces. This survey was published in 2013 and 2015. The CHARLS pilot sample is representative of people aged 45 and over, and their spouses, living in households in various provinces. More discussion on data will be included in the empirical analysis section. The second dataset would be the fifth and sixth population census. These kind of macro data would provide current study with a more comprehensive and representative analysis on the actual living arrangements of older people.

In order to guarantee the quality of data and regression processas well as the effectiveness and scientific nature of final results, this study would employ a series of scientific methods for data processing.Before further data processing, all variables are collected and listed for multicollinearity test, based on correlation analysis. Then, Heckman correction is employed in the regression stage of analysis for controlling the selection bias problem which is endemic in grouping samples into different groups

according to their demographic characteristics. Hausman specification test[15] is also introduced into the statistical analytic part for discrimination between fixed effects and random effects model in processing panel data.

(3)Theoretical discussion

This study is related to different disciplines, including real estate economics, econometrics, gerontology, and larithmics. Theories that will be employed in this study include the principle of social justice, sociology principles including the purchase of privacy hypothesis, the demographic availability hypothesis, and the normative/ cultural hypothesis. This study, based on the above theories and employment of those methodologies, would build correspondent empirical model for identifying determinants and constraints of living arrangements of older people.

Meanwhile,in existing theoretical research of older people living arrangements, the utility function of older people is modeled with endogenous consumption and living arrangement decision under the entire bundle of income resources of older people including saving, bequests, assets and family and social transfers in the local social and political context. This study would identify the differences of influential determinants of living arrangements between western countries and China. Firstly, theoretical papers are analyzed for further investigation of living arrangements factors in western countries. With integration of all factors adopted and considered in theoretical papers in western countries, this study would further analyzespecific features of influential determinants in China. Finally, this study would be able to identify the various between China and western countries.

(4) Empirical tests

Empirical research methods such as statistical analysis, regression analysis, and comparative analysis are adopted. Based on the econometric research paradigm, this study conducts empirical analysis respectively for the older people choice influential determinants and constraint factors. Through gaining the general patterns of statistical analysis, this paper would adopt regression analysis for revealing the strength of various factors on the living arrangements decision.

Regression analysis for living arrangement will be carried out based on micro and macro data for each country from various perspectives including aging patterns living environment, health condition as well as geographical distribution. Major factors that revealed from theoretical study will be used as independent variables in the Logit model

and found out the magnitude of economic variables in the model.

1.3.2 Technical route
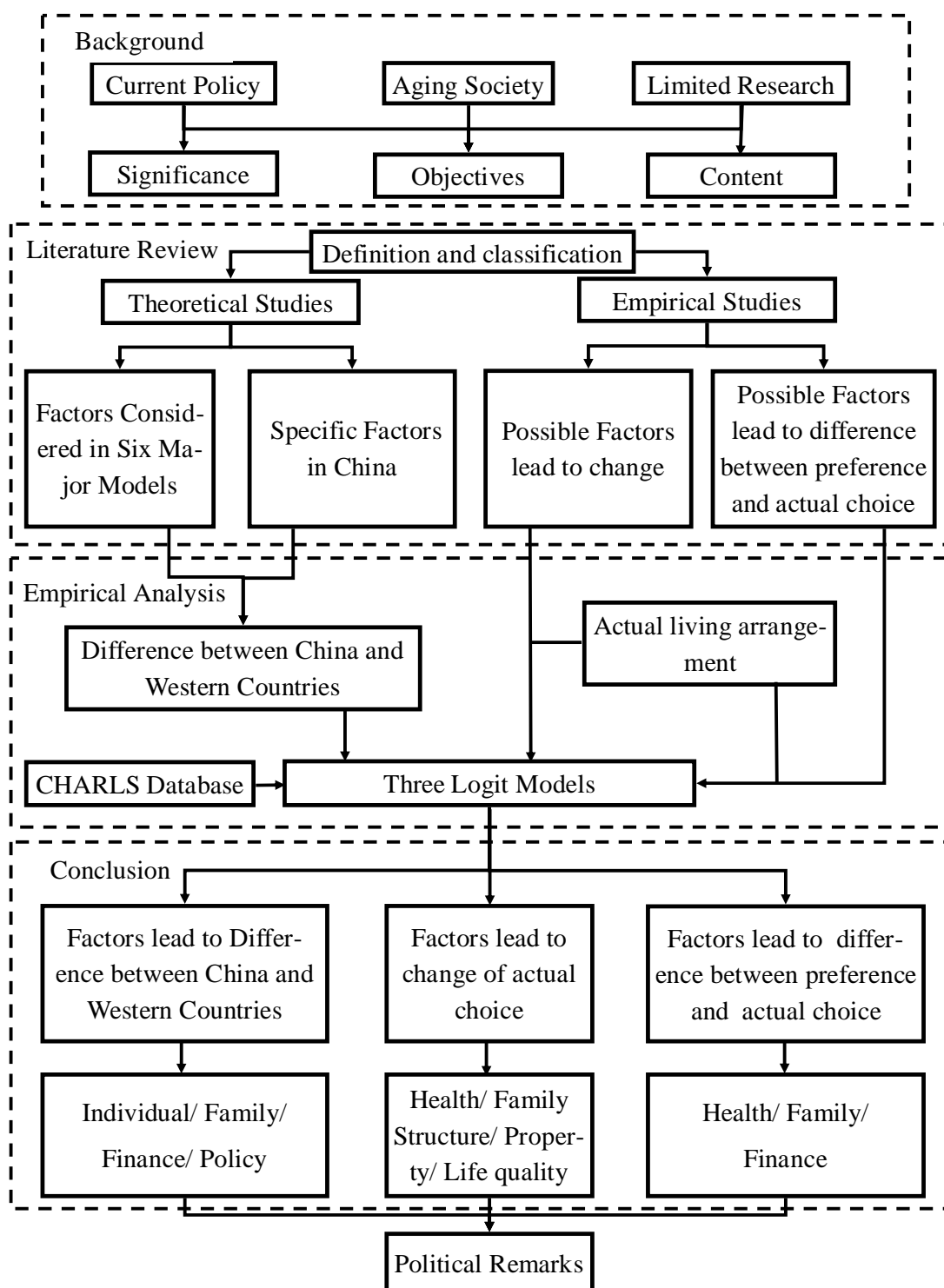
Figure 1.1 Technical Route

Figure 1.1 shows the technical route of the thesis. Four main parts can be divided from the figure. They are the background, literature review, empirical analysis and conclusion. Starting from social needs as well as academic short, current policy, aging society and limited research are the three main ideas came up from the beginning of the paper. Then, significance, objectives and research content of the thesis are settled. Literature review would firstly require definition and classification of living arrangement of older people. Then, theoretical and empirical studies are reviewed and deeply studied. From the review of theoretical studies, factors considered in six major models and specific factors of older people living arrangement in China are then determined. On the other hand, possible factors lead to change and possible factors lead to difference between preference and actual choice.

Empirical analysis is divided into two parts. The first part aims to find out difference between China and western countries. The second part tries to identify the dynamic features of living arrangement choice. These two analyses are both adopting CHARLS database and employing Logit model. Conclusion of the thesis identifies items that are potentially impacting choice of older people under different circumstances. Specific policy remarks are provided concerning the conclusion.

Chapter 2 Literature Review

2.1 Concept of Living Arrangements

2.1.1 Definition of living arrangements

From the perspective of philosophy, people would define living arrangements as an arrangement allowing people to coexist. At the beginning level of studying living arrangements, living arrangements is generally defined as what you do to live where and how you want to live. However, this definition only focuses on the choices of life, but not considering the interpersonal relationships embodied in the connotation of choices. Therefore, there is an extreme definition of living arrangements which rarely considers living arrangements as a variable that collects the familial and non–familial relationships of a person to all the other people with whom they usually reside.Obviously, this definition, which totally ignore the objectivity of living arrangements, is also not desirable for this study.

To conclude, this study would suggest that living arrangements of older people literally represent the arrangements of living of older people, which is not limited to only the place for living. Concept of living arrangements includesmore. It is about the choice of privacy from independent living and caring provided from living together. It is also related to the economic support for each choices which can be economically supported by the government, the family or by older people themselves.

2.1.2 Features and classification of living arrangements

Each living arrangement demonstrates diverse features, such as living location, whether they live in their own house or in the institutions, transfers sources, whether the main income or the formal or informal support of them comes from their children, the community or the society, people that older people are living with, numbers of children or grandchildren that living with them and presence of spouse, and etc. [16].It is thus clear that there are plenty features of living arrangements and it would be more comprehensive consideration of this study to classify living arrangements of older people according to corresponding features.For instance, living arrangements can be constructed with an

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individual or a household as the basic unit that generally studies tends to consider living alone and living with spouse only as one living arrangement choice as there is only very less differences when the study not considering widowing effect. Living arrangements can furthermore be considered with who are the older people living with, what are the housing types of older people living in, where do older people living at, which party is financially or informally supporting older people. Generally, living arrangements in papers are grouped according to the research aims of the project.

Of course, living arrangements classification always depends on the particular objective of the study and classification as well as definition of living arrangements would thus present certain regularity. Although, there are different ways to group living arrangements of older people, including grouping according to the main source of transfers, and the living partners, which maybe only their spouse, their children, the kin group or with other older persons in the institute. Obviously, however, core standard of living arrangements is whether older people are living with their children which also highlights the requirement of older people as the subject of receiving aged care service.

2.1.3 Living arrangements classification based on parent-child relationship

Traditional concept of 'raising son for old age' suggests that parent and children living together enable adult children to fulfill and meet demand of diversified pension requirement of older parents. In modern society, development of technology as well as the gradually improving pension services development by both the society and the government reduces the necessary of older people living with children. Therefore, no matter in western developed countries or in Asian countries, proportion of adult children living together with parents is falling.

In China, scholars suggest that 'live with departure but not away', which indicates that adult children are living very close but not together with older people, is a common living arrangement choice. It is because that this living arrangement, on the one hand, allows both parent and children to possess privacy and living space, on the other hand, also enables children to provide support for parent as required. Existing research focused mainly on the influential mechanism of actual living arrangements among parent and child, but lack of attention on the older people living arrangements preferences.

In addition, there are controversies among conclusions of studies. Parsons and Bales

[17] based on social and geographic mobility theory suggest that a modern economic system should have a more flexible family form in order to facilitate labor supply yet Ferrie [18] suggested otherwise. Goode [19] and Elamn [20] based on the urbanization theory suggested that urbanization weakening the function of family as a support source for older people. Kobrin [21] suggested demographic change, which is mainly due to the low fertility rate and hence reduce of children number for each older people, causes the decrease number of co-residence while Kramarow [22] disagreed. Goldscheider and Lawton [23] and Engelhardt et al. [24] suggested affluence hypothesis and thought that all older people prefer living independently, only when they are economically unaffordable or not healthy enough to take care themselves would choose to live with children. Ruggles [25] proposed otherwise that older people who live independently are commonly with a lower income and worse health condition. Aquilin [26] and Ruggles [27] suggested economic development hypothesis which believes that co-residence is decided and preferred by children.

Chinese scholars, such as Zhang and Li [28], Wang and Zuo [29], Yang et al. [30] and Zhang [31], also carried out studies for parent-child relationship and living arrangements and present controversy conclusion.

Lei et al. [32] define living arrangements with special consideration to the proximity of child which they divide living arrangements into five categories according to the number of children living together, distance between residential address of older people and their children. This grouping method is detailed and being particularly useful when considering the correlation between living distance towards children and living arrangements of older people which is inapplicable for this report.

Some research [33] which mainly concerning co-residence and demographic distribution of children impact of aging would divide living arrangements according to the number and people of coresidencing with older people, which includes three main types of living arrangements, living alone (with or without spouse) while children do not live nearby, living alone (with or without spouse) while children live nearby, and co-residence with children, ignoring older people living in institution.

Sarma and Simpson [34] who adopted utility model to study living arrangements choice of older people suggested that there should be mainly three of them, including staying in the community alone, living in an intergenerational family, or living in nursing home, according to the extent of informal and formal care provision.

As this report, aiming at finding out the major factors affecting living arrangements, the grouping of living arrangements of older people would be carried out corresponding with characteristics of major variables posting effects and putting constraints on the choice of older people. There would be (1) aging-in-place independently, indicating that they live in original house alone, with or without spouse, (2) aging-in-place with children, which is combination of aging-in-place and getting formal and informal support from children, and (3) aging-in-place without children around, which simply represents older people living in their own housing and children live in a far distance and only possible to provide financial support. These three types of living arrangements are grouped according to the living distance from children and the support that children are able to provide for older people.

2.2 Theoretical Research on Living Arrangements

The selection of living arrangements is often the most important choice of an older person and its family as various living arrangements of older people would give out different financial and familial arrangements. How the older people or their families arrive their decisions, why it makes certain decisions and behaviors in particular way and the decision-making process are all of tremendous complexity and crucial. All of these should be determined through an appropriate theoretical model of living arrangements so as to reveal the mechanism behind statistics.

On the other hand, current studies on living arrangements of older people in China tend to concentrate on the empirical result coming from reduced form of regression. Only employing empirical reduced form model could hardly provide us a clear sight of the decision process of older people or the family. For the sake of understanding the actual influential factors of the decision, revealing the mechanism of older people or their families deciding older people's living arrangements is a must.

In this area, early studies on older people living arrangements, their determinants as well as influential factors try to find out the decision-making process of older people or their families. However, current research of older people's living arrangements, especially those focus in China, often pays attentions on empirical factors, which barely supported by a conceptual model based on economic concepts and theories, such exogenous variables as demographics variables of older people and their family members, financial conditions and current housing status. In order to understand decision-making

process of older people in China, an applicable theoretical model would be extremely useful for political formulation as well as future in-depth study.

2.2.1 Theoretical Foundation of Living Arrangements

According to Lin [35], theoretical base of discussing living arrangements includes the principles of social justice. The principles of social justice are all about the basic rights of justice should be inviolate. Rawls [36], who came up with Justice of Fairness, believed that a justice that social system should ensure that every people in the system to sustains their basic freedom and rights even if the system may be injustice while working for the advantages for the least well off. It therefore suggests that in order to ensure and rectify the overall justice of fairness politically, the government can economically help the disadvantaged groups through maybe redistribution or taxation for the overall benefits of the society and social harmony and stability. Under the same situation, older people should be helped and delivered from their limited affordability of choosing living arrangements of them.

Apart from sociology principles, there are several hypotheses that should be clearly stated in the beginning of the discussion of theories that constructed for explaining diverse living arrangements choice, which is the arisen of living alone in place [37]. He suggested three important hypotheses including (1) the purchase of privacy hypothesis, which considers the raised of income enable more older people to purchase for privacy; (2) the demographic availability hypothesis, which points out that the decreasing fertility lower the possibility of co-residence; (3) normative/ cultural hypothesis, which believes that the alternated social norm and personal preferences caused the increasing value of living independently.

Of course, there are still more principles and hypotheses that should be discussed when studying living arrangements of older people with diverse affordability, such as Maslow's hierarchy of needs and Family Life Cycle suggested by Glick in 1947.

Utility model assumes decision maker makes rational decision by choosing the choice with the highest expected utility. Observing how decisions are made through model offers insight in how decision makers value factors under certain circumstances. The reason for adopting utility model for older people decision is that under assumption older people are expected to make decisions of living arrangement which allows them to maximize their expected future lifetime utility. There are several studies of living

arrangements of older people adopting utility model [38-41]. Most of the studies merely discuss the theoretical development of utility model in determining rational living arrangements but not adopting the result on empirical study to find out the diversity between actuality and rationality decision.

Application actuality of reduced form models in the area of living arrangements choice is common in sociology study. Scholar suggested that adopting reduced form for studying living arrangements is to use survey information in a specific time of period in the model and observe probabilities of one living arrangement comparative to a number of other choices [42]. However, Palloni [42] also suggested three obvious drawbacks of using this method in the research. The first drawback is that those models failed to give explicit decision making process for choice of living arrangements; and may hence be plagued by endogeneity problems, opaque observable living arrangements patterns and cannot reveal constraints of older people making decision towards living arrangements. The second one is that this kind of model does not able to provide diverse combination of kin and children as an option for older people and even it does, the model can hardly further reveal the characteristics of offspring and consider them as influential variables. The last shortcoming is that there is lack of consideration of family and social transfers in the model. Transfers between older parents and adult children are not in single pathway but occurring in two-way and interact with each other significantly so that only considering one part or even ignoring it would cause a huge defect in the finally conclusion.

2.2.2 Major Theoretical Studies on Living Arrangements

Several classic theoretical studies on older people living arrangements are revealed in this part. This is for the further in-depth research on the older people and their families determining the living arrangements. Various stating point of scholars give out different considerations on their theoretical models. Some may concentrate on the impacting route of factors on the final decision while some may focus on the decision process of older people. On the other hand, scholars also suggest different determination process by only older people, by their adult child or by the whole family. There are also structural models paying attention to economic utility of persons or family while others focus on the family role of older people.

2.2.2.1 Graphical model by Wister

Wister [43] started looking into the living arrangements of older people from 1980s. He suggests that both the social norms and personal preferences of older people are the most significant variables in the decision of whom to live with. Among all norms and preferences, preference of living independently with more privacy is confirmed to be the strongest predictor of living arrangements. Firstly, three hypotheses, the purchase of privacy hypothesis, the demographic availability hypothesis, and the normative/ cultural hypothesis, of older people deciding whom to live with are elaborated. All of these hypotheses are partly adoptable in explaining the living arrangements of older people, but they can hardly include all influences of the decision.

A "schematic representation of the proposed decision-making framework" with all known variables on and with a clear decision-making process is then presented. The main idea of this framework is that decision of households by personal level consideration is to satisfy certain needs. It is observed that there are five major parts. The normative and preference structures underlying choice can be divided into two parts, the social norms, such as kin obligations in taking care of old parents, and the personal preferences, for example, of privacy and independence. This is obtained through questioning two open questions of living arrangements satisfaction as well as the reasons of having such preference. Constraints on choice, which is not like ordinary model, involve much more than just economic, but extend to include health condition, informal support and family characteristics, and domestic competence. The third part is evaluation of "goods" surrounding household status. To simplify the idea of this part, this actually involves a consideration of which to gain and which to lose by choosing such living arrangement. Those "goods" include domestic services, privacy and independent, and intimate companionship of family. Wister suggests that determinants of living arrangements other than in constraints or norms and preferences are classified as socio-demographic variables. Then, the fifth major part would be living arrangement decision.

2.2.2.2 Structural model by Kotlikoff and Morris

After years of research on living arrangements of older people, most scholars concentrate on evaluating the decision-making process of older people as it is often assumed that older people to be the only decision maker. Yet, Kotlikoff and Morris [44] suggest otherwise. Family utility, as the sum of weighted old parent utility and adult child

utility, is proposed to be the utility for final living arrangements decision. This indicates that decision of living arrangements is not only involving older people but also family members, in this case is the child. Kotlikoff and Morris start with carrying out probit and Logit regression so as to find out basic influential factors of living arrangement decision. However, only reduced models could hardly reveal precisely the role of income and other economical determinants, structural model is therefore introduced in the paper.

Before constructing a model, several important assumptions should be stated. Firstly, utility of both parent and child is maximized when they are living separately and family utility is maximized when both of them live together. The second assumption is that the structural model considers only single parent with one living child. In the model, there are parent utility, U_p, and child utility, U_c, we also get family utility, U_F, by summing them up. Then, θ, which is chosen by both parties, is introduced in the model as a weighted average of both preferences so as to show the bargaining result between two parties.

$$U_F = \theta U_P + (1 - \quad) U_c \qquad (2\text{-}1)$$

Utilities of the parent and child mainly describe the preferences of living together of parent and child separately and cannot be calculated directly but can be found out their determinants can be found out which equal to 1 if they live independently; on the other hand, if they live together, to range from zero to one depending on their preferences of living together.

This model is then subject to the budget constraint of both parent and child as follow,

$$C_p + C_c + qH = Y_p + Y_c, \qquad (2\text{-}2)$$

where C_p and C_c are relative consumption of the parent and child, respectively.; in terms of income, Y_p and Y_c are relative income of the parent and child on respective level. As this is a budget concerning living arrangements in housing, qH represents consumption on housing by both parent and child, while q is the relative price of housing services. H_p and H_c are housing services quantity consumed by the parent and child; therefore, H is the sum of H_p and H_c.

Then, maximize utility model subjected to budget constraint, so as to get the demand relation equations when they live dependently,

$$\text{H} = \frac{Y}{2q}, C_p = \frac{\theta A Y}{[\theta A + (1-\theta)B]2}, C_c = \frac{(1-\theta)B Y}{[\theta A + (1-\theta)B]2} \qquad (2\text{-}3)$$

After that, for the purpose of getting main determinant affecting living arrangement decision, an equation is introduced here

$$G(A, B) = Y^2 - Y_c^{2/B} - Y_p^{2/A} = 0 \tag{2-4}$$

Through development of a structural model, authors discover that bargaining process between parent and child can be ignored when studying decision process of living arrangements of older people. Also, role of income level of parent and adult child is analyzed in the paper. It is concluded that, income of both sides, but not relative income differences between parent and child, makes huge difference in the decision of living arrangements. However, income effect varies in families, some may have positive income effect some may not. More discussion can be found in the paper by Kotlikoff and Morris (1990).

2.2.2.3 Multiperiod-Probit Model with Unobserved Heterogeneity and Autocorrelated Errors by Börsch-Supan et al.

Börsch-Supan et al. [39] discuss a lot on the choice of model and suggest that there are setbacks even for a multiperiod-multinomial Probit model. In order to improve the model, they enable the model to be with unobserved heterogeneity as well as auto-correlated errors. First of all, they suggest that each choice substitutes each other variously and unobserved correlated variables violate the independence of irrelevant alternatives (IIA) assumption, which hence should not adopt discrete model in living arrangements choice. Then, they point out that determinants of living arrangements in one time period also affect each other, which two main correlated components are unobserved personal characteristics such as health status and the autoregressive error structure. Therefore, in order to overcome correlations among econometric variables, authors develop a model approach captures both unobserved heterogeneity and autoregressive errors. Through a series of process, authors combine these three components, , together and get the following result from a utility model,

$$u_{it} = v(X_{it}, \beta) + \varepsilon_{it} \tag{2-5}$$

which u_{it} to be the utility of choice, i, in each period of time, t, that depends on the utility of each choice, v_{it}, affecting by observed variables, X_{it}, and parameter β, with a random utility error, ε_{it}. After maximization of random utility, authors then introduce linkages of variables in the same time of period, and drop IIA assumption for enabling

panel data adaptation. More exact operation can be referenced from Börsch-Supan et al.
[39].

As the paper of Börsch-Supan et al. [39] provides a brand new approach to investigate living arrangement choice of older people, scholars begin to look into this issue by referencing the model developed by Börsch-Supan et al. For instance, Hoerger et al. [40], and Sarma and Simpson [41] both adopt and use this model for further investigation in older people living arrangement choice.

2.2.2.4 Three structural models with three separate utility models by Hoerger et al.

Initiate the paper from the perspective of government, Hoerger et al. [40] investigate how public subsidies and private provision influencing the living arrangement choice of older people. Based on the probit model by Börsch-Supan and others, Hoerger and others consider more. They economically include parent and child in the model and also give out three separate models for each choices of living arrangements. They believe that each choice is determined by various economics determinants and should be considered by both parent and child individually. Parent and child both evaluate utility of each arrangement and choose the optimal one with the highest utility. It is worth mentioning that, once the parents pass away, their all wealth will directly transfer to the child. This assumption allows the influence of parent by threatening child of not bequeathing wealth. Utility function for three choices of older people, living independently i, living together with child t, and living in nursing home n, are as below,

$$U^i(F, I, H, C^P, C^K) \tag{2-6}$$

$$U^t(F, I, H, C^P, C^K) \tag{2-7}$$

$$U^n(\bar{N}, H, C^P, C^K) \tag{2-8}$$

where F to be formal care, and I to be informal care from community and family. H is the total housing consumption of the family for the first two options and housing consumption of older parent in the third option. There are two consumption components, the parent's consumption C^P, and the adult child's consumption C^K. As this paper concerns more the influence of public subsidies on older people choice, authors include this in budget constraint of the whole family in three choices as below,

$$i: p^F F + p^H H^P + p^H H^K + C^P + C^K = Y^P + Y_i^K(l, w) + S^i(Y^P) \tag{2-9}$$

$$t: p^F F + p^H H^T + C^P + C^K = Y^P + Y_t^K(l, w) + S^t(Y^P) \qquad (2\text{-}10)$$

$$n: p^N \bar{N} + p^H H^K + C^P + C^K = Y^P + Y_n^K(O, w) + S^n(Y^P) \qquad (2\text{-}11)$$

while p^F, p^H, p^N to be the price of formal care, informal care from family and community, and nursing home, respectively. Then, considering housing expenditure, H^P and H^K are housing expenditure consumed by older parent and adult child respectively, and H^T, which is the total housing expenditure consumed by both parent and adult, to be the sum of H^P and H^K. On the other side, income of parent, Y^P, and adult child, Y^K, are the major income of the family. In order to consider government subsidies on living arrangements, $S(Y^P)$ is used to represent the amount of subsidies, which amount is highly depend on income of parent, to move in nursing home.

Therefore, only the living arrangement with highest utility level would be chosen by the family. In this case, it is living arrangement j.

$$U^j \geq U^k for all k \neq j \qquad (2\text{-}12)$$

Then, probability of each choice is presented in the paper. Probability of living in nursing home is different from that of living independently and living with child. More discussion can be found in the paper.

This paper concludes that income is not the only economic factor that should be considered in the research of living arrangements, but other variables such as government subsidies should be included. Also, this paper confirms that government subsidies, in this case to be the Medicaid subsidies from the U.S. government, poses positive impact on choosing to live in nursing home. This paper hence suggests the government to provide subsidies on community services in order to encourage older people to age in place.

2.2.2.5 Panel multinomial Logit model by Sarma and Simpson

Unlike Hoerger et al. [40], Sarma and Simpson [34] concentrate on the specialty of panel data in Canada. As in the U.S., aging of population also increases the demand of Canada government financial support on older people to pay for their long-term care services. Even worse, long-term care services in Canada are all basically shouldered by the government. In order to find a way to ease the financial burden, it is crucial to identify major factors that affecting living arrangements decision of older people. As authors point out, unobserved health status and heterogeneity variables are common in panel micro data of living arrangements, hence it is necessary to adopt the model of Börsch-Supan et al. As in the last two papers, older parent in this case also do the same

decision, choose the living arrangement with highest utility. It is however different from Hoerger et al. that this paper only employ one utility model to represent all choices as below,

$$U_j(F, C, X) \tag{2-13}$$

where U_j to be the utility of choosing j, which $j = 1, 2, 3$ representing living independently, living with family and living in nursing home. Three components are included in the utility model, F, C, X which are formal long-term care, consumption of goods and services other than formal care, and personal characteristics, respectively. Then, authors maximize expected lifetime utility of older people subjected to budget constraint,

$$C_t + P_t F_t = Y_t + S_t \tag{2-14}$$

which all variables are collected at the time period of t. P is the price of formal long-term care and Y is the income of older parent. As this model is also concentrating on government subsidy, S would be the amount of Canada government subsidies for older people long-term care services decided based on their income level.

For the sake of data limitation, indirect utility model is thus introduced in the paper as,

$$V_j(P, Y, X) \tag{2-15}$$

Random effects multinomial Logit model is then employed in the paper for the following analysis. To conclude, significant effect including subsidy on living arrangement choice is also found in Canada by adopting longitudinal data. Increasing support for formal long-term care in community as well as owning a house can both significantly reduce the proportion of older people moving in nursing home, which cost the government more.

2.2.2.6 Nonlinear MIMIC model by Börsch-Supan, McFadden and Schnabel

Health status of older people always is the crucial determinant of living arrangements decision. However, Sarma and Simpson[41] suggest that health status of older people in database is not so reliable due to the special nature of the "health" item in data collecting process. It is necessary to look into the paper of Börsch-Supan, McFadden and Schnabel [45], which emphasizes the importance and complexity of "health" in database.

Authors suggest that actual health status, so call the latent health, of older people affects both the decision of living arrangements and other variables affect decision. They suggest that relationship among these four components, including living arrangement choice u, latent health status h^*, health indicators y_k, and exogenous variables z_j, can hardly be revealed by a multinomial Logit model. Same as all of the study older people will choose the living arrangement with highest utility u_i^*, while i to be three living arrangement choices, living independently, living with family and living in nursing home. In the nonlinear MIMIC model, utility of unobserved determinants is,

$$u_i^* = \beta \quad _i z + \gamma \quad _i h^* + \varepsilon_i \qquad (2\text{-}16)$$

Instead of adopting health indicators, authors employ latent health in the model. Latent health is in turn composed by exogenous variables as in stacked form,

$$h^* = \qquad z + \qquad (2\text{-}17)$$

This model is also presented in graphical form. There are two main parts in the model. One is on the left hand side, includes multinomial Logit model from utility to choice of living arrangements and the relationship from exogenous variables to utility of living arrangement choice as well as to latent health status. The second part is on the right hand side, starting from exogenous variables to latent health status. Then, the model goes from latent health status to utility and the health indicators, which is also the nonlinear part in the model. Activities of daily living (ADL) and instrumental activity of daily living (IADL) are indicators that are usually employed to represent health status through ordered probits model.

After constructing this model, authors calculate the likelihood function for older people who choose one of those three choices. The unconditional likelihood function for choosing one out of three choices is the product of Logit model and ordered probit model. More discussion of the model can be found from Börsch-Supan, McFadden and Schnabel.

There are two conclusions made from this paper. First of all, this paper demonstrates a classic way to evaluate living arrangements decision of older people with considering latent health of them from an econometric perspective. However, it is hard to achieve this goal since this requires a panel database for investigating latent health status of older people. The second conclusion of this paper is related to the two major concerns, health

and wealth of older people. It follows the expectation that the healthier and wealthier the older people, the higher likelihood for them to live independently. In addition, income, which always adopted in study of older people are, is not as significant as wealth in living arrangement choice. Also, it is not easy to find proxy for latent health of older people, it is valuable for authors to point out that age and basic capabilities of older people are able to capture most of the effect of the health component.

2.2.2.7 Summary

It is obvious that all of the studies are based on western countries. When China facing the coming largest aging population, it would be necessary for scholars to reveal theoretical analysis of living arrangements of older people. However, it is well known that there are much differences between China and Western countries no matter individually perception or social characteristics. Before constructing a model for situation in China, a summary and comparison of these six papers would help a lot in understanding what have been done in western countries. In addition, this is also significantly helpful for understanding the similarities and differences among them. Table 2.1 is demonstrated to compare features as well as factors considered of above models.

Table 2.1Summary of 6 papers

Papers	Methodology	Perspectives for model	Factors considered in the model
Wister (1985)	Graphic model	This paper provides a clear idea of decision path and categories of influencing factors for living arrangements.	Based on the Hypothesis of Purchase Privacy, when older people have higher income, they will purchase privacy. Decline of fertility limited number and probability of children to live together with older parent. Family modernization with change of norms, attitudes and values causes decreasing co-residence.
Kotlikoff and Morris (1990)	Structural form model	Authors suggest that decision concerns shared living is economically separated from bargaining process. Family utility is decided by utilities of both older parent and adult child.	Emphasize the importance of child characteristics in decision making process. Include bargaining/ discussion between older parents and adult children during decision making process so as to maximize the family utility which mainly composited with preferences of two parties. If there is no difference between living together and living apart, decision would be highly influenced by income levels of both parties.
Börsch-Supan *et al*. (1992)	Multiperiod-Probit Model with Unobserved Heterogeneity and Autocorrelated Errors	This paper emphasizes the importance of panel data with longer period of time from the perspective of econometric. Also, the sample of living arrangements is selective due to the only inclusion of survivors.	If older people are financially and ability affordable, they will choose to live independently. Functional ability, age and income level are significant factors affecting living arrangements choices. Number of children does affect the probability of co-residence. Importance of adopting a panel data with longer time period.

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Continued Table 2.1 Summary of 6 papers

Papers	Methodology	Perspectives for model	Factors considered in the model
Hoerger *et al.* (1996)	Three structural models with three separate utility models for every living arrangement choice	This paper considers three utility models due to the discrete choices and various financial considerations of choices. These models require data to support for empirical analysis.	Separate modeling utility of living arrangements into three utilities due to the discrete choice characteristics and differences in determining factors of choices. Does not incorporate when there is conflict between two parties Parent would affect child's opinion strategically by threatening disinheritance.
Sarma and Simpson (2007)	Panel multinomial Logit model	Authors add government subsidies for older people into the model.	Significance of home care and home ownership availability on decision making. Existence of long term care services by policy legislation also impacts choice making. Importance of public transfers on decision to live in institution.
Börsch-Supan, McFadden and Schnabel (1996)	Nonlinear MIMIC model including latent health	Authors establish a non-linear model to graphically express the concept of non-linear relationships between variables. They also propose that the represent of actual health condition, which is also known as latent health, by health indicators is not comprehensive enough for health	Introduce health indicators, ADL and IADL, in the model and point out the draw backs of only using these 2 health indicators that this is unable to reveal latent health perfectly. Importance of employing panel data with longer period of time for better investigation of actual health condition. Influence of wealth is higher than income.

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2.3 Empirical Research on Living Arrangements

Most of the study from China mostly focus onhow empirical analyzing factors affecting decisions of living arrangements. Some of them are for political purposes and point out needs of older people, such as medical needs [46], as well as necessary supports that should be provided by the government [47]. Decision of living arrangements is actually a dynamic process which changes with health conditions and financial status of older people as well as the family structures of old-age households. However, limited by data accessibility and difficulties in collecting demographic data from continuously, there are very limited panel data for older people in China. Even if there are panel data for older people in China, there are rarely empirical studies focusing on the dynamic choice of older people. In addition, factors affecting choice of older people are mostly similar but not well straightened out. Without a comprehensive analysis of influential factors, there will not be a persuasive conclusion.

On the other hand, some studies in western areasconduct empirical study based ona spare and simple theoretical study [34]. A representative theoretical study of living arrangements of older people is done by Hoerger et al. [40] who proved utility models for older people in different living stages, including living alone, co-residence with children and living in nursing home, as they suggested that there are obviously different constraints of the family deciding various living arrangements.

2.3.1 Variables in empirical studies of living arrangements

Foreign scholars are interested in living arrangements from diverse perspectives. Wilmoth[48] investigated the transition mode of older people living arrangements in two periods of time and found out that older people are living with more stability when they live alone in their early aging life and live with children when they get even older. It is strongly proved that financial affordability and self-care ability are two important influential factors affecting decision of older people in living arrangements[49]. Gaymu et al. [50] examined and compared the influences of socio-demographic characteristics of older people in nine European countries. Due to the high diversity of data definition and collection, this paper could only concentrate on simple statistical analysis of factors. It is important that they suggested that socio-demographic characteristics of older people from different living environments, who are living under different culture and social

norm, are impacting their living arrangements diversely. It indirectly supports that it is necessary for studying situation of older people in China which is a country with significant unique and special culture and social norm. Li[51] suggests that older people also can be divided into groups, according to their living location, income and wealth. It can be concluded that older people in China is a group with specific features.

Research of living arrangements of older people in China mostly focuses on the social as well as financial impacts which are very important in policy making. Based on the discussion of national census in 2000, Zeng and Wang [52] confirmed that changes of older people living arrangements in China are basically due to two reasons. On one hand, direct interference from the government significantly alters demographic development in China in the past decades; on the other hand, changes of social and economic atmosphere in China also cause variations in personal behaviors. As early as in 1999, Li [53] suggested that older people in China cannot be treated as only one group of people. Due to the differences in nature as well as payment level of their occupations, variations in choosing or existing living arrangements highly deviated from each other.

Apart from those demographic variables, self-rated living standard of older people also significantly correlated with living arrangements choice as well as changes. Liu[54] investigated and pointed out that aging-in-place is getting more common in China, while living standard of older people is highly related with older people who are aging-in-place. In addition, Liu and Lin [55]investigate the satisfaction level of older people towards their current life. They found that there are factors that affecting their satisfaction while medical condition poses the most significant impact.

However, pathway of thinking of most of the conclusion of the above research is not well-organized and piecemeal which can hardly be used in making policy advice for the government.

2.3.2 Determinants and constraints of living arrangements

Preferences and actual choice of older people are two separated but correlated concepts. Preferences of older people represent their own choice without any reality limitations, such as health condition, financial affordability, which stop or change their decisions from preferences. Actual choice of older people is made with considerations on both preferences and reality limitations. However, it is difficult to determine whether preferences of older people are presented and illustrated through their actual choice of

living arrangements. In addition, preferences of older people are more or less an objective measures on their thoughts. Older people may over or under estimate their ability and affordability towards their preferring living arrangements. However, to access the limitations, also called the constraints, of older people making choice on living arrangements, studying differences of factors affecting living arrangements between preferences and actual choice is still the most authentic way.

Table 2.2 Factors affecting preferences of older people in studies

Factors	Studies that considered these factors
Age	Fu, 1997; Cheng et al., 1999[62]; Deng et al., 2003
Gender	Deng et al., 2003; Long et al., 2007
Marital status	Fu, 1997; Cheng et al., 1999; Deng et al., 2003;
Hukou	Chen, 2010[56]
Education level	Fu, 1997; Cheng et al., 1999; Long et al., 2007
Income (monthly or annually)	Fu, 1997; Cheng et al., 1999; Deng et al., 2003;Long et al., 2007; Jiao et al., 2015[63]
Housing condition	Cheng et al., 1999; Jiao et al., 2015
Role of older people in household	Fu, 1997
Relationships with children	Jiao et al., 2015
Health condition (such as ADL, social participations, psychology health)	Cheng et al., 1999; Deng et al., 2003
Actual living arrangements	Jiao et al., 2015

Although most of the studies adopt actual choice of older people to replace their preferences as actual choice is a part of preference [50]. Chen [56] investigated older people in Suzhou and tried to find out factors affecting preferences of older people. She suggested that there are two mainstreams in studying older people preference. Scholars may concentrate on describing and illustrating the implications as well as trends of older people preferences in years [57-58]. Or they may try to analyze factors that affecting preferences of older people [59-61]. It can be summarized studies in Table 2.2 with considering various factors affecting preferences of older people in deciding living arrangements.

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However, there are still limited research that is focusing on comparing preferences and actual choices of older people in choosing their living arrangements and dynamic observations on change of older people living arrangements. Zhang[64] and Jiang et al. [65] investigate both the preferences and actual choice of older people in China. However, they do not adopt micro-demographic data to analysis this problem, further they have not compared factors that affecting preferences and actual choice of older people. Sereny[66] adopted study differences between preferences and actual choice by using the surveying data from in-house interviewing older people. This paper concentrated on the differences between preferences of older people and the actual choice of them. Obtaining preferences of older people through interview can only reveal the personal preferences of older people which is personal and does not have scientific representative in economic study that emphasizing rational people making rational choice. However, on the other hands, classification of determinants in this paper is favorable in the study of living arrangements from the perspective of governments providing economic support for older people. Connidis [67] pointed out that there are actually huge differences between preferences and actual choice of living arrangements of older people and it is not a scientific study if only assuming that actual choices of older people represent most of their preferences.

2.4 Related research summary

Living arrangement has been the hot topic in the recent decades. Foreign scholars in developed countries are paying more attention on the issue macroscopically and personally [68], while Chinese scholars focus on the economic implication of living arrangements more, such as the development and improvement of the pension system and the political implication of alternation of living arrangements in the last decades[69]. Currently, when economic gets booming in China, focus of study is more than on economic issue of living arrangements, but also involves more diverse study directions, such as personal preferences[66] and health [32]. From the perspective of object of study, to focus on older people in urban area of China is common[70]. On the other side, accounting to the change of social structure, more researchesfocus on the living arrangements of older people in rural area in China due to the economic development as well as the universality of empty-nest older people in rural area while most of their children are out to the urban area for work or education [32].

Just like Hoerger et al. [40] using random utility model to construct their theoretical framework to model older people living arrangements, Sarma and Simpson [41] also adopted random utility model by assuming older people, or so called to decision maker, would make a decision under rational consideration for maximizing the utility. In China, Duan [71] and Wu [72] simply adopted Logit models for statistical analysis of the significance of each variable against living arrangements choice. Therefore, specific factors for study in China are necessary for further comprehensive discussion.

In addition, although there are plenty of conclusion and political advice in existing empirical analyses, these analyses are mainly adopted the current actual choice of living arrangements of older people as the final stage of choice. Adding preferences of older people would significantly help to the improvement of happiness of older people.

Chapter 3 Living Arrangements of Older People in China

3.1 Specific features of older people in China

3.1.1 Personal characteristics

Three crucial components of personal characteristics are the preferences, health conditions as well as demographic characteristics of older people.

Wister [37] suggests the purchase of privacy hypothesis and quotes that Michael et al. [75] treated income level to be a "reflection of an economic demand for privacy". In western countries, people value personal privacy in the way of maintaining independent living style[76]. Norms and preferences of people in western countries suggest that they prefer to live independently for privacy and keep their own life style. It is sure to be one of the factors for older people deciding living arrangements. That would make choosing to live independently in western countries become an active choice. However, in China, choice of living independently, or mostly use living alone in China, is consensually a passive living arrangement choice.

Health conditions of older people critically affect their living arrangements. He and Wu [77] analyzed health condition and living arrangements of older people through a survey table called EQ-5D and suggested that in Beijing. Jiao [78] also studied.

Demographic characteristics of older people include their age, working status and income level.

3.1.2 Family features

Family, also commonly called as household, is the basic unit in considering social issue apart from individual. Features of a family could be significantly affecting living arrangements of older people as decision could be made by older people themselves, children of them as well as the whole family. Norms and culture of family in China is very special. In addition, numbers and characteristics of children also pose influences on decision making. Financial issues, including income differences between child and parent as well as bequest tendency of older people, are likewise affecting decision of living

arrangements. Of course, apart from all of these factors, family structure is also markedly impacting the choice.

In urban or rural areas, there are differences in family structures, means of livelihood, parent-child relationship, and more [69, 79-81]. So there are various possible reasons as factors of living arrangements decision making in rural and urban areas. In rural area, there are plenty of young people going out to more developed area searching for a job opportunity with higher salary and better prospect in career path. As a result, older parents would be left behind in their rural house living alone. Or even worse, young people gave birth to a baby and still have to go out for money. This leads older parents have to take care of their grandchild apart from only taking care of themselves. In contrast, older people in urban area is generally with higher income level and larger wealth and have control and affordability to choose without less constraints. Yet, in urban area family, for convenience of adult child to go to work, older parent would normally respect the opinion of them. If adult child decide not to co-residence with older parent, older parent would have to live alone or live in the institution. Also, if adult child get married and form a new family, they would rather not stay with their origin family. This is mainly to avoid conflicts between two families with various norms, family cultures and customs. Furthermore, it is also questioned that if older people in China being so value about their privacy and independence. It is because that there is still common to know the faith of "raising children for retirement safeguard" among older people, especially oldest people, in China.

Cultural norm concerning child staying at home after reaching an adult age between China and western countries is also not so similar. In western countries, most of the young adults move away from original families and start live independently. Therefore, the case of older people living with their children for the whole time is not so common in western countries. In contrast, China is a society which emphasizes filial piety and common to see an adult child living with older parent so as to take care of parents. Of course, there are also other reasons for them to live together. Housing price becomes so high and difficult in applying mortgage that child cannot afford to move and grandchild that requires older people to take care of are also common reasons for urban families to live together.

Income difference between child and parent is significantly affecting the power of deciding living arrangements of older people [82-84]. If older parent has a higher income level, then she would be the economic household head of the family. As an economic

household head, she would have more bargaining power on familial level decision, such as living arrangements of older people in the family. Equally, if child has a higher income level, she would be able to decide where her older parent going to stay, which is living arrangement of her older parent. Bequest motivation of older people in China is so strong that it become a social norm. Under normal condition, most of the children would inherit property or financial assets from their parent. In this case, that would be a less chance of older people using bequest as a method of gaining the decision making role in the family because it is obvious that parents would no matter what bequest their assets to children. In addition, income level may also decide the decision making role in the family. Generally, the part with higher income level would be the decider in the family. That is commonly observed in both China and western countries.

The most commonly discussed family structure characteristic is that whether the family have any under-aged grandchildren. This is significantly important in China. As older grandparents raising grandchildren is commonly seen in China [85-86]. As most of the young family are two-earner family and parent of grandchild do not usually stay at home to take care of them. If there are under-aged grandchildren, older people may have to live with their children and take care of grandchildren for the maximization of family utility. In addition, there are more than 49% of older people live alone in China which is predicted to reach 90% of older people will be live alone in 2030[87]. Studies also show that older people living alone would be facing a lot of problems [88-90].

3.1.3 Financial issue

Throughout the development process of the old age social work in China and western countries, economic development is always an important factor that restricting it. Without certain economic base, local government is unable to financially support older people to have a sustainable and well-supported old age life and help those older people who have difficulty out of woods. There are two main financial sources of supporting older people, the government and the social organization, while government takes up most of the burden. Guarantee of spending money on projects for older people, such as the coverage of the pension system, the number of activity centers built for older people, sophistication of nursing home, as well as the well-planned community support network, is necessary. As a result, an economic developed country would have a comparatively sophisticated community supporting system for older people, for those developing

countries, aging society becomes one of the biggest social and financial problems of local government.

Wealth is significantly influencing living arrangement choice of older people. Wealth of older people can be divided into two groups, wealth with risk and wealth without risk. Wealth with risk is in stock, fund, as well as loan, while wealth without risk including deposit, government bond, housing fund, and housing wealth. A more financial independent older person would be able to have a comparatively independent and autonomic decision power of their living arrangements.

3.1.4 Policy legislation

Of course, there are many differences among aging social security systems in China and western countries. In China, government takes up most of the financial burden of providing caring and medical services for older people. However, aging social security system in China can still hardly fulfilling diversified services demand of older people [91-93]. Only basic life standard can be supported by the social endowment insurance system [94-96] and basic medical requirement of older people can only be satisfied by the social medical insurance system [97].

In order to cope with the challenge of aging of population, government of China started to effectively mobilize all social resources to provide support and care for the older people services. Aiming to establish a harmonious society, Chinese government put forward a new aging model in the 'twelfth five-year plan' that combining resources from community and family [98]. Furthermore, the government also completes the aging-in-place security [99-101] and care services policy [102,103], implements the urban one-child parents rewarding policy[104], and establishes an adjustment mechanism of rewarding support of older people[105]. In addition, Dibao[106] is financial support for poor people by the government which can be considered as the indicator of poor family. On the other hand, health insurance provided by various sources may have difference implications[107-109].

3.2 Statistics of older people in China

3.2.1 General statistics of older people in China

Aging society always comes with a series of aging problems. In China, due to the fast aging rate and large population base, aging problems have been aggravated. To tackle

with aging problems, it would be necessary to identify possible problems. Economic is highly affected by older people as they have a lifetime saving in the bank and generally have housing wealth. In addition, due to the huge influences of financial support, housing arrangements, and social security system of older people which is highly impacting society and economic, living arrangements of older people is a very momentous political issue. For instance, if family members as tradition sources of taking care of and financially supporting older people is sustainable.

Population age structure of China in 2000 and 2010 is shown in Figure 3.1 for revealing and comparing the differences as well as trends of population structure. It is found that older people, aged 60 or above, in China increases from 10% in 2000 to 14% in 2010. According to United Nation, when a country or region with 10% or more people aged 60 or above, this country or region would be suggested to become an aging society. Therefore, China has become an aging society since 2000. In addition, percentage of population aged 40 to 59, which is about to become older people, has increased from 22% to 29%. This means that aging problems in China has become more serious every day and will be highlighted soon with increasing aging speed. More seriously, people aged under 40 and newborn population fell from around 70% in 2000 to 57% in 2010. In a long tern perspective, current and future labor supply would be insufficient and dependency ratio would be so high that production power in the society and a stable and happy family are threatened.
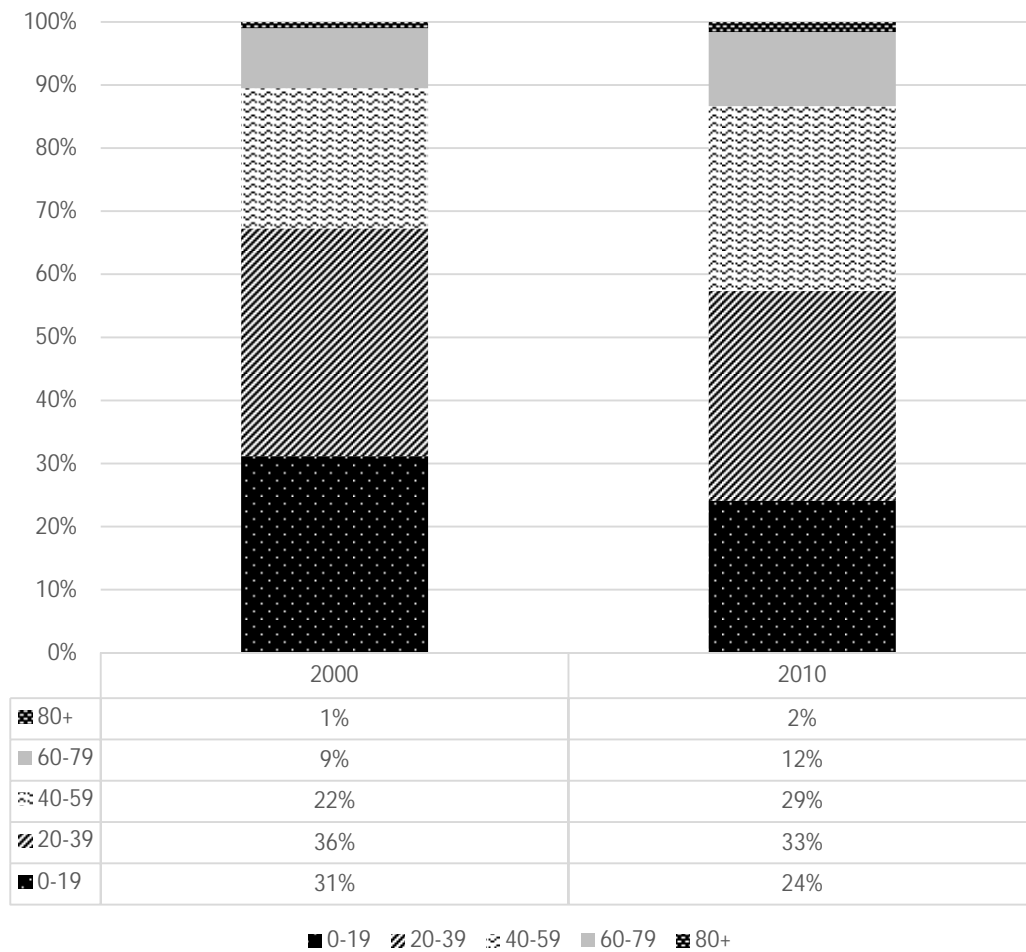
Figure 3.1 Population age structure of China in 2000 and 2010

	2000	2010
▓ 80+	1%	2%
▪ 60-79	9%	12%
≈ 40-59	22%	29%
▨ 20-39	36%	33%
▬ 0-19	31%	24%

■ 0-19 ▨ 20-39 ≈ 40-59 ▪ 60-79 ▓ 80+

■ delta ■ 2010 ■ 2000
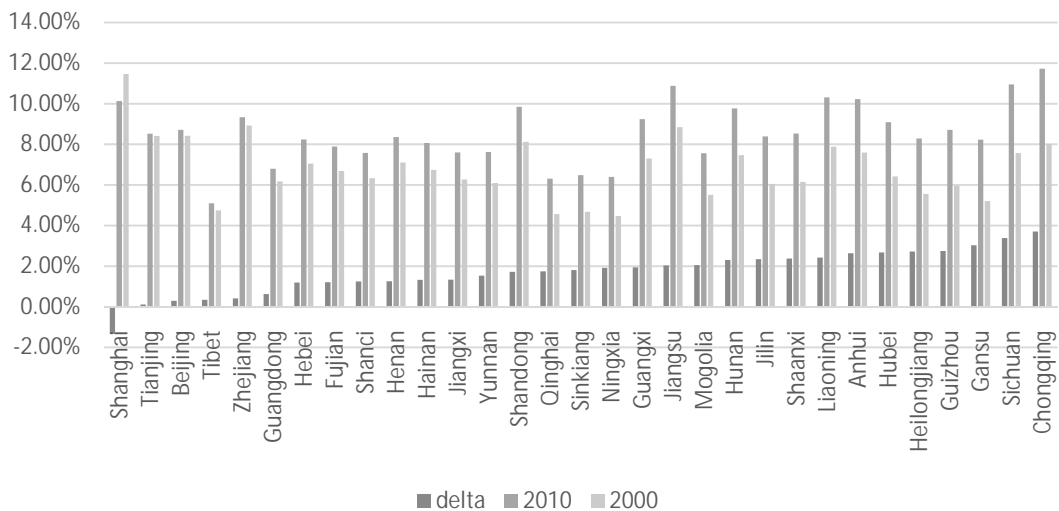
Figure 3.2 Percentage of older people (aged 65+) in 2000 and 2010

According to the new definition of aging society by United Nation, a region with

more than 7% of older people aged 65 or above would be defined as an aging society. Figure 3.2 shows a statistical summary of older people aged 65 or above from different provinces and municipalities. This figure included comparison and ordering of percentage of older people in each region. It can be noticed that in 2000, most of the provinces and municipalities have become aging society which is consistent with national statistics. In 2010, percentage of older people increased in almost every province and municipality, with an average increasing 1.71% and 0.33% increasing rate, except for Shanghai. This indicates that aging problems have already existed and starved for solution.

Moreover, developed provinces and municipalities, such as Shanghai, Tianjin, Beijing, Zhejiang and Guangdong, have an average lower increasing rate, less than 0.6%, especially Shanghai has a negative increasing rate. This is due to the ever-increasing number of immigrant workers from other regions leading to a larger group of young adult, and hence increasing the denominator of people in calculating older people percentages. This low increasing rate of older people in these provinces and municipalities therefore does not necessarily indicate that these regions do not have aging problems. Those corresponding low-ranking western and northeast regions in China also reflect that young people are leaving their original places for work and better living and stay at those more developed regions from other side of the story. Therefore, it is obvious that aging problem is more serious and worthy attention of government in less developed provinces and municipalities which are always poor and with bad social security system.
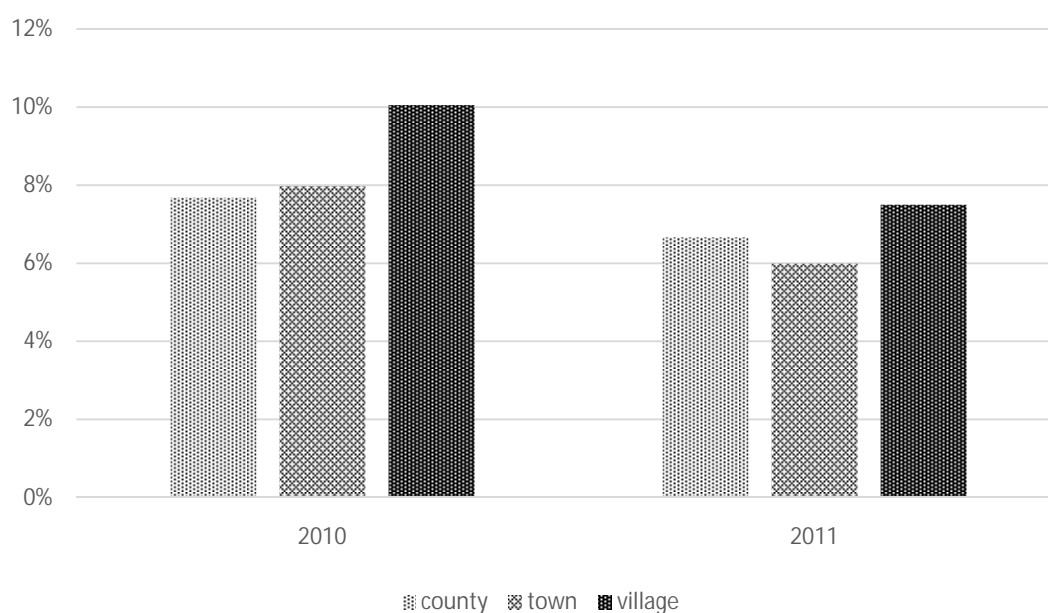
Figure 3.3 Percentage of older people (aged 65+) in county, town and village of China
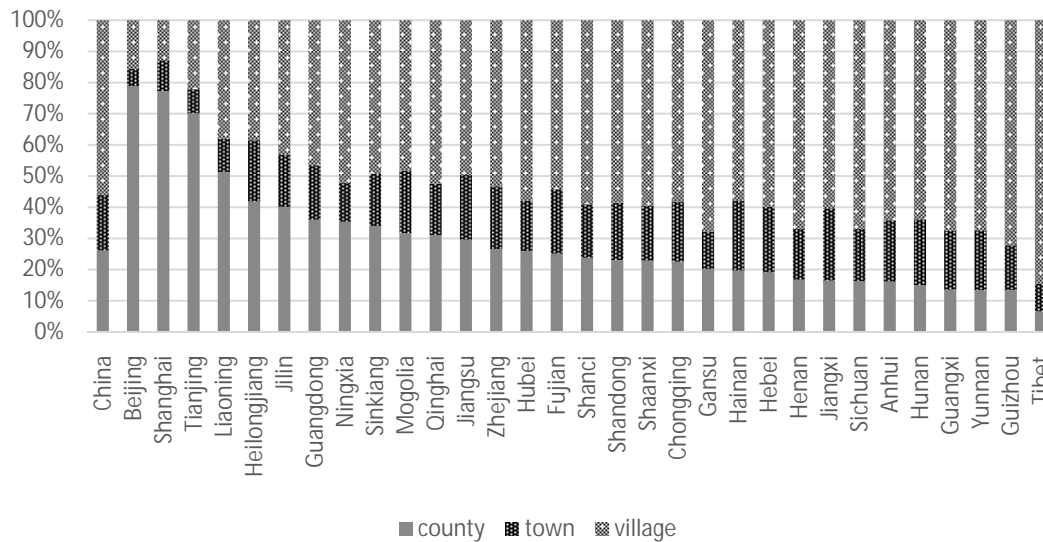
Figure 3.4 Percentage of older people (aged 65+) from county, town and village in provinces and municipalities

Based on the Hukou location of population, Figure 3.3and Figure 3.4 present the percentage of older people aged 65 or above in population in three regional levels, the county, town and village levels , in the whole country and in provinces and municipalities. Generally, in both 2000 and 2010, percentage of older people is presenting increasing trends while reaching the highest rate in village level and lowest percentage increasing rate in county level. This may also due to the immigrant workers from villages to counties and leading to a high rate of empty-nest elderly. Another result from this trend of migration as well as the improvement of medical techniques in villages is that older people distribution in these three regional levels being changed from 2000 to 2010, older people in villages out run that of in counties.

In order to deepen the understanding and analysis of imbalance in regional development, Figure 3.3 statistically analyzes the distribution of older people in county, town and village and order them according to the ratio of older people population in county level. Obviously from Figure 3.4, older people in developed provinces and municipalities are mostly located in county while older people in less developed provinces and municipalities are mostly located in village. In China, more than 70% of older people stay in town and village. This phenomenon highly enhances difficulties of dealing with aging problem as town and village, especially those in less developed

provinces and municipalities, are financially and institutionally unable to afford and provide a well-planned security and services for older people.

3.2.2 Health and economicconditions of older people in China
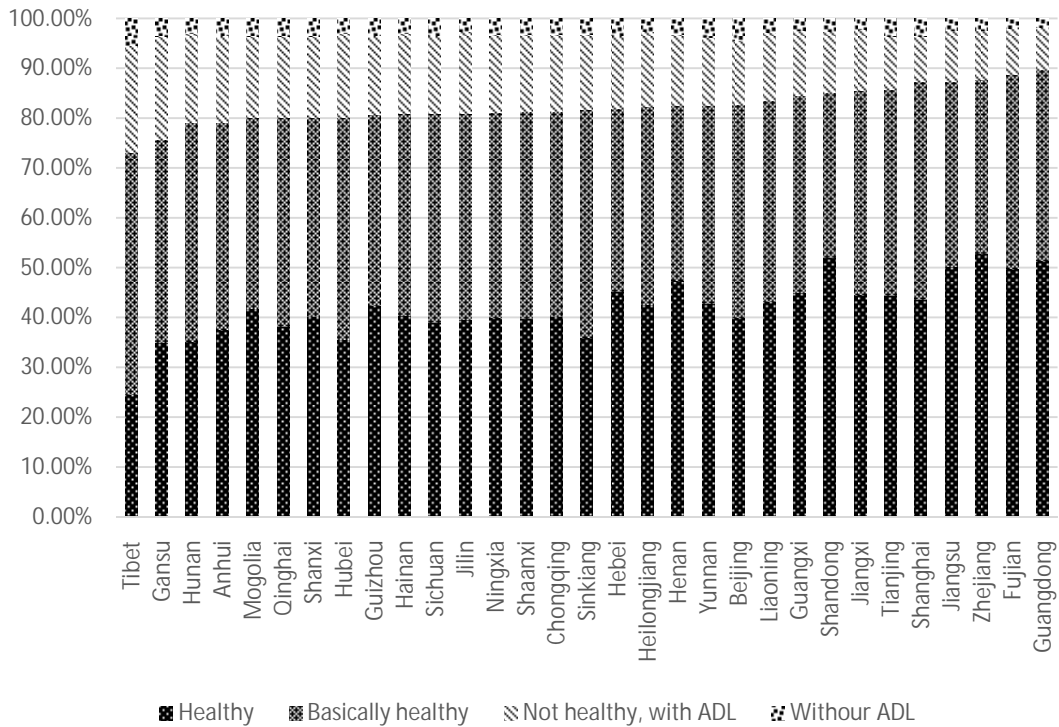
Figure3.5 Health condition of older people (aged 60+) in China

Health condition of older people highly impacts the living arrangements decision as different health condition could determine the ability of older people to take care themselves as well as medical and daily support requirements. Figure 3.5 illustrates health condition of older people in provinces and municipalities in China. Health condition here is divided into four levels, healthy, basically healthy, not healthy but able to carry out basic activities of daily living (ADL), and without ability of basic activities of daily living. Generally, around 40% of older people are healthy and the rest of them are more or less not so healthy. For most provinces and municipalities, there are around 20% of older people are having health problems which also indicates that medical support of those regions are urgent. Furthermore, provinces and municipalities are ordered according to the percentage of older people that are not healthy. This shows that health condition of older people is obviously presenting interregional differences while older people in developed regions are with better health condition than that of in less developed

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regions. This on one hand indicates that local governments in developed regions are investing more in old-age services and medical security; on the other hand shows that even private investment in medical services in less developed regions can hardly significantly make up the differences amount of government investment. This phenomenon may cause people to move to developed regions with well-planed and built medical services and facilities which hence enhance gap between rich and poor in less developed areas as private medical expense there are highly demanded. Of course, there may be biases in data as older people without ADL are not living long.
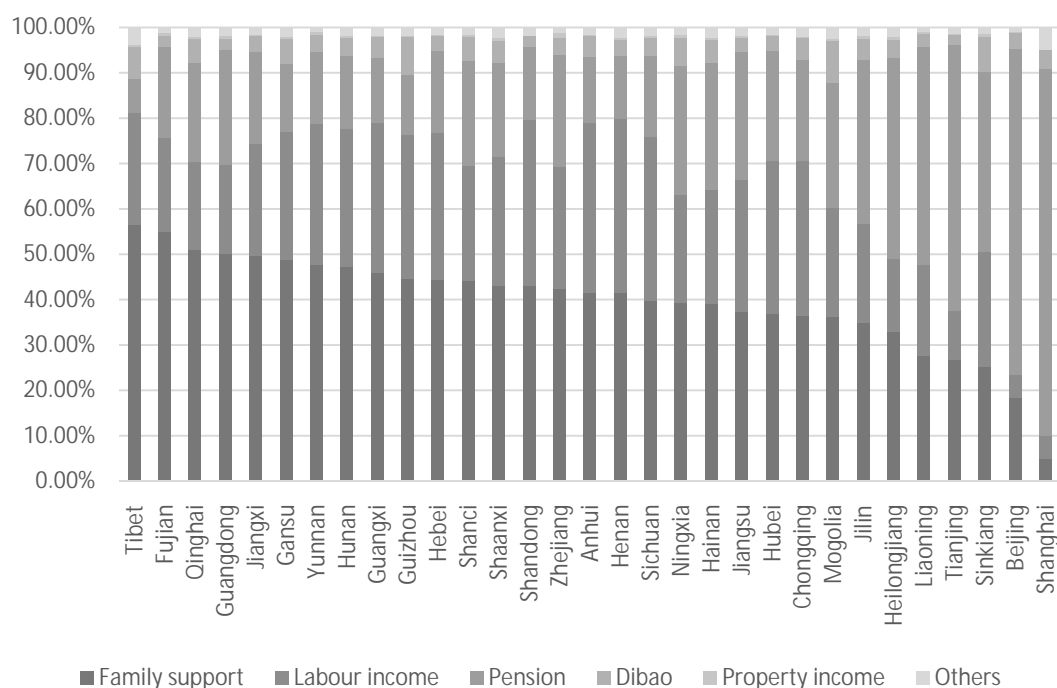
Figure 3.6 Major income sources of older people in 2010 China

Apart from health condition, financial affordability of older people also posing huge effects on living arrangements decision of older people. Figure 3.6 presents a general statistical summary of older people with different major income sources in 2010 China. There are six major income sources, family support, labor income, pension, Dibao, property income and others, for older people. In China, older people with major income from family support take the highest proportion with more than 40%. The second and third most income source as major income of older people is labor income, with more than 29%, and pension, with 24%. Older people with Dibao as their main income source only take around 3%. It is therefore concluded that, apart from pension and Dibao, family support and labor income are the major income of older people in China. However, these

two types of income are highly depending on the others and restricted by personal workforces level and health condition. This hence can say that income level and stability of older people are not high.

After sorting provinces and municipalities according to percentage of older people having family support as major income, it is illustrated that there no significantly differences among regions. However, it is still worthy mentioning that Beijing and Shanghai are two places with high percentages of older people having pension as their major income source. This means that security system and old-age support from local government for older people in these two regions are comparatively more comprehensive and well-planed.

3.2.3 Family structure of old-aged households in China

Family structure is also impacting living arrangementdecision of older people through different channels. Until 2010, there are 401,934,196 households and 1,332,810,869 individuals, which leads to an average of 3.3 people in each household, in China. This suggests that driven by the implementation of one-child policy as the basic policy of family planning, economic and social transformation, increasing population migration rate, and raising rate of women participation in labor markets, family size in China is continuously miniaturized which also represents the weakening of traditional family endowment function. Although with the awareness of Chinese government and implementation of two-child policy, this trend is not going to be switched in the short run.

Figure 3.7 statistically analyses households with at least one older people and orders provinces and municipalities according to percentage of old-age households in total number of households. This shows that among all provinces and municipalities, Guangdong, Jiangsu, Liaoning, Shandong and Shanghai are those with highest number of old-age households while Shanghai, Liaoning and Jiangsu are also presenting comparatively high ratio of old-age households in total households. This indicates that these regions are facing a more large older people population now and aging problems are a more common phenomena.
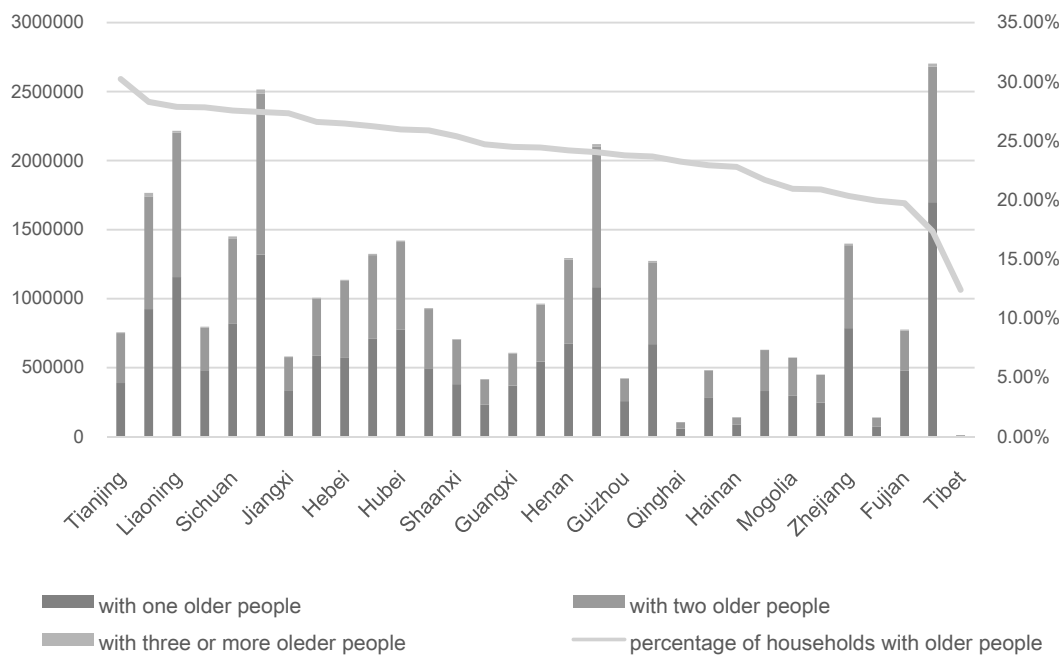
Figure 3.7 Households with older people (aged 60 or above) in provinces and municipalities
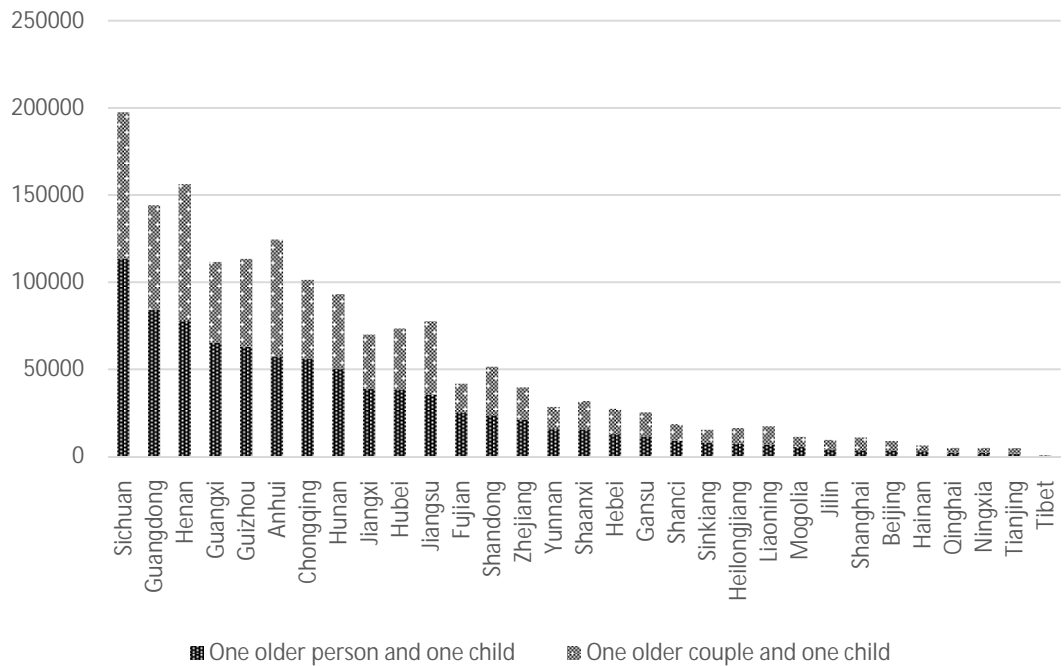
Figure 3.8 Number of old-age households (aged 65 and above) live with children (aged below or equals to 15) in 2010 China

In order to investigate and understand the role of older people in those old-age households, Figure 3.8 presents a summary condition of older people aged 65 or above

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living with children aged under or equals to 15 only. Statistical result clearly shows that among all provinces and municipalities, Sichuan, Guangdong, Henan, Guangxi, Anhui and Chongqing are those with significantly higher rate of older people or older couples living with children alone. It thus could be deduced that in these regions, older people are living with and taking care of their grandchildren. This is possibly the result of adult parents of their children working in other places and requiring older parents to take care of the children. Problems of leftover older parents and children are with significant severity in those provinces and municipalities. Therefore, older people in a household could be a party of requiring financial and nonfinancial support or a party of providing care to their grandchildren.
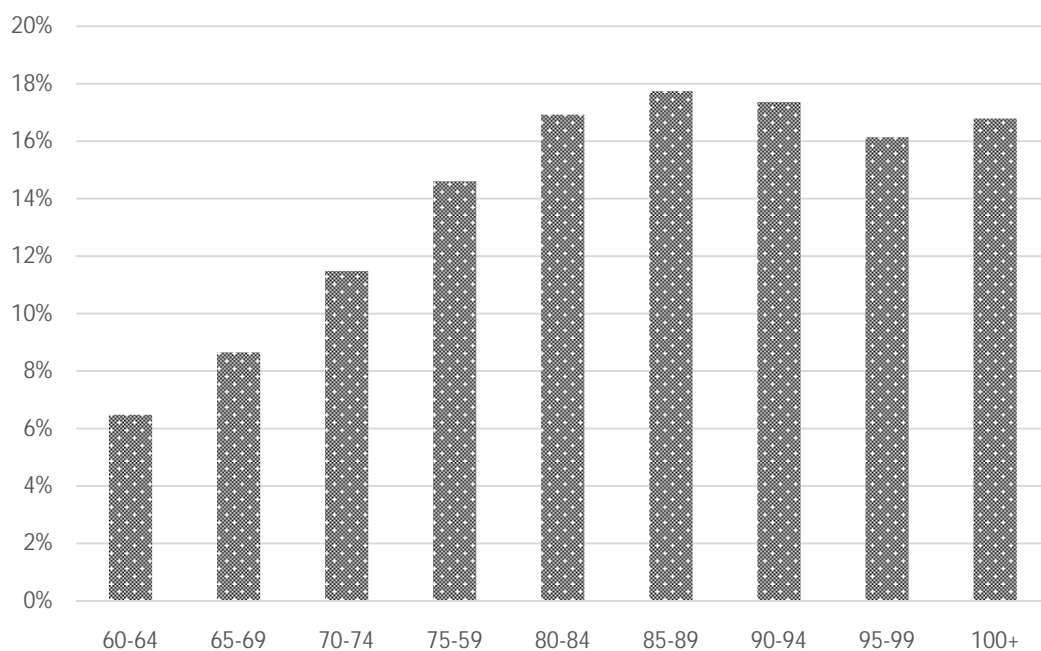
Figure 3.9 Percentage of older people living independently in groups, 2010

For the purpose of deeply studying the condition of older people living independently, Figure 3.9 shows the percentages of older people living independently in groups aged above 60 in 2010 in China. Generally, there are only 4% of people living independently in all aged while there are 14% of older people aged above 60 living independently. Such a high rate of older people living independently may due to complex reasons. It may due to the well-developed economic market in China which, in turn, raises affordability of people to have their own house and improve medical techniques development in China enhancing ability of older people to take care themselves. On the other hand, when comparing with western countries, such as the U.S., there are around 30%

of older people living independently. Of course, there are always other reasons of traditions and norms of Chinese society that adult children are living with their older parents while older people can also provide care for their grandchildren. Percentages of older people starting to live independently sharply increase when they reach 80 year-old. This may due to the bereavement of spouse.

Population dependency ratio, also known as population burden coefficient, refers to the ratio of non-working age population to every 100working age population. It is commonly used to measure the influence of population age structure on social and economic development in a country. It is calculated as the percentage of non-working age population divided by the working age population. Non-working age population is defined as people who are under 14 or above 65 while the others are working age population. Aged dependency ratio is the ratio which only considers older people but not underage children. The larger the aged dependency ratio indicates the more the older people are depending on each working age population, and hence increasing burden for labors. Aging of population is directly increasing the aged dependency ratio.
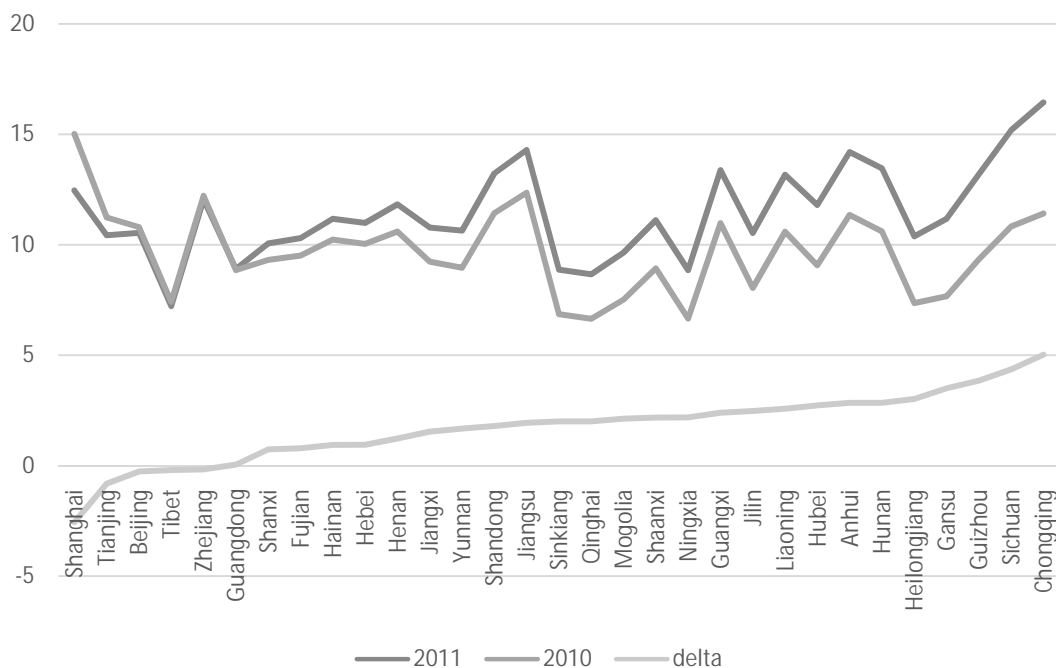
Figure 3.10 Aged dependency ratio in 2000 and 2010

Figure 3.10 shows the aged dependency ratio in provinces and municipalities of China in 2000 and 2010. Average aged dependency ratio raised from 10.15 in 2000 to 11.98 in 2010 with an increasing rate of 18%. After sorting regions according to

increasing rate, delta, of aged dependency ratio, it is investigated that developed regions such as Shanghai, Tianjin, Beijing, Zhejiang, Guangdong do not have significant increasing age dependency ratio, some of them even shows negative increasing rate. This illustrates the phenomenon of developed regions having abundant workforces from other regions to fill up the emptiness. In contrast, Heilongjiang, Gansu, Guizhou, Sichuan and Chongqing are showing increasing aged dependency ratio all of which are showing more than 40% of increasing ratio. This is crossly reflecting the turnover of labor forces, hence posing high pressure of affording older people in these regions.

Chapter 4 Determinants of Living Arrangementsin China

4.1 Determinants of choice

Global population is aging rapidly due to low fertility and low mortality rates. This has been recognized for some time in developed countries. This however has been acknowledged in China only recently, yet with higher urgency due to the tremendous population size and predicted growth; China will have 64 older people for every 100 workers by 2025. China virtually presents a different aging trajectory from European countries, and has unique characteristics shaped by its distinct historical, cultural economic and political contexts. Yet, recent demographic changes and significant economic transformations have led China to move from traditional dominated familial elder system of care, where older people are being cared for by the extended family structure, to seek for efficient and sustainable social care support by community services and government financial support . Aging-in-place, which is economically and socially supported by older people themselves and their families, is therefore promoted by the Chinese government in order to ease the huge financial burden from aging population [1, 73].

In China, economic growth and development of housing market have increased housing availability for older people who choose to live alone. Nowadays, there are an increasing number of older people choosing to live independently at their homes. Additionally, the shrinking family size and more dispersed living arrangements which are similar to European trends has significantly changed the traditional living arrangements in China. A growing number of Chinese older people prefer to age-in-place and this trend tends to be persistent. [74] The attitude towards living arrangements between older people in China and Europe may to a certain extent be different in light of understanding the relative importance of the family care and institutional support. However, it raises common concerns such as the governmental financial support for older people which would inevitably grow in both China and Europe, and it will have a substantial impact on accommodation settings and society.

In this chapter, CHARLS (China Health and Retirement Longitudinal Study) will be employed to analyze influence of different factors posing on living arrangements choice of older people in China. Five main factors are considered, including health condition, income and wealth, housing condition, transfers from children and the public. The second part would be data analysis of CHARLS and discussion of variables. Then, empirical analysis and results would be shown in the part three and four. Lastly, this chapter will provide conclusions of results.

There are many theoretical studies by western countries due to the early aging society in western countries. In China, however, aging issue in the society has just been found in current two decades. This highly limited the theoretical progress in China. On the other hand, until recently, most researches on older people living arrangements are concentrating on the empirical perspective for supporting the developed theoretical hypothesis as well as model in western countries. This section hence provides an insight on the differences between China and western countries in developing theoretical model for living arrangements of older people in China.

Firstly, Table 4.1 would represent a simple summary on factors that are considered in western countries. Then, four aspects including personal characteristics, family features, financial atmosphere, and policy legislation are being discussed below from the perspective of China.

Table 4.1 Summary of factors considered in western countries

Factor types	Factors considered in the model	Model
Personal characteristics	Preferences of older people	Wister (1985)
	Ability affordability to live independently	Wister (1985) ; Börsch-Supan et al. (1992)
	Health conditions, such as ADL and IADL	Börsch-Supan, McFadden and Schnabel (1996)
	Functional ability, age and income level	Börsch-Supan et al. (1992)
Family features	Family modernization with change of norms, attitudes and values	Wister (1985)
	Child characteristics	Kotlikoff and Morris (1990)
	Number of children in a family	Wister (1985); Börsch-Supan et al. (1992)
	Income levels of both parties and bequest tendency of older parents	Kotlikoff and Morris (1990); Hoerger et al. (1996)
Financial issue	Financial affordability	Wister (1985); Börsch-Supan et al. (1992)
	Wealth and income of older people	Börsch-Supan, McFadden and Schnabel (1996)
Policy legislation	Availability of public transfers	Sarma and Simpson (2007)

From the discussion in section 3.1, it is obvious that features in China are different from western countries which hence causes various impacts from influential factors. Table 4.2 summarizes China specified factors of older people living arrangements.

Table 4.2 China specified factors of older people living arrangements

Factor types	Factors
Personal characteristics	Personal preferences, health conditions, and other demographic characteristics of older people
Family features	Norms and culture of family in China, number and characteristics of children in the family, income differences between adult child and older parent
Financial issue	Wealth of older people
Policy legislation	Public transfers such as health insurances

4.2 Model construction

For the purpose of identifying China's specific determinants of older people living arrangements and finding out the specificvariables in China, this section is going to introduce a regression model for analyzing relationships between living arrangements decision and characteristics of older people as well as their family. As choosing whether to live independently, here including living independently or only living with spouse,is not a binary choice of older people, in addition, choice of older people is unlikely to follow normal distribution, Logit regression model is introduced in this case.There are two groups of Logitregression models, regression to find out China specific determinants of living independently and the robust test of identifying determinants on living with children, carried out in this section. Based on the discussions and conclusions in previous sections, four main categories of China's specific influential factors are adopted for constructing regression model. They are the personal characteristics, family features, financial issues and policy legislation. In order to find out the determinants of living arrangements of older people in China, specifically the China-particular characteristics, these four types of determinants are employed for investigating if there are any China-specific features in determining living arrangements of older people. In order to estimate the heterogeneity between dependent and independent variables, Hausman test is conducted for every newly added variables.

Logit regression model of determining whether older people are choosing to live

independently or not, which is to find β parameters that are the best in explainingthe choice. Specific regression model is shown below,

$$lv1 = \begin{cases} 1, \bigwedge(x'\beta) > P_u \\ 0, \text{otherwise} \end{cases}$$

where,

$$\bigwedge(x'\beta) = Prob(lv1 = 1|x) = \frac{e^{x'\beta}}{1 + e^{x'\beta}}$$

In the first equation, $lv1$ equals to 1, which indicates older people living independently, when probability falls in the set range; otherwise equals to 0. β is the intercept parameter, coefficient terms of each independent variable, including control variables and determinant variables of the regression model while in the second equation indicates thatthe probability isfollowing standard logistic distribution. As it is a simple all or nothing choice selection problem, therefore, simple Logit linear regression is adopted.

Table 4.3 is a summary and description of determinants employed in regression models. There are five types of determinants, including control variables, personal characteristics of older people, family features, financial related variables and policy legislation variables.

<center>Table 4.3Description variables</center>

Variables	Description
ADL	=1 if do not have ADL, 0 otherwise.
IADL	=1 if do not have IADL, 0 otherwise.
disability	=1 if has any disability, including physical disabilities, brain damage or mental retardation, vision problem, hearing problem and speech impediment, 0 otherwise.
social	=1 if has participated in at least one social activity in the last month, 0 otherwise.
ADL_disability	Interaction term of ADL and disability.
IADL_social	Interaction term of IADL and social.
rely_support1	=1 relies on children for old-age support, 0 otherwise.

Variables	Description
grandson	=1 if there is existence of grandson, 0 otherwise.
granddaughter	=1 if there is existence of granddaughter, 0 otherwise.
riskasset	=1 if interviewee has risky asset, including loan, fund and stock, 0 otherwise.
nonriskasset	=1 if interviewee has non-risky asset, including deposit, savings, government bond, housing fund and housing wealth, 0 otherwise.
rely_support1	=1 if rely on children for old-age support, 0 otherwise.
h_govsub	=1 if interviewee has received government subsidies in the past year, 0 otherwise.
gov_hinsurance	=1 if interviewee has joined government supported health insurance programs , 0 otherwise.
h_insurance7	=1 if interviewee has joined the Private medical insurance purchased by union, 0 otherwise.
h_insurance8	=1 if interviewee has joined the Private medical insurance purchased by individual, 0 otherwise.

Determinants can be divided into four major groups. For personal characteristics, preference of older people to live with their children (preferLV1) are included to investigate if preferences are posing any effects on ultimate living arrangements decision. Health condition of older people is reflected by four individual variables, ability to perform activities of daily living (ADL) and instrumental activity of daily living (IADL), if older people have any disability (disability) and the participation condition to social activities (social). However, ADL and disability may be related because disability would possibly cause the loss of ADL, while losing IADL may also lead to the low frequence of participating in social activities. Therefore, two interact terms (ADL_disability and IADL_social) are constructed for presenting their cross effects on living arrangements decisions.

Government subsidies include reforestation, agricultural subsidies, Wubaohu (targets to people that have no means to financially support themselves), Tekunhu (targets to very poor people), work injury subsidies to the immediate family members, and emergency or disaster relief.

Government supported health insurance programs include Urban employee medical insurance (yi-bao), Urban resident medical insurance, New cooperative medical insurance (he-zuo-yi-liao), Urban and rural resident medical insurance and Government medical insurance (gong-fei).

Family features mostly includetwo major parts. The existence of grandson (grandson) and granddaughter (granddaughter), on one hand, may represent the family requirements of older people to take care of young grandchildren.On the other hand, existence of grandchildren may also indicate the less room for older people to live with adult children. This highly depends on the age and self-care ability of grandchildren. Term that represents the expectation of older people on whether children could be the person of older people's old-age support (rely_aupport1) is also employed. Expectation of older people to their adult children towards reliability could be a sign of relationship between older people and children. The closer relationship between them is, the higher expectation would be from older people.

Risky asset (riskasset) and non-risky asset (nonriskasset) are investigated as financial issues. The tendency of bequest can be represented by non-risky asset, which includes deposit, savings, government bond, housing fund and housing wealth.It is understood that non-risky assets are with higher possibility to be inherited due to the stable and non-fungible characteristics of non-risky asset such as housing. Risky assets are loan, fund and stock. It is assumed that older people who possess risky asset are having more intention to invest which leads to a higher level of indeterminacy of the asset. In addition, older people possessing non-risky asset may suggest that they are actually wealthier with higher independency and affordability as well as knowledge in finance.

Effects of policy legislation posing on living arrangements of older people can be accessed through analyzing three groups of variables, the access to government subsidies (h_govsub), the health insurance supported by government and work units(gov_hinsurance h_insurance7) and by individuals (h_insurance8). With more financial support from the government, which would suggest a more difficult financial condition of older people as they must be very poor in order to be subsidized in China. Therefore, those older people would not be able to afford a house for themselves to live independently while living together could further lower daily cost of living. Majority of older people have health insurance supported by government. There are different health insurances supported by government, work units and individuals. Older people who are affordable to private health insurance may have a higher level of income and wealth and hence a higher possibility to live independently.

Specifically, the first step of starting Logit linear regression is to analyze and test the data quality. Each control and determinant variableis added into the model with passing

Hausman test which is able to check endogeneity and validity of a variable. Variables that are showing high endogeneity with living arrangements choice of older people, on the left hand side of the Logit regression model are processed or deleted. In addition, in order to check the stability of the model, a robust test is introduced. Although living independently and living with children are not exclusive, determinants of living independently and living with children can still be assumed as totally mirrored in these two cases.

4.3 Data description and preparation

4.3.1 Data description

This study adopts CHARLS (China Health and Retirement Longitudinal Study) which focuses on living arrangements, health status as well as personal and financial characteristics of those aged above 45 living in households in China. This unique tracking survey is led by National School of Development at Peking University and takes place every two years, started from 2011and continued in 2013 in 28 provinces. With detail information of main respondents divided into seven parts, demographic background and health status of older people, family features, socioeconomic status and community facilities, this database enables us to carry out statistical analysis for living arrangements of older people. All parts of this survey are tailored to make for older people in China which is presenting specific characteristics when compared with western countries.

This survey employs the method of multiple random sampling by probability proportional to size (PPS) which means that this survey starts selection of 150 counties from all districts units randomly   according to the total amount of district units in China. After that, 3 communities   are also randomly selected by PPS from each district samples, and 24 households are again randomly selected through PPS from each community based on the age eligibility and response rate in each community. There are 7,605 interviewees in year 2011 and 5,054 individuals in year 2013 of the survey. Loop data of the family and health detailed data were just released on the 17th November 2015 and are too late for considering these details in the current study. More details on CHARLS before 2011

Districts for urban areas and counties for rural areas in this survey. Both of district and county are with similar household numbers and housing facilities.

Communities for urban areas and villages for rural areas in this survey. Community and village share approximate numbers of household and housing facilities.

could be found from Zhao et al. [14].

This population based on micro database is adopted mainly due to its design. Questionnaires and data organization of CHARLS is based on HRS (Health and Retirement Study), which is a longitudinal cross-sectional data, and similar to all of the databases developed all over the world, such as SHARE in European countries, ELSA, KLSA, and JSAR. With all of these similarly designed databases, analysis of CHARLS could be more conveniently and accurately compared with other countries. Also, further analysis on CHARLS with longer time-period would be perfect for longitudinal analysis of older people in China.

Living in institution is one of the choices of living arrangements. However, as CHARLS is an in-house survey which only interviews older people who are living independently, living with spouse or child, or living with family. Living in institution is not a common way of aging in Chinawith only around 1% of older people living in nursing homes [110]. Due to the social norm that suggests adult children should take care of their old parents and the preference of older people to stay at home, only a small percentage of older people actively choose to live in institution. According to the "9073" living arrangements plan suggested by Shanghai government[111,112], by 2010, there should be 90% of older people in Shanghai aging-in-place, 7% of older people stay in their houses but financially and non-financially supported by the community, and 3% of older people will stay in institutions. Similarly, Beijing government put forward the "9064" living arrangement plan for local older people. By 2020, there will be 90% of older people aging-in-place, 6% of older people aged with supports from the community, and 4% of older people staying in the institutions. From the above statistics, it can therefore be concluded that there are only a very small proportion of older people living in institutions which will only affect the following analysis slightly.

Living arrangements of older people in this survey are simply divided into four types, living independently or living with spouse, living with children, living close with children, and living far away from children. These living arrangement choices are confirmed by three variables, which are household size, marital status , and distance of children livingwith older parents. By dividing living arrangement choices into these four categories, this section could be able to identify numbers and percentages of older people

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There are six different marital statuses of respondents. Only the first choice, married with spouse present or living with a partner as if married, is considered as living with spouse.

who are living independently or with spouse and requiring further support from the community and government. Furthermore, the other three living arrangements of older people are related to the living arrangements of children. This allows the further investigation of daily non-financial and financial support from children and identify role of government in fulfilling needs of older people. Table 4.4 shows the statistics of older people living arrangements in 2011 and 2013. On the other hand, Table 4.5 illustrates the living arrangement of older people with their adult children.

Table 4.4Number of older people with different living arrangements(2011 and 2013)

Living arrangements of older people	Frequency	Percentage
Living independently or with spouse	2,233	18%
Living with children	5,549	44%
Living with others	4,877	38%
Total	12,659	100%

Table 4.4 summarizes four different living arrangements of older people in China based on statistical analysis of CHARLS in 2011 and 2013. There are only 18% of older people living independently or only living with spouse. While the rest part of older people, 82% of them, are actually living with family members apart from spouse. Then, when considering if older people are living with their children, there are almost half of them are living with offspring.

Table 4.5Living arrangements of older people with children(2011 and 2013)

Living arrangements of older people with children	Frequency	Percentage
Living with children	5,549	44%
Living close with children	4,265	34%
Living far away from children	2,845	22%
Total	12,659	100%

As the current studyconcentrates on investigating living arrangements of older people with their adult children, classification of living arrangements of older people can also be classified as living with children, living nearby with children and living far away from children.Living nearbywith their children indicates that older people are, although living separately, living in the same community or village with their children; while,

living far away from children means that both parties are neither living together in the same house nor living in the same community or village. There are 34% of older peoplewho are living close with children which also indicates that older people are highly probably taken care by their children due to the convenience of visiting and the intention of living close with each other. In turn, there are 22% of older people with children that are not living close with them that children may live in the same province or even not in the same province nor the same country. This proportion of older people is only possibly financially supported by their children. They require more attention and care from the community and government.

4.3.2 Statistical analysis

In the following part, statistical analysis of living arrangements determinants is carried out and mainly divided into five parts according to the summary in section 3.1. The four parts are the personal characteristics, family features, financial issues and policy legislation. For each part, there are particular variables employed for indication of specialties in China. Any significant impact of variables on current living arrangements of older people would be considered as determinants of older people living arrangements.

Before discussing variables by categories, there are several control variables included in all regression models for controlling differences of individuals. Those variables are gender, age, type of Hukou, and education level of the older person, year, provinces, and cities of older person located. Gender of older people is adopted due to the relationship between gender and living arrangements choice[113]. Also, for older people with older age, they would be more likely to live independently[114]. Based on the suggestion of Singh and Siahpush [115], although life expectancy of older people is significantly related to gender, they are statistically not affecting each other in this case under analysis by Hausman test. Then, type of Hukou, including agricultural Hukou, non-agricultural Hukou, and unified residence Hukou, is adopted due to the highly influences of it on various areas and characteristics of older people in China. Education level of older people is also significantly proved to impact living arrangements choice of older people in various studies[116-118]. Apart from personal differences of older people which are controlled, year, which only includes 2011 and 2013, provinces and cities of older people being interviewed are also introduced to the model to control time and spatial differences of older people. All these eight variables are employed in all the

following regression models.

The first regression study is concentrating on personal characteristics of older people. There are two groups of variables, health condition of older people, as well as, income of older people. Health condition of older people is simply represented by ADL and IADL of older people which can easily reflect the ability of older people to take care of themselves and how this ability affects current choice.

All variables are processed and shown in Table 4.6 with basically statistical information.

Table 4.6Statistical analysis of major variables

Variable	Obs	Mean	Std. Dev.
ADL	12659	0.017142	0.1298054
IADL	12659	0.083182	0.2761679
disability	12659	0.269611	0.443775
social	12659	0.547121	0.4977944
ADL_disability	12659	0.012007	0.1089221
IADL_social	12659	0.040446	0.1970095
rely_support1	12659	0.636933	0.480903
grandson	12659	0.538826	0.4985099
granddaughter	12659	0.362983	0.480879
nonriskasset	12659	0.889328	0.3137382
h_govsub	12659	330.451	928.9647
gov_hinsurance	12659	0.9252706	0.2629647
h_insurance7	12659	0.004753	0.0687823
h_insurance8	12659	0.008318	0.0908274

Family features of older people family are illustrated by the existence of grandson and granddaughter as well as the person on whom older people relied in their old-age life. Financial issues, which are mainly the wealth, of older people is also highly affecting decision of older people. Wealth of older people is represented by risky asset and non-risky asset. These types of asset are helpful when bequest tendency of older people is aimed to be proved. Policy legislation is also affecting decision of older people. However,

it is highly difficult to perfectly catch the influences of policy legislation on decision making of older people. Subsidies from government to older people as one of the major linkages between policy and financial issues of older people are analyzed for investigating the effects of policy legislation. Government subsidized, and privately supported health insurances are included for distinguishing differences between two conditions.

4.4 Regression result analysis

After statistical analysis of variables, Logit regression can be carried out. Aim of this part is to identify determinants of older people living arrangements. As is introduced previously, four groups of determinants are separately analyzed. After the regression analysis, a robust test is introduced for testing the stability of this model.

4.4.1 Logit regression of older people living independently or with spouse

In this part, binary Logit regression is conducted for four groups of determinants on whether older people are choosing to live independently, which is shown in Table 4.7. The first case (1) is studying the impact of personal characteristics factors on choice of older people living arrangements. The second case (2) is to analyze effects of family features of older people on their living arrangements choice. The third case (3) is focus on the financial condition of older people. The last case (4) aims to find out if there are any policy legislation related factors, which is represented by presence of government medical subsidies, are posing effects on living arrangements decision of older people.

In Table 4.7, four groups of estimation results, whether to live independently or not of older people is decided according to the value of probability from the binary Logit regression. All control variables, including gender, age, income, type of Hukou, education level of older people, are significantly controlled variances demographic characteristics of older people. First of all, IADL of older people is posing significantly, at 0.1% significant level, negative effects on choice of living independently. Then, existence of grandchildren, both grandson and granddaughter, are positively affecting decision of older people within 0.1% significant level. Expectation of relying on child in old-age life of older people presents a negatively 0.1% significance. On the other hand, non-risky asset is also significantly posing negative effect on choice of older people. In

case four, existence of government subsidies is negatively affecting the result at 0.1% significant level. In addition, government subsidies and health insurance financially supported by the government is significantly posing negative influences on choosing to live independently.

Table 4.7Estimations of the binary Logit regression models (Living independently)

	(1) Personal characteristics	(2) Family structure	(3) Financial condition	(4) Government subsidies
ADL	0.0586			
	(0.16)			
IADL	-0.856***			
	(-5.70)			
disability	-0.0887			
	(-1.41)			
social	0.0386			
	(0.73)			
ADL_disability	-0.467			
	(-1.03)			
IADL_social	-0.0919			
	(-0.43)			
grandson		1.593***		
		(17.78)		
granddaughter		0.988***		
		(11.82)		
rely_support1r		-0.776***		
		(-12.20)		
nonriskasset			-0.577***	
			(-6.59)	

Continued Table 4.7 Estimations of the binary Logit regression models (live independently)

	(1) Personal characteristics	(2) Family structure	(3) Financial condition	(4) Government subsidies
h_govsub				-0.000192***
				(-4.05)
gov_hinsurance				-0.311***
				(-3.20)
h_insurance7				0.0951
				(0.31)
h_insurance8				0.185
				(0.56)
Constant	4503.4***	4244.7***	4545.5***	4464.9***
	(22.52)	(20.83)	(22.62)	(22.34)

Note: 1.* p<0.05, ** p<0.01, *** p<0.001

2. *t*-values are in brackets.

3. Provinces and cities where the household locates and, years differences and demographic variables, including gender, age, income, type of Hukou and education level, are controlled.

4. There are 12,659samples in this regression.

4.4.2 Robust test: Older people in urban and rural area

This binary Logit regression adopts identical independent variables and estimates whether living in urban or rural areas are posing effects on choices of older people. Table 4.8 indicates that there are 76% of agricultural Hukou older people and 23% of non-agricultural Hukou older people in this survey. The rest older people are either having the unified residence Hukou or do not have Hukou. In order to differentiate the differences of government subsidies and government medical supported insurances in urban and rural areas, the variables of h_govsub as well as gov_hinsurance are modified

to only include items for each group of older people. For example, urban employee medical insurance as well as urban resident medical insurance are only existing in the variable for non-agricultural Hukou older people. In contrast, variable for older people with agricultural Hukou includes the new cooperative medical insurance (He Zuo Yi Bao).

Table 4.8Hukou types of older people(2011 and 2013)

Hukou of older people	Frequency	Percentage
Agricultural Hukou	9,589	76%
Non-agricultural Hukou	2,956	23%
Unified Residence Hukou	106	1%
Do not have Hukou	8	0%

Robust test is based on the binary choice of older people with either agricultural or non-agricultural Hukou to live independently or not. Again, all control variablesare significantly controlled demographic characteristics variances of older people. It is observed that IADL of older people with both agricultural and non-agricultural Hukou are significantly decreasing possibility of older people to live independently with 0.01% significance. Also, for older people with agricultural Hukou, interaction term of explaining possible correlation between ADL and social is negatively influencing the possibility to live independently at significance level of 0.05%. Then, existence of grandchildren, no matter they are boys or girls, is positively impacting choice of older people, both agricultural and non-agricultural Hukou older peopleat 0.01% significant level. Possibility of older people to live independently is negatively significantly affected by whether older people are relying on their adult children to support for their old-age life at 0.01% and 0.1% significance levels for older people with agricultural and non-agricultural Hukou respectively. Risky asset is negatively affecting the possibility of older people with non-agricultural Hukou at 0.05% significance level. For older people with agricultural Hukou, possessing of non-risky assets, accessibility of government subsidies and participation in government supported medical programs are all significantly affecting possibility of older people to live independently at 0.01% significance level.

Table 4.9 Four estimations of binary Logit regression models (living independently with agricultural or non-agricultural Hukou)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Personal characteristics (agricultural)	Personal characteristics (non-agricultural)	Family structure (agricultural)	Family structure (non-agricultural)	Financial condition (agricultural)	Financial condition (non-agricultural)	Government subsidies (agricultural)	Government subsidies (non-agricultural)
ADL	0.227	-0.456						
	(0.56)	(-0.55)						
IADL	-0.862***	-0.877***						
	(-4.91)	(-2.92)						
disability	-0.0466	-0.191						
	(-0.66)	(-1.37)						
social	0.0637	-0.114						
	(1.02)	(-1.08)						
ADL_disability	-1.493**	1.327						
	(-2.45)	(1.47)						
IADL_social	-0.124	0.0133						
	(-0.49)	(0.03)						

Continued Table 4.9 Four estimations of binary Logit regression models (living independently with agricultural or non-agricultural Hukou)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Personal characteristics (agricultural)	Personal characteristics (non-agricultural)	Family structure (agricultural)	Family structure (non-agricultural)	Financial condition (agricultural)	Financial condition (non-agricultural)	Government subsidies (agricultural)	Government subsidies (non-agricultural)
grandson			1.905***	1.306***				
			(15.19)	(9.87)				
granddaughter			0.756***	1.276***				
			(6.77)	(9.86)				
rely_support1			-0.790***	-0.269*				
			(-9.50)	(-1.90)				
nonriskasset					-0.698***	-0.180		
					(-7.11)	(-0.91)		
h_govsub							-0.427***	0.0000440
							(-6.65)	(0.80)
gov_hinsurance							-0.232**	-0.289**
							(-2.17)	(-2.36)

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Continued Table 4.9 Four estimations of binary Logit regression models (living independently with agricultural or non-agricultural Hukou)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Personal characteristics (agricultural)	Personal characteristics (non-agricultural)	Family structure (agricultural)	Family structure (non-agricultural)	Financial condition (agricultural)	Financial condition (non-agricultural)	Government subsidies (agricultural)	Government subsidies (non-agricultural)
h_insurance7							0.558	-0.278
							(0.93)	(-0.78)
h_insurance8							0.359	0.102
							(0.72)	(0.24)
Constant	4679.6***	4137.7***	4468.3***	3828.4***	4700.8***	4178.9***	4638.2***	4142.0***
	(17.82)	(13.31)	(16.65)	(12.08)	(17.82)	(13.40)	(17.66)	(13.32)

Note: 1.* $p<0.05$, ** $p<0.01$, *** $p<0.001$

2. *t*-values are in brackets.

3. Provinces and cities where the household locates, year differences and demographic variables, including gender, age, income, type of Hukou and education level, are controlled.

4. There are 12,659 samples in this regression.

4.5 Discussion

Generally, there are four groups of regression results on older people living arrangements. It is observed that determinants in personal characteristics are partially significant in affecting decision living independently. On the other hand, government subsidies and health insurance funded by the government are also significantly affecting older people living independently.

Then, specific discussion on every factor is presented according to four types of independent variables. First of all, expectation is reasonably interpreted because when older people are having lower expectation of relying on adult children during old-age life,it gives a higher possibility of living independently. Health condition of older people, represented by IADL, is negatively affecting choice of living independently. Furthermore, it is negatively significant in both cases of older people with agricultural and non-agricultural Hukou. That means when having difficulties in proceeding IADL, older people are less likely to live independently. This is obviously because they are less capable to take care of themselves under such condition. However, in western countries, older people tending to live independently while adult children also tending to have privacy leads to a result of moving in nursing homes once older parents are no longer capable of taking care of themselves. It is understandable that ADL and disability of older people are not significant in this case as once older people are losing ADL and being disabled, they are highly likely not to stay in their own houses nor stay with their children, with significantly negative effect on living with children, but move in to nursing homes or hospital. In addition, it is more significantly influencing in the case of older people with agricultural Hukou. That is because it is possibly that older people with agricultural Hukou are having less developed community medical support as well as less contact with commercial medical care services in rural area. CHARLS is an in-house face-to-face survey which may neglect those groups of older people. Interaction terms in the case of living with children are significantly controlling interaction effects between health representing variables.

Factors representing family structure are posing highly significant effects on choice of older people. When there are grandsons or granddaughters in the family, older people will have a higher probability to live independently. As older people in this survey are generally aged above 60 and data limitation of not able to consider the age of

grandchildren, we assume that grandchildren in this case are mostly old enough to take care of themselves. Existence of grandchildren indicates a larger household size as well as, more importantly, a more mature form of family of adult children. In addition, average housing area in nowadays commercial residential housing is getting smaller aiming for nuclear families. It is hence less likely for older people to live with children due to the limitation of housing area. This case is happening similarly in both urban and rural areas. Expectation of older people in relying on children in old-age life illustrates that the higher expectation of living with children, and the less possibility to live independently. This indicates that expectation is anastomosing with actual choice of older people. In addition, expectation of older people is more significantly affecting the choice of older people with agricultural Hukou and less significant in non-agricultural Hukou older people. It is reasonable that older people in rural area are having closer relationship with children.

The financial factor considered is the intention of bequest. Based on the assumption that most number of older people are having tendency of bequest in China as well as the stable and non-fungible of non-risky asset, absence of non-risky asset means that older people are having higher possibility to live independently due to the lack of inheritance. In addition, older people with agricultural Hukou are having a higher tendency of bequeath.This also indicates that financial condition of older people is important and worth paying attention when discussing living arrangements of older people in China.

Policy legislation of government in China is represented by government subsidies as well as government supported health insurances. Most of the case is that older people living independently are not having government subsidies, which is also shown not significantly in the case of living with children. This is because most types of government subsidies are concentrating on being related to agricultural and work injury of the whole family which is likely to have other family members. This is also proved in the case of older people having agricultural Hukou and with significant variable. On the other hand, presence of health insurances financially supported by government leads to a less probability of older people to live independently. This may because older people without medical expenses that are financially supported by the government are not feeling secured, living independently requires better condition of health and higher financial affordability. This variable is significant in both case of older people with agricultural and non-agricultural Hukou.

Chapter 5 Changes of Living Arrangements in China

5.1 Living arrangements of older people in China

For decades ago, age has become a hot topic in developed countries for studying demographics and housing demand [119]. The reason for demographic study of housing focuses on aging group is that mobility declines dramatically when age grows and housing type changes with age[120,121]. Many of the researches overseas on population aging in China is concerned with living arrangements and family relationships between older people and their families [122-124]. Recently, living arrangements of older people has been discussed a lot in society and by scholars in China from different angles [125], and different disciplines [126] from the perspectives of actual significance, foreign experience [127] and existing problems and corresponding solutions[125,128,129].

On the other hand, traditions and special cultures in China contribute a lot in differentiating China from the other countries [120]. A growing number of Chinese older people prefer to age-in-place and this trend tends to be persistent [131]. Nowadays, there are an increasing number of older people choosing to live independently at their homes. The different attitudes towards living arrangements between older people from China and other countries can be explained in a way from the important role of family playing in taking care of older people. It was suggested by Asis et al. [132] that children are considered as the responsible persons to take care of their older parents, which mentioned as a moral obligation. In the culture of China, concept of parent repayment in children, which means that the children owe their parents for child care and giving of birth, is common and even crystalized into proverbs and phrases [130]. As in almost everyone's mind that care giving should be facilitated with co-residence, however, not living together does not means that the family does not take care of the older people, which is proved by scholars that in China some adults children may live close to their older parents in order to keep privacy of each other and take care of them at the same time[133].

Nowadays, huge change in social norm of older people in China potentially changes the traditional attitudes and personal preferences of them toward filial piety and co-residence [134]. Responsibility of taking care of older people changed from only on family to involving family and the lacking of appropriate social welfare and pension

system to protect and support the basic needs of older people may impact the well-being of older people in China greatly. Studying living arrangements choice of older people from the perspective of affordability would help understanding future needs and future scenarios of the society and provide applicable political advice for government to further improve well-being of older people.

Living arrangements of older people in China becomes a crucial issue from both social and financial perspectives. Demographic characteristics as well as economic and financial conditions of older people are always considered in both theoretical and empirical studies of older people living arrangements [135-137]. Living arrangements of older people is actually a decision making process according to persistent or dynamic characteristics of older people as well as their families. By only adopting cross-sectional data is obviously not perfect for studying such a dynamic issue, as living arrangements of older people changes with the same time as the determinants of the decision. However, most of the empirical studies adopted cross-section data which is highly available and convenient to analyze. Cross-section data can only help to identify the current choice of older people. In addition, in order to carry out regression analysis and reveal the statistical relationship behind different influential factors, most scholars tend to employ micro-data. Only employing micro-data has some drawbacks that sample size of those data are not exceeding a hundred thousand. Actually, most of the micro-data only interview around one thousand interviewers, however there are around 14% of the population, which means around 180 million of older people are aged more than 60 in 2010 China.

In addition, all sampling methods have their own drawbacks that a complete sample would definitely be able to avoid. A complete sample of older people in China is able to comprehensively reflect population structure and condition without any bias. Hence, data of the 5th and 6th National Census in 2000 and 2010 is adopted in this section. National census in China refers to the national individual survey of population with unified methods, projects, questionnaires and standard time as 1st November. It is widely used around the world for collecting national basic demographic data.

In this chapter, CHARLS (China Health and Retirement Longitudinal Study) will again be introduced to find out factors that may change living arrangements choice of older people in China as well as causing differences between preferences and actual choices. Three groups of factors are considered, including health condition, financial status and family structures. The second part would be data analysis of CHARLS and

discussions of variables. Then, empirical analysis and empirical results would be shown in the part three and four. Lastly, this chapter will provide conclusion of results.

5.2 Model construction

For the purpose of constituting the leading factors of causing change of living arrangements, also for identifying the factors that leads to differences in preferences and actual choices of older people, Chapter 4 aims to carry out two groups of regression. In addition, this section, in order to catch the changes of living arrangements of older people, adopts data from CHARLS from year 2011 to 2013 for 28 provinces and municipalities . Two years of a panel data is a little bit short, but there are still around 600 data, totally 300 individuals were included in the regression. This caused that in the second part of the regression, there is a problem of comparing preferences and actual choices of older people in one regression model. This empirical research is conducted by Stata Programme.

Firstly, in section 4.4.1, dynamic choices of older people from 2011 to 2013 would be investigated through carrying out three panel Logit regressions to panel data after adopting Hausman test. There will be three panel Logit regression models for constituting the factors of influencing changes of living arrangements of older people, including moving together of older people and their adult children, and moving away of older people and their adult children. There are three reasons for employing panel Logit to study living arrangements changes of older people. First of all, studying change of choices and treating choices of older people dynamically allows the study to be able to consider time-varying factors. Secondly, panel Logit model enables this study to interpret regression coefficients closer with current condition of older people, as a result, to obtain a more convincing result. The third reason is that, considering time variance in panel Logit models is capable to increase preciseness of the result due to the veracity of research emphasis as well as the focus on critical issues. As employing panel data and there is heterogeneity between various individuals behaviors, a heterogeneity term has to be adopted tothe model controlling these differences. There are two types of penal data models accounting for individual differences, they are the fixed effects model and the

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Provinces and municipalities are including but not limited to Anhui, Beijing, Chongqing, Guangdong, Guangxi, Guizhou, Heilongjiang, Hunan, Hubei, Inner Mongolia, Jiangsu, Jiangxi, Liaoning, Shanghai, Shannxi, Shanxi, Sichuan, Tianjin, Xinjiang, Zhejiang.

random effects model. Generally agreed difference between two models is that in fixed effects model, there are correlations between heterogeneity term and independent variables, otherwise it would be random effects. In order to decide which model should be adopted for the panel Logit model, Hausman test is conducted. In this case, there are several individual heterogeneity control terms included, but not all heterogeneities are able to be obtained. These individual heterogeneity terms are possibly correlated with independent variables, therefore, Hausman test should be conducted.

After that, three Logit regression modelsare carried out according to the result of Hausman test. Fixed modelemployed in the first estimation, and change of living arrangements, are shown as,

$$Prob(lvc_{it} = 1) = \bigwedge(\alpha_i d_{it} + \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it})$$

where lvc could beused as 1 denoting changes occurred, 0 otherwise, for each provinces and municipalities, i, in 2011 and 2013 t. Specific for fixed effect Logit regression, d_{it} is a dummy variable included for each individual i equals to 1 when all other determinant factors equals to 0.

For the case of random effect introduced in moving together and moving away between two parties,

$$Prob(lvc_{it} = 1) = \bigwedge(\beta_0 + \beta_1 X_{it} + \beta_2 Z_{it})$$

where almost the same as fixed effect model except for the term of dummy indicating fixed effect for provinces and municipalities which is ignored.

For the second regression set in section 4.4.2, aiming to investigate the difference between preferences and actual choices of older people, a similar Logit regression for panel data is carried out for two cases. There are two questions, separating the married and unmarried older people into two groups, were asked for preferences of living with adult children. Therefore, two cases were conducted in order to comprehensively obverse the effect of factors on choices of older people.In addition, in the test of effect of distribution of married and unmarried in regression, since two cases are seperated, in order to avoid selection bias, a two-stage Heckman procedure (Heckman, 1979) is employed to control for selective and simultaneous bias in the test. We incorporate an Inverse Mills Ratio (lambda) into the equation,

$$Lambda_i = \phi(-X\_2i/\sigma\_2)/(\phi(X\_2i/\sigma\_2)$$

which demonstrates the normal density function. Mill's ratio (lambda) is estimated from Logit model with full samples. It is a monotone decreasing function of the probability that married or unmarried older people are selected into the samples. By incorporating it as an additional variable into the model only with the sample of married or unmarried older people, the bias raised by omitting variables which indicates that the impact of tenure choice can thus be corrected.

Table 5.1 summarized variables that are includedin the regression of studying dynamic choices of older people.

Table 5.1. Variables description

Variables	Description
ADL	=1 if do not have ADL, 0 otherwise.
IADL	=1 if do not have IADL, 0 otherwise.
disability	=1 if has any disability, including physical disabilities, brain damage or mental retardation, vision problem, hearing problem and speech impediment, 0 otherwise.
social	=1 if has participated in at least one social activity in the last month, 0 otherwise.
pay_health	Person that contributes most paying health related cost. Equals to 1 indicates themselves, equals to 2 represents their spouse.
grandson	=1 if there are existence of grandson, 0 otherwise.
granddaughter	=1 if there are existence of granddaughter, 0 otherwise.
nonriskasset	=1 if interviewee has non risky asset, including deposit, savings, government bond, housing fund and housing wealth.
lifestandard	Rate of standard of living. Range from 1 to 5, the smaller number indicates the higher rate would be the living standard.

5.3 Data description and preparation

5.3.1 Data description

This study also adopts CHARLS (China Health and Retirement Longitudinal Study) which focuses on living arrangements, health status as well as personal and financial characteristics of those aged above 45 living in households in China. This unique tracking

survey is led by National School of Development at Peking University and takes place every two years, started from 2008 in Zhejiang and Gansu and continued in 2011 and 2013 in 28 provinces. With detail information of main respondents divided into seven parts, demographic background and health status of older people, family features, socioeconomic status and community facilities, this database enables us to carry out statistical analysis for living arrangements of older people. More detail discussions of CHARLS can be found in section 4.3.1.

Living arrangements of older people in this survey are simply divided into four types, living independently, living with spouse, living with one child and living with family members. These living arrangement choices are statistically shown in section 4.3.1.

Apart from the actual living arrangements of older people derived from the survey, there are actually two more questions related to the preference of living arrangements of older people. This is a particularly interesting variable that could be included in the empirical analysis for identifying factors of determining preferences of older people. One question is concerning the condition of having a spouse and children, while the second question is concerning on the situation of those with children and no spouse. These two questions open a window for us to reveal the preference of older people in choosing living arrangements without consideration of constraints in real life. Distribution of living arrangements preferences is shown in Table 5.2.

Table 5.2 Living arrangements preferences of older peoplewith spouse (2011 and 2013)

Preferences of older people	Frequency	Percentage
Living with adult children	2,167	61%
Not living with but near with adult children	1,099	31%
Not living together nor close to adult children	169	5%
Living in nursing home	56	2%
Other	46	1%

It is summarized that there are more than 60% of older people prefer to live with their adult children. On the other hand, that are more than 30% of older people choose to live independently with adult children living around. These two choices actually reflect that more than 90% of older people prefer to depend on care of children. In order to further investigate the dependent tendency of older people, another term is analyzed in

Table 5.3There is no specific statement that illustrates if there is any difference between financial and non-financial care that is provided by parties. In this case, older people could choose one party of them planning to rely on when they enter old-age and require to be taken care of.

Table 5.3People to be relied on in old-age life of older people (2011, 2013)

Preferences of older people	Frequency	Percentage
Children	4,196	69.5%
Savings	186	3.0%
Pension or retirement salary	1,246	21.5%
Commercial pension insurance	24	0.4%
Other	282	5.6%

It is observedthat almost 70% of older people planning to rely on their children when they enter old-age life. This is not surprising at all as traditionally in China, there is an idea of older parents relying on their children as one of the purpose of raising a child. The second coming up choice of older people is to rely on pension and their retirement salary. This indicates that there are around 20% of older people are financially independently and may be willing to live independently. In addition, it also indicates that older people are relying on government providing pension or union with retirement salary for them. This is actually a huge financial burden posing on government as well as unions and will get worst with more number of older people existing in the following decades. However, it is worth be aware that there are only 0.4% of older people planning to rely on commercial pension insurances.This may due to the high requirement of financial affordability of older people to join privatized pension program. Furthermore, commercial pension products in China are not so well-developed and there are high risks for older people to invest in this kind of program.

5.3.2 Statistical analysis

Change of living arrangements from 2011 to 2013 is summarized and shown in Table 5.4. There are 20% of older people changed their living arrangements during 2011 and 2013. Half of them were moving together with their children however half of them were moving away with them. Here is an assumption that moving is the decision of older people and only characteristics of older people as well as condition affecting them which

are possibly causing changes of living arrangements. Although it is obviously not the real case in real life, it is still convincing as living arrangements of older people is more likely the decision that affects themselves the most, in addition, in China, social norms are supporting adult children reverencing their older parents' preferences and opinions.

Table 5.4 Change of older people living arrangement (From 2011 to 2013)

Living arrangement change of older people	Frequency	Percentage
Moving	321	19%
Movingapart	152	9%
Moving coresidence	169	10%
Not moving	1333	81%

A variable is introduced for representing if preference and actual choices of older people living with their adult children are the same. Table 5.5 summarized the distribution of matches between preference and actual choices of older people living arrangements. It is seen that there are only around 6% of older people could match their preferences and actual choices. There may be plenty of causes of them, in section 5.4.2, authors tried to find out what are determining preferences for older people.

Table 5.5 Different between preferences and actual choices of older people

Condition	Freq.	Percent
Preference and actual choices do not match	3,093	93.5%
Preference and actual choice match	215	6.5%

Dependent variables in section 5 are mostly likely similar with that in section 4.3.2, except for adding living standard (lifestandard) and person that paid most for medical expenses of older people. There are mainly four types of variables employed in the following regression models, the health condition, the financial affordability as well as the family restriction of older people. These are all possibly changing living arrangements of older people and potential constraints of preventing older people to choose their preferred living arrangements.

Same as that in section 4, control variables in these two regression cases are gender, age, type of Hukou, and education level of the older person, year, provinces, and cities of older person located, while determinant factors in this case are divided into four groups.

For identifying the factors causing changes of living arrangements of older people, these four groups of variables are employed.

Health condition of older people is represented by ADL, IADL, whether older people have disability (disability),whether older people are joining any social activities in the last month of the interview took place (social) and who paid most for older people medical expense. It is reasonable that once health condition of older people is changed, their ability of daily living may be changed and then causing switch of living arrangements from living independently to living together with adult children or living in nursing homes.

The second group of variables is the financial status of older people. This included if older people are possessing any non-risky assets (nonriskasset), containing deposit, savings, government bond, housing fund and housing wealth. If older people are having non risky asset, that would represent the possibility of bequest tendency and they will highly likely tending to live with their child.

Then, change of family structure also may change living arrangements of older people. There are only two variables employed in the model for denoting family requirements of older people to live together. They are the presents of grandsons and granddaughters (grandson, granddaughter). If there are any new born grandchildren, young parents may have to invite their older parents to come and help them to take care of babies. However, on the other side, if children are old enough to take care of themselves and there is limitation of housing space, then, existence of grandchildren may lower the possibility of older people living with adult children.

The forth group of variable actually only contains one that is the self-rated living standards of older people themselves.This is to investigate the effects of older people satisfaction degree on standards of living on living arrangements choices. The higher the satisfaction is, the lower would be the chance of older people to move during 2011 and 2013. This variable can generally help authors to understand and consider the opinion of older people on their current living condition.Table 5.6 statistically analyzes all variables.

Table 5.6Statistical analysis of variables

Variable	Obs	Mean	Std. Dev.
ADL	3308	0.007255	0.0848804
IADL	3308	0.057739	0.2332842
disability	3308	0.300181	0.458406
social	3308	0.493954	0.500039
nonriskasset	3308	0.893289	0.3087921
pay_health	3308	1.589782	0.6604135
lifestandard	3308	4.246675	1.62334

5.4 Regression result analysis

There are two major parts in this section. The first one is to study the dynamic choices of older people in 2011 and 2013. In addition, after identifying factors of changing older people living arrangements, either two parties moving together or moving apart, a robust test is carried out to provide evidence of the wellness of this model. The second part is to compare the differences between preferences and actual choices of older people. Then, three cases of Logit regressions are carried out to identify factors that determine preferences of older people.

5.4.1 Dynamic choice of older people

First of all, Hausman test is carried out and fixed effects model is adopted for two cases.Change of living arrangements of older people during 2011 and 2013 is studied, moreover, moving closer to each other is also estimated. This estimation aims to find out which factors are significantly coming with changes of living arrangements. In addition, to be more comprehensively investigating the issue, factors that come with the change of living arrangements from not living together to living together are identified.

Table 5.7Estimation of binary Logit regression models(dynamic choice)

	(1) Change	(2) Closer
disability	3.272***	18.86
	(2.62)	(0.01)
social	0.942**	0.197
	(2.34)	(0.20)
ADL	10.44	-0.865
	(0.01)	(-0.00)
IADL	1.187	4.783
	(1.07)	(1.48)
pay_health	0.755**	0.715
	(2.27)	(0.81)
grandson	1.493***	-3.075*
	(3.71)	(-1.73)
granddaughter	-3.224***	-7.864**
	(-6.09)	(-2.24)
nonriskasset	1.464**	1.414
	(2.03)	(1.02)
lifestandard	1.198***	1.087***
	(6.42)	(3.18)
Observations	642	366

Note: 1.* p<0.05, ** p<0.01, *** p<0.001

2. *t*-values are in brackets.

3. Provinces and cities where the household locates and demographic variables,

including gender, age, income, type of Hukou and education level, are controlled.

Result shows that in health condition of older people, including disability, social,and the person mainly responsible for medical expenses are significantly positively impacting changes of living arrangements. Health condition however is not

so significant in moving closer of two parties. On the other hand, existence of grandchildrenposes significant effect on changes and moving together. In case 1, grandson is presenting positive effects while granddaughter is posing negative effects. In addition, self-rated living standards of older people significantly causing living distances between older people and their adult children.

5.4.2 Preference and actual choices of older people

From the result of section 5.3, it is found out that there is only a small proportion of older people who are able to match their actual choices with their preferences. It would be a more comprehensive and persuasive analysis by comparing preference and actual choices of older people through regression models. However, the sample size is too small that comparison of differences between preferences and actual choice is not feasible.

Table 5.8Estimation of binary Logit regressions (preference when married and unmarried)

	(1)	(2)
	Preference married	Preference unmarried
ADL	-0.103	12.96
	(-0.07)	(0.01)
IADL	-0.723	0.00185
	(-0.82)	(0.00)
disability	0.442	-28.69
	(1.22)	(-0.01)
social	-0.108	-1.723***
	(-0.46)	(-2.87)
nonriskasset	0.274	-0.0226
	(0.69)	(-0.03)
lambda	-0.866	-39.60***
	(-0.39)	(-4.70)
Observations	434	268

Note: 1.* $p<0.05$, ** $p<0.01$, *** $p<0.001$

2. t-values are in brackets.

3. Provinces and cities where the household locates and demographic variables, including gender, age, income, type of Hukou and education level, are controlled.

This regression aims to identify differences between preferences and actual choices of older people in two cases, including older people that are having spouses and those without. spouses In order to eliminate selection bias of dividing older people into two groups, Heckman test is also carried out and *lambda* from the result of Heckman test is included in every estimation. Before conducting regression for preferences of older people living with children, Hausman test is again employed for choosing between fixed effect model in the preference estimation and random effect model is introduced for actual living arrangements of older people.

Result in Table 5.8 shows that there are different factors affecting preferences and actual arrangements of older people. Times of joining social activities in last month is negatively affecting preferences of older people without spouses at 1% significant level.

5.5 Discussion

Dynamic choices of living distance with children by older people is mainly determined by health condition, existence of grandchildren, financial asset and self-rated living standards of older people. Disability of older people may cause them to move from living independently to living with children, or even to nursing home due to the demand requirements of skilled care. Social participation of older people indicates higher needs of social activities with family members or the community. The person who is responsible for paying medical expense of older people is also posing significant effect on living arrangements choices. The higher possibility of family pay for medical expenses for older people, the more likely older people to move. This may due to the intimacy relationship between older people and their children. Existence of grandchildren is presenting different impacts on changes of older people. The existence of grandson encourages move but not moving together. This may due to the limited housing space for older people to join adult children's family when grandchildren are grown up. Then, possessing of non-risky asset indicates intention of inheritance. Therefore, intention of bequeath may encourage moving together between two parties. After all, self-rated living standard tends to show significantly impacts on making changes of current living arrangements. This indicates that, on one hand, choices of

older people is highly depend on the current living standards; on the other hand, older people are highly driven to improve their living standards.

In order to find out the difference between factors which impact actual choices and preferences of older people living arrangements, estimation results from Table 4.7 and 5.8 should be discussed with comparison. First of all, preference of older people is proved to be considered in making actual choice of living arrangements. However, the reason of such a high number of older people having actual choices that are not matched with their preferences is constrained by several factors. It is undoubtedly that health condition of older people, especially the capability of older people to take care of themselves, is the constraint of older people deciding their actual living arrangements. It is observed that preferences of older people are actually not affecting by health conditions while health condition increases odds of older people to live with children. This indicates that older people prefer to live independently especially when they loss their spouse but health condition causes them to live with children. This can also be understood as they are moving in with children in order to be taken care of. Social participation in this case is also not significantly posing any effects on actual choices of older people but significantly influencing the preferences of older people with spouses. It can be treated as a presentation of personality of older people that is also affecting their preferences. Health condition is hence significant when deciding if older people are able to live as they wish.

For tendency of bequest, older people do not consider financial issues in their preferences. In the case of actual choices of older people with spouses, the presence of non-risky asset does not increase any odds of living together. This can be concluded that older people may rely on their spouses to take care of them and therefore, even with tendency of bequest, it is not necessary for them to live with children. In fact, it can be seen that for married older people, there are nothing affecting their preferences of living arrangements as they know that their spouses will be with them and they will take care of each other. On the other hand, for unmarried older people, the only factor that is considered in their living arrangements preferences is the social communication needs.

Preferences of older people in this study are treated as an objective variable but not a subjective consciousness of older people. However, it should be noticed that preferences of older people are only an objective choice of older people, it only represents the willingness of older people living arrangements. In addition, it is also a consideration of

older people according to existing condition, it is not possible to totally separate preferences with health status, financial condition as well as family issues.

Chapter 6 Conclusion

6.1 Summary

This study carried out elaborative study of existing empirical studies on living arrangements and thorough understanding of major theoretical studies. Aim of this study is to reveal decision mechanisms of older people living arrangements.There are three critical conclusions drawn from the in-depth study.

First of all, there are specific factors on deciding if older people are living independently in China. Health condition, not as severe as disability or lack of ADL, of older people indicates that if older people are not able to take care of themselves, they would very probably live with their children.It is varied from western countries that older people tend to live in nursing home when needed care. However, it is highly similar in both urban and rural area. Better relationship between older parents and adult children leads to a higher expectation from older people to adult children of taking care of them in old-aged life.This expectation is highlighted in China. The existence of grandchildren does not add any odds of older people living together with adult children in both rural and urban area. It is possibly because grandchildren are already able to take care of themselves. In contrast, due to the limited housing space, grandchildren actually reduce the likelihood of older people living with their children. Tendency of bequest is reducing the likelihood of living independently which may hence increase the odds of living with children.There are no significant influences from government supported health insurance on older people living arrangements. In addition, older people with agricultural Hukou indicates significance lower odds to live independently.

Change of older people living arrangementsis passively impacted by health condition, family structure and degree of satisfaction of current life of older people. The attenuation of health urge older people to terminate their independent living status. Older people in this case could only either go to live with their children or enter nursing home. Moving of older people also due to the limited housing area which can hardly fit a single core family with both teenage grandchildren and older people. Therefore, with existence of grandchildren, older people would be moving out of the family. Older people with a low self-evaluated living standard are more likely to change their current

living arrangements. This indicates that older people are pursuing quality life. When comparing preferences and actual choice of older people living arrangements, it is concluded that even if actual choice is affected and determined under so much considerations, preferences of older people seem not to be affected by any of these. In fact, for married older people, spouses are taking care of them. Hence, they do not have to surrender towards poor health and seek for help. For unmarried older people, stem from the requirement of communication with families and relying on children, older people may consider more when it comes to living arrangement preference.

To conclude, this paper analysis factors which are posing effects on living arrangements based on binary Logit regression models with adaptation of CHARLS database in 2011 and 2013. It is concluded that older people living arrangements are specific in China. In addition, health condition is the most significant factors in changing the current living arrangements. Preferences of older people do not affected by factors for actual choice but only concern about if spouse is staying around.

6.2 Policy advice

As there are significantly effects of China specified factors on choice of older people, it would be necessary for government to formulate policies based on China features but not indiscriminately adopt experiences from western countries.For instance, nursing home is not so well promoted and accepted in China. This is not only about the demographic characteristics or financial affordability of older people in China. It is more about the social norms in China that most of older people may have the impression of adult children who are not filial and that is the reason why they have to live in nursing homes. In fact, the reason of adult children may merely due to the lack of knowledge in skilled-care and want their parents to be well taken care of. Norms and culture are so much different in China and require specific means to conform these. More and more legislation measures are implemented to solve the aging problem. Adding China specific considerations in those measures can not only pose larger impacts on the society, the effectiveness of favorable practice of older people living arrangements can also be enhanced.

Health condition as the main factors of causing older people to have to move and differences between preferences and actual choices of living arrangements should be well managed and supported by the government. If health is the only reason of

preventing older people from aging-in-place, the government should focus on the sources of medical expense as well as community medical and care support network development. These are able to raise accessibility to medical and care of older people. Such as house calls of doctors for inconvenience older people, delivery of medicine and passing on health related knowledge, these are measures of the government can be carried out for helping older people to stay in place with a healthier life. Self-rated living standard of older people also significantly causing the change of current living arrangements. Although living standard can be broad, this can be interpreted as the objective opinions towards living arrangements, living locations all kind of these. In addition, in order to release financial pressure from taking care of older people, Chinese government should encourage adult children taking care of older people through introducing tax benefits.

6.3 Limitations and Future Research Direction

Limitations of the current thesis mostly occur in the data. As loop data for family and detailed health condition in year 2013 of CHARLS just disclosed in 17th November 2015. It is too late for processing and adding them into the analysis. In the future research of CHARLS, it would be a more comprehensive study for adding it in the research. In addition, as CHARLS focuses on the sociology demographics of older people, consumption and assets of older people are not completely covered. Also, due to the sample size is too small, comparison between preferences and actual choice of older people living arrangements is not feasible.

Due to the length limitations of the thesis, theoretical model of older people does not constructed. Future study of older people living arrangements should build a theoretical model for older people in China. Furthermore, with increasing number of older people in a family, work force of one family can hardly afford to take care of all older people in one family. Older people can live in the nursing home, which however is expensive and not so accepted by social culture and norms in China. A thorough design and construction of medical care network should be carried out for supporting older people to age-in-place.

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/Personal Statement

The author asseverates: this thesis was prepared solely by myself under instruction of my thesis advisor. To my knowledge, except for documents cited in the thesis, the research results do not contain any achievements of any others who have claimed copyrights. To contributions made by relevant individuals and organizations in the completion of the thesis, I have clearly acknowledged all their efforts.

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