LIVING ARRANGEMENT, HEALTH INSURANCE AND WELFARE AT OLD AGE IN CHINA

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ฉิ่งหยวน ซูย : การจัดการความเป็นอยู่ ประกันสุขภาพและความกินดีอยู่ดีในยามสูงวัยในประเทศจีน. (LIVING ARRANGEMENT, HEALTH INSURANCE AND WELFARE AT OLD AGE IN CHINA) อ.ที่ปรึกษาหลัก : รศ. ดร.นพพล วิทย์วรพงศ์

วิทยานิพนธ์นี้ศึกษา (1) ความสัมพันธ์ระหว่างแบบแผนการอยู่อาศัยและการถ่ายโอนความมั่งคั่งระหว่างรุ่นจากบุตรที่เป็นผู้ใหญ่ (2) ความสัมพันธ์ระหว่างประกันสุขภาพ พฤติกรรมสุขภาพ และการใช้บริการทางสุขภาพ และ (3) ความสัมพันธ์ระหว่างตัวชี้วัดต่างๆ ของสุขภาพและสถานะทางเศรษฐกิจและสังคม วิทยานิพนธ์นี้ใช้ข้อมูล 3 ชุดสุดท้ายจากแบบสำรวจ Chinese Longitudinal Healthy Longevity Survey (CLHLS) ที่จัดทำขึ้นในปี ค.ศ. 2005 2008-2009 และ 2011-2012 ซึ่งสามารถเป็นตัวแทนของประชากรในประเทศได้ เนื้อหาของบทที่ 2 พิจารณาการใช้แบบแผนการอยู่อาศัยที่แท้จริงและความแตกต่างระหว่างแบบแผนการอยู่อาศัยที่แท้จริงและแบบแผนการอยู่อาศัยที่พึงประสงค์ในฐานะปัจจัยอธิบายการถ่ายโอนความมั่งคั่งระหว่างรุ่นในรูปแบบต่างๆ ได้แก่ การถ่ายโอนเงิน การติดต่อกับพ่อแม่สูงวัย การดูแลแบบไม่เป็นทางการ และการสนับสนุนทางอารมณ์ เนื้อหาในบทที่ 3 พิจารณาบทบาทของประกันสุขภาพที่มีต่อรายจ่ายรวมด้านสุขภาพ รายจ่ายทางด้านสุขภาพที่เกิดขึ้นจริงที่ไม่ได้ครอบคลุมด้วยประกันสุขภาพ การสูบบุหรี่ การดื่มเครื่องดื่มแอลกอฮอล์ และการออกกำลังกาย เนื้อหาในบทที่ 4 เป็นการสำรวจตัวแปรตามที่เป็นตัวแปรหุ่นทั้งสิ้น 2 ตัว ได้แก่ การประเมินสุขภาพด้วยตนเอง และภาวะสุขภาพ โดยใช้สถานะทางเศรษฐกิจและสังคมทั้งแบบอัตวิสัยและวัตถุวิสัยเป็นตัวแปรอธิบายหลัก วิทยานิพนธ์นี้มีระเบียบวิธีวิจัย คือ เทคนิคของข้อมูลแบบพาเนล เช่น แบบจำลองอิทธิพลตรึงเชิงเส้นแบบที่ใช้ตัวแปรเครื่องมือ แบบจำลองอิทธิพลตรึงความน่าจะเป็นเชิงเส้นแบบที่ใช้ตัวแปรเครื่องมือ และแบบจำลองอิทธิพลตรึงโลจิตแบบที่ใช้ตัวแปรเครื่องมือ โดยได้พิจารณาแก้ไขปัญหาอคติจากการประมาณการ วิทยานิพนธ์นี้พบว่าแบบแผนการอยู่อาศัยแบบที่พ่อแม่สูงวัยอยู่ร่วมกันกับบุตรวัยผู้ใหญ่สามารถทดแทนการถ่ายโอนเงินจากบุตรได้ และส่งผลเชิงบวกต่อความน่าจะเป็นที่พ่อแม่สูงวัยจะได้รับการติดต่อ การดูแลอย่างไม่เป็นทางการ และการสนับสนุนทางอารมณ์จากบุตรวัยผู้ใหญ่ นอกจากนี้ ยังพบว่าประกันสุขภาพเพิ่มรายจ่ายรวมด้านสุขภาพและลดรายจ่ายที่ผู้ป่วยต้องจ่ายเอง ซึ่งชี้ให้เห็นว่าประกันสุขภาพเพิ่มโอกาสในการเข้าถึงบริการสุขภาพและลดภาระทางการเงินของผู้ป่วยไปพร้อมกัน อย่างไรก็ดี ประกันสุขภาพทำให้ความน่าจะเป็นของการสูบบุหรี่ การดื่มเครื่องดื่มแอลกอฮอล์ และการออกกำลังกายเพิ่มขึ้น และสุดท้าย วิทยานิพนธ์นี้พบว่าสถานะทางเศรษฐกิจและสังคมส่งผลกระทบอย่างมีนัยสำคัญต่อสุขภาพของผู้สูงอายุในประเทศจีนในภาพรวม แต่มีระดับที่แตกต่างกันไปตามเพศและช่วงอายุ โดยผลกระทบดังกล่าวมีความอ่อนไหวต่อการนิยามตัวแปรสุขภาพและสถานะทางเศรษฐกิจและสังคม วิทยานิพนธ์นี้ได้เพิ่มพูนความเข้าใจในพฤติกรรมของผู้สูงอายุและบทบาทของครอบครัวในสภาวะที่ประเทศจีนกำลังมีการปฏิรูประบบประกันสังคม

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This thesis investigates (1) the associations between living arrangements and different types of intergenerational transfers from adult children, (2) the associations among health insurance, health behavior and health care utilization, and (3) the associations between different measures of health and socioeconomic status. It uses the latest three waves of the Chinese Longitudinal Healthy Longevity Survey (CLHLS) conducted in 2005, 2008-2009, and 2011-2012, which are nationally representative. Chapter 2 uses both actual living arrangements and the discrepancy between actual and preferred living arrangements as potential determinants of different types of intergenerational transfers, including monetary transfers, contact, informal care, and emotional support. Chapter 3 explores the role of health insurance on total health expenditures (THE), out of-pocket expenditures (OOP), smoking, drinking and exercising. Chapter 4 investigates two dependent dummy variables of self-rated health and functional health and employs subjective and objective measures of socioeconomic status as explanatory variables. Panel-data methods, e.g. fixed-effects instrumental-variable linear models, fixed-effects instrumental-variable linear probability models, and fixed-effects instrumental-variable logistic models, are used, addressing potential endogeneity bias. This thesis finds that co-residence serves as a substitute for monetary transfers and is positively associated with the probability that parents would receive contact, informal care and emotional support from adult children. It also finds that health insurance increases THE and reduces OOP, suggesting that it increases access to health services while minimizing financial burden, and health insurance leads to increased probabilities of smoking and drinking as well as exercising. Finally, the thesis finds that socioeconomic status positively affects both self-rated health and functional health of Chinese older people. The positive impact holds true across different gender and age groups, but it is sensitive to the choice of health and socioeconomic status measures. This thesis provides a better understanding of elderly and the role of the family amidst ongoing social security reforms in China.

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Chapter 1 Introduction

China has the largest population in the world. The population's growth rate has changed over the years. There has been a great transformation in the age structure of the Chinese population during the past 60 years. Immediately after the founding of New China in 1949, the population was relatively young and fast-growing, with the median age of 24 and the population 65 or older accounting for only 6%. The age structure had changed considerably; by 2010, the median age was 35 and the population 65 or older accounted for 8.8%. By 2050, it is expected that the age structure would change dramatically; the median age would approach fifty and approximately 25% of all Chinese people would be at least 65 (United Nations, 2010). Because of the large decline in the population growth rate and the fertility rate as well as an improvement in life expectancy during the past years, China is quickly moving towards becoming an aging society. There have been signs of problems associated with population aging.

China is experiencing significant health transitions with older people living longer but with chronic diseases. Most older adults are at a high risk of health decline both functionally and cognitively (Zhou et al., 2018). Of all groups in society, the elderly are at the greatest risk of incurring high health care expenses. The fifth National Health Service Survey (NHSS) of China, conducted in 2013, demonstrated that the proportion of the elderly who had an outpatient visit in the past 2 weeks was 56.9%, the prevalence rate of chronic diseases was 71.8%, and the annual rate of inpatient visits was 17.9% (Center for Health Statistics and

Information, 2015). These figures were much higher than other groups. International evidence has shown that old people are more likely to suffer from serious illness and become impoverished due to health care expenses (Ekman, 2007). The provision of adequate and good-quality health care services is therefore of great importance (Mendis & Chestnov, 2014). While health behavior modification is an effective approach to control NCDs and to reduce medical expenses among the elderly (Wang et al., 2018), China has a distinct culture such that much more older adults engage in drinking and smoking compared to Western countries (Cheng et al., 2010; H. G. Cheng et al., 2015). In 2018, 26.6% of the Chinese adult population (age 15 and above) and 23.1% of the population aged 65 years and older were smokers (Hu et al., 2019). Drinking by older people is also common in different events in the Chinese culture, e.g. during festivals, celebrations, family reunions and friends' gathering (Wu et al., 2008). In fact, approximately 11.4% of Chinese older adults excessively consume alcohol (WHO, 2015).

Health (and wellbeing) of older people is determined by a host of factors. Socioeconomic status (SES) is increasingly recognized as a short-term and a long-term determinant of health and health behaviors for older people (Everson-Rose et al., 2003; Wang et al., 2018); better SES means a greater ability to purchase health services and health-enhancing goods. However, despite rapid economic growth in the past three decades, a significant proportion of the elderly in China still face socio-economic difficulties. The imposition of mandatory retirement ages, migration from rural areas to urban areas as well as changing family structures pose considerable challenges for older people (Kumar et al., 2016). In particular, as the Chinese government provides limited support, older

people have two main sources of wealth: private transfers (particularly from children) and their own resources, such as pension, income and savings. For many older people, their wealth is insufficient to cover costs of living and health care expenses (Lee & Kim, 2008), leading to impoverishment and socioeconomic disparities (Hu et al., 2011).

The second major determinant of health is government policies, especially health insurance. To enhance access to health services and remove financial barriers to health care (Liu et al., 2012), the Chinese government has developed a universal health insurance system composed of three main programs, including Urban Resident Basic Medical Insurance scheme (URBMI), Urban Employee Basic Medical Insurance scheme (UEBMI) and New Rural Cooperative Medical Insurance Scheme (NRCMS). Initiated in 1998, UEBMI covers urban employees and retired employees and is a mandatory medical insurance scheme. Launched in 2003, NRCMS is a voluntary program targeting people living in all the rural districts. Finally, formulated in 2007, URBMI covers urban residents without formal employment who could enroll voluntarily, including children, the elderly, and unemployed working-age people. UEBMI is mainly financed by payroll taxes from beneficiaries, while NRCMS and URBMI are financed primarily by government subsidies (Qingyue et al., 2015). In general, the list of medical services eligible for reimbursement for NRCMS and URBMI is shorter than UEBMI and the reimbursement rate is lower (Qingyue et al., 2015). Near-universal coverage has been achieved, from only 85% (1.13 billion) of the Chinese population having been covered in 2008 to 97% (1.33 billion) in 2015 (National Health and Family Planning Commission of People's Republic of China, 2016).

These insurance programs have provided fair and affordable health services in China (A. Zhang et al., 2017). Out-of-pocket health expenditures (OOP) appear to have been declining (China National Bureau of Statistics, 2018; China National Health Development Research Centre, 2015). The proportion of OOP relative to total health expenditures declined from 60% in 2001 to 28.4% in 2019 (China National Health Development Research Center, 2020).

Finally, families play an important role, affecting health status and welfare of the elderly (Albertini et al., 2007; Silverstein et al., 2006). More specifically, intergenerational transfers, including monetary transfers, in-kind transfers and time transfers from adult children to older parents, make up a large proportion of the elderly's wealth. Their importance lies partly in the fact that the formal, state-based social support system in China is insufficient. The latest population census in 2010 shows that about 41% of the Chinese older population rely on family members (primarily adult children) as the primary source of income. In-kind transfers and time transfers from adult children can help older parents improve their health status, wellbeing and emotional closeness with their children (Chen et al., 2017).

Nevertheless, intergenerational transfers are not exogenous and may be determined by living arrangements, which in themselves represent a policy concern. In China, the traditional living arrangement is to live with families (Gu et al., 2007; Zimmer, 2005), but since the family structure has undergone changes owing to urbanization, the one-child policy and rapid socioeconomic development (J. Wang et al., 2014), living arrangements have become more complex, with a greater tendency toward more independent living (Gu et al., 2007). These phenomena have

implications for financial wellbeing and, consequently, health of older people.

As the largest developing country with the most aging population in the world, a deeper investigation into China is warranted, as studies related to older people in the country remain sparse (Chen et al., 2017; Silverstein et al., 2006) and existing studies provide mixed results (Lei et al., 2015; Sun, 2002). There are also gaps in the literature. Most existing studies are based on cross-sectional data and do not adequately account for endogeneity bias, suggesting lack of evidence regarding the causality between health and wellbeing, on the one hand, and the factors of interest, on the other. Socioeconomic transitions during the past decades mean that norms are changing (Aboderin, 2004; J. Wang et al., 2014; Whyte & Ikels, 2004; Zhan, 2012) and that a re-investigation of some of the existing research is required.

This thesis uses the latest three waves of the Chinese Longitudinal Healthy Longevity Survey (CLHLS), which are nationally representative. As one of the first large surveys of the oldest old conducted in a developing country, the CLHLS was conducted by Peking University's Center for Healthy Aging and Family Studies, China's National Research Center on Aging, and Duke University, with support from the US National Institute on Aging and the Max Planck Institute for Demographic Research. Face-to-face interviews were conducted with 8,959; 11,161; 20,421; 18,524; 19,863 and 10,188 individuals in 1998, 2000, 2002, 2005, 2008-09 and 2011-2012 respectively. For each wave, survivors were re-interviewed, and deceased interviewees were replaced with new participants. Data used in this study come from the latest three waves, as they contain more complete data on the included variables than

the earlier waves. Only respondents who were 65 or older at the time of the interview, had at least one living child, and were interviewed in at least two waves are included in the sample. For Chapter 2, respondents with missing data on key variables in the analyses and institutionalized participants (n=265) are excluded from the analysis. The final sample consists of 6,896 uniquely identifiable Chinese older adults, including 2,600 respondents who were interviewed in all three waves and 4,296 respondents who were interviewed twice. For Chapter 3, respondents with missing data on key variables used in the analyses (n=232) are excluded from the analysis. The final sample consists of 9,729 uniquely identifiable Chinese older adults, including 3,676 respondents who were interviewed in all three waves and 6,053 respondents who were interviewed twice. For Chapter 4, respondents with missing data on the variables used are excluded. The sample selection process yields the final sample of 24,452 person-year observations with 3,990 respondents interviewed in all three waves and 6,241 interviewed twice.

The objectives of the thesis are to investigate (1) the associations between living arrangements and different types of intergenerational transfers from adult children, (2) the associations among health insurance, health behavior and health care utilization, and (3) the associations between different measures of health and socioeconomic status. Panel-data methods, e.g. fixed-effects instrumental-variable linear models, fixed-effects instrumental-variable linear probability models, and fixed-effects instrumental-variable logistic models, are used, addressing potential endogeneity bias.

The thesis is structured as follows. Chapter 2 investigates the impacts of living arrangements of older people on intergenerational

transfers from their adult children in China. Chapter 3 explores the impacts of health insurance on health care utilization and health behaviors among the aged Chinese population. Chapter 4 considers the effects of socioeconomic status on health of older people in China. Chapter 5 presents concluding remarks and policy suggestions.

Chapter 2 The Impact of Living Arrangements of Older People on Intergenerational Transfers from Their Adult Children in China

2.1 Introduction

In low- and middle-income countries (LMICs), public resources for old-age security are limited and older people rely on intra-family transfers for financial support (Frankenberg et al., 2002; Witvorapong, 2015). Evidence shows that transfers from adult children to older parents are linked with the parents' health (Zhang et al., 2005) and emotional wellbeing (Chen et al., 2014; Cong & Silverstein, 2014) as well as their saving behaviors (Witvorapong et al., 2021). An understanding of how intergenerational transfers are determined is key to the improvement of social welfare and the optimal design of the social security system (Chow, 2000).

In China, old-age support is a serious problem. It has been projected that, by 2050, approximately 25% of the Chinese population would be at least 65, compared to 8.8% in 2010 (United Nations, 2010) and that the old-age dependency ratio would rise from 13 older dependents per 100 working-age people (aged 15-64) in 2010 to 45 by 2050 (Wu & Li, 2014). While significant progress has been made toward establishing a social security system, government-based support remains inadequate. The pension system has a low coverage, with only half of the working-age population having been enrolled (Cai & Cheng, 2014). Also, even though older people are in principle covered by public health insurance, the effective coverage is not universal and geographical inequities in terms of access to health services persist. The sub-optimal coverage leaves older

people financially vulnerable, as they require more health services and shoulder larger medical bills (Wu & Li, 2014).

Transfers from adult children are arguably the most important form of old-age support in China. Monetary transfers account for a significant proportion of income of older parents. The 2010 population census suggests that 41% of the older population identified family members (primarily, adult children) as their main source of income. In-kind transfers and time transfers are similarly prevalent. In 2010, about 33 million older people reported having limitations in daily living activities and almost one-third were dependent on others (primarily, adult children) for functional assistance (Zhang et al., 2014).

Defined as geographical distance between older parents and adult children, living arrangements represent an avenue through which intergenerational transfers take place and they directly determine transaction costs of intergenerational transfers (Silverstein et al., 2007; Witvorapong, 2015). A general hypothesis, which is not always supported by empirical evidence, is that parents who live independently are more likely to lose control over their children's labor income and receive fewer transfers (Aboderin, 2004).

Nevertheless, related studies are sparse in the Chinese context. A plausible reason is that, traditionally, older people live with and reliably receive support from their adult children and, until recently, there has been little deviation from the norm (Gu et al., 2007; Zimmer, 2005). Existing studies provide mixed results. Some studies do not find evidence for a linkage between living arrangements and transfers (Sun, 2002), some find a negative association between living independently and financial wellbeing in old age (Benjamin et al., 2000), while others find

that older parents with children living further away are more likely to receive transfers than those whose children reside in the same county (Lei et al., 2015). Also, most existing studies are cross-sectional and correlational, not accounting for endogeneity bias. This suggests lack of evidence regarding the causal linkage between living arrangements and intergenerational transfers.

The family structure in China is changing. With the rise of urbanization, increasing population mobility, and socioeconomic changes in the past few decades, shifts in familial norms (more specifically, a drop in family orientation) have been observed (Aboderin, 2004; J. Wang et al., 2014; Whyte & Ikels, 2004; Zhan, 2012). There is now a greater tendency for Chinese older adults to adopt independent living and rely less heavily on children for financial means (Meng & Luo, 2008; Palmer & Deng, 2008; Yi & Wang, 2003). These changes complicate decisions regarding living arrangements and undermine the reliability of family-based transfer mechanisms, necessitating a re-investigation.

The purpose of this chapter is to investigate the extent to which different types of transfers from adult children are influenced by living arrangements of older parents in China, using the latest three waves of the Chinese Longitudinal Healthy Longevity Survey (CLHLS). Based on fixed-effects instrumental-variable linear models and linear probability models where potential endogeneity bias is considered, the primary finding of this chapter is that living arrangements impact intergenerational transfers in a complex manner and their relationship depends on the type of transfers considered.

This chapter contributes to the literature in many ways. First, it encompasses a range of intergenerational transfers, including monetary transfers and different types of time transfers, and considers all possible living arrangements, including co-residence and independent living with children in the same city, and independent living with children in different cities. Previous studies have focused on limited measures of living arrangements and transfers (Korinek et al., 2011; Witvorapong, 2015; Wu & Li, 2014; Zimmer, 2005). Second, this chapter introduces preferred living arrangements as a determinant of intergenerational transfers. While the economics literature typically ignores the variable, existing studies in demography, gerontology and sociology have illustrated that it influences health and life satisfaction of older adults (Guan et al., 2015; Kim & Rhee, 1997; Sereny & Gu, 2011). This chapter adds to the ongoing discussion by showing that the variable also impacts transfer behaviors. Finally, this chapter uses panel data and tackles endogeneity bias explicitly. Consequently, it is able to establish a causal relationship between living arrangements and intergenerational transfers more credibly than studies using cross-sectional data and/or not using an IV approach (Chen et al., 2017).

The chapter is structured as follows. Section 2 discusses more findings in the related literature. Section 3 describes data, variables and the empirical strategy. Section 4 provides results. The chapter ends with a discussion and conclusions in Section 5.

2.2 Literature Review

Defined as the act of proffering money, material goods, or time across different generations within the same family, intergenerational transfers may occur throughout the life course (Witvorapong, 2015). Focusing specifically on the period in which parents are older and children are working-age adults, intergenerational transfers can be made 'downstream' from parents to children. The phenomenon is more commonly observed in high-income countries than in LMICs. For example, it has been estimated that more than one-third of older parents offer their children money in the U.S. (Hurd et al., 2007) and, in Poland, it has been found that parents provide financial help to children with low income (Cox et al., 1997). Transfers can also be 'upstream', made by children to older parents. This type of transfers occurs more frequently in LMICs. For example, in 2011, it was estimated that 84% of older parents in Thailand received monetary or in-kind transfers from their children (Witvorapong, 2015), while, in China, remittances from adult children to older parents take place regularly (Li et al., 2010). In general, the literature suggests that upstream intergenerational support is critical to financial wellbeing of older people especially in Eastern and Southeastern Asia (Ofstedal et al., 1999; Peng & She, 2018; Witvorapong, 2015).

Intergenerational transfers and living arrangements are closely linked. Bengtson and Roberts (1991) pointed out that the geographic proximity between parents and adult children constitutes a major part of the "opportunity structure for interactions" that influences intergenerational transfers. In general, it is expected that there is an inverse relationship between intergenerational transfers and the distance between the residential locations of parents and adult children (Folbre,

1994). The relationship coincides with the rise of urbanization with industrialization, which facilitates out-migration of adult children, resulting in a decrease in family-oriented traditions and values (Aboderin, 2004).

The influence of living arrangements on intergenerational transfers has been explored in China. However, the conclusions are inconsistent because of the differences in datasets and methodologies used. Benjamin et al. (2000) used household data collected in Hebei and Liaoning provinces and showed that older people who did not live in an extended household were worse off in financial terms than those who lived with their children. Sun (2002) utilized data collected in Baoding city in 1994 and found that the probability of receiving monetary support from adult children was not statistically associated with non-residence of older parents. More recently, employing the China Health and Retirement Longitudinal Study (CHARLS), Lei et al. (2015) discovered that older parents who lived in the same county as their adult children received a lower amount of monetary transfers than those who lived in different counties. The lack of consensus among studies in China implies that knowledge gaps remain.

2.3 Methods

2.3.1 Empirical Model

The outcome of interest is the receipt of intergenerational transfers by older parents. In this chapter, intergenerational transfers (*IGTF*) are represented by four variables. The first variable, $IGTF^{(1)}$ represents net monetary transfers. It is a continuous variable and defined as the amount

of money that older parents received from their adult children minus that given to their adult children in the past year. It is based on questions regarding upstream and downstream transfers between older parents and their sons and daughters in the survey.[1] The second variable, $IGTF^{(2)}$, represents contact. It is a dummy variable that is based on the following question: "Do all of your children, who live with you or live elsewhere, frequently visit you?" It takes the value of 1 if at least one child was reported to pay frequent visits, and 0 otherwise. The third variable, $IGTF^{(3)}$, is a measure of informal care. It is drawn from the following question: "Who is the primary caregiver when you need assistance in bathing, dressing, toileting, indoor transferring, continence, and eating?" It is defined as a dummy variable that is equal to 1 if adult children were identified as the primary caregiver, and 0 otherwise. The fourth and final variable, $IGTF^{(4)}$, denotes emotional support that older parents receive from their children. It is based on the following three questions: "To whom do you usually talk most frequently in daily life?", "To whom do you talk first when you need to share some of your thoughts?", and "Who do you ask first for help when you have problems/difficulties?". The variable is defined as a dummy variable, equal to 1 if adult children were identified as the answer to at least one of the questions, and 0 otherwise.

Since intergenerational transfers are represented by both continuous and discrete variables, two models are used. For $IGTF^{(1)}$, which is a continuous variable, a linear model with individual and time fixed effects

1 These four questions are as follows. How much did you receive from your son(s) or daughter(s)-in-law both living and not living with you? How much did you receive from your daughter(s) or son(s)-in-law both living and not living with you? How much money (including cash and value of materials) did you give to your son(s) or daughter(s)-in-law both living and not living with you? How much money (including cash and value of materials) did you give to your daughter(s) or son(s)-in-law both living and not living with you?

and with heteroskedasticity-adjusted standard errors is adopted. For $IGTF^{(2)}$, $IGTF^{(3)}$, and $IGTF^{(4)}$, which are binary variables, a linear probability model (LPM) with individual and time fixed effects and with heteroskedasticity-adjusted standard errors is adopted. The two-way fixed-effects linear model and the two-way fixed-effects LPM share the same specification:

$$IGTF_{it}^{(k)} = \beta_0 + \sum_{m=2}^{3} \beta_m ALA_{it}^{(m)} + \beta_3 DLA_{it} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \qquad (1)$$

Superscript *k* corresponds to the four measures of *IGTF* above, with *k*=1 referring to the amount of net monetary transfers received by the i^{th} individual at time *t*, and *k*=2, 3 and 4 referring to whether the i^{th} individual received frequent contact, informal care, or emotional support from adult children at time *t* respectively. The primary explanatory variables are two measures of living arrangements: actual living arrangements (*ALA*) and the discrepancy between actual and preferred living arrangements (*DLA*). *X* is a vector of other explanatory variables. Individual fixed effects, α_i, and time (survey-wave) fixed effects, λ_t, are also included to control for unobserved time-invariant characteristics and temporal variations in intergenerational transfers respectively. Finally, ε_{it} represents the error term.

The variable representing actual living arrangements of older parents, *ALA*, is based on three sets of questions in the survey: “Co-residence with whom?”; “How many people are there in your household?”; and “How far is the residential distance between you and your 1st -11th child?”. It is defined as a categorical variable. It takes the value of 1 if the older parent lived alone (or with spouse) and all of his/her children lived in different cities, the value of 2 if the older parent lived alone (or with spouse) and at

least one of his/her children lived in the same city, and the value of 3 if the older parent lived with adult children. The notation related to *ALA* in Equation (1) refers to the fact that the variable is converted into two variables: $ALA^{(2)}$, a dummy variable that is equal to 1 when *ALA*=2 is true and 0 otherwise, and $ALA^{(3)}$, another dummy variable that is equal to 1 when *ALA*=3 is true and 0 otherwise. Here, living alone with children in different cities, *ALA*=1, serves as the base category. The other living arrangement variable, *DLA*, is based on questions regarding living arrangements that were preferred by older parents.[2] It takes the value of 1 if there was a discrepancy between the preferred and the actual living arrangements and 0 if the preferred and actual living arrangements were consistent.

The variables representing living arrangements are likely to be endogenous. While the literature review above suggests that living arrangements affect intergenerational transfers, the reverse may also be true. Boyd (1991) argued that intergenerational transfers influence financial constraints and the ability of the elderly to afford independent living. To tackle potential endogeneity bias, this chapter adopts a two-stage approach by first regressing each of the living arrangement variables on instrumental variables (IVs) and using the predicted values from the first-stage regressions to replace the living arrangement variables. Following Wu and Li (2014), the IVs include three dummy

2 DLA is based on two questions: current and preferred living arrangements. They share the same responses, where the values of 1, 2 and 3 represent the fact that the older parent lived alone (or with spouse) with all of his/her children in different cities, that the older parent lived alone (or with spouse) with at least one of his/her children in the same city, and that the older parent lived with adult children respectively. The number of possible combinations when comparing the two variables is therefore 3*3 = 9, three of which is coded as 1 for DLA when the responses are the same, and 0 otherwise.

variables, one representing whether the respondent was disabled, one representing whether he/she had been laid-off or fired or had closed his/her business before turning 60, and the other representing whether the respondent had experienced an accident that limited his/her daily activities. More specifically, $ALA^{(2)}$, $ALA^{(3)}$, and *DLA* are regressed on these IVs in fixed-effects LPM models in the first stage and their predicted values are used in place of their actual values in fixed-effects linear or LPM models in the second stage. The second-stage regression is given by:

$$IGTF_{it}^{(k)} = \beta_0 + \sum_{m=2}^{3} \beta_m \widehat{ALA}_{it}^{(m)} + \beta_3 \widehat{DLA}_{it} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \qquad (2)$$

Although LPM is usually criticized for producing predicted probability values that are not within the [0,1] interval, the use of fixed-effects instrumental-variable LPM models is justifiable. The empirical strategy in this chapter involves endogenizing dummy variables ($ALA^{(2)}$, $ALA^{(3)}$, and *DLA)* in models where some of the dependent variables are binary, namely $IGTF^{(2)}$, $IGTF^{(3)}$, and $IGTF^{(4)}$. Existing studies have shown that LPM based on the two-stage approach, which is adopted here, provides a reasonable method of estimating a binary choice model with binary endogenous regressors. Angrist (2001) argued that LPM and discrete choice models, including logit and probit, produce consistent results in terms of statistical inference. Carrasco (2001) suggested that LPM has an advantage over discrete choice models in that the standard two-stage linear IV method is applicable in the former but may lead to inconsistency in the latter. Finally, Witvorapong et al. (2021)

demonstrated empirically that LPM and discrete-choice modeling with endogenous dummy regressors produce qualitatively similar results.[3]

In addition to living arrangements, the regression specification includes other explanatory variables, captured by vector *X*. In general, intergenerational transfers are hypothesized to be influenced by what Deindl and Brandt (2011) call 'needs' and 'opportunities', which loosely refer to characteristics of recipients and donors respectively. Parental characteristics, including age, household size, health, and location of residence, have been considered (Cong & Silverstein, 2008; Gu et al., 2009; Knodel & Ofstedal, 2002; Korinek et al., 2011; Li & Wu, 2019; Zimmer, 2005). Children's characteristics, such as the ratio of female versus male children and the percentage of children living nearby and in different cities, have also been explored (Lei et al., 2012; Rosenzweig & Wolpin, 1993; Wu & Li, 2014). Particular attention has been paid to wealth of both parents and adult children (Cox et al., 2004; Li et al., 2010), as they represent the need for and costs of intergenerational transfers, although it should be noted that studies in LMICs tend to focus on wealth of older parents alone, as information on each child is not well documented (Cai et al., 2006; Witvorapong, 2015). In this chapter, all of the variables discussed here are included to reduce specification bias.

3 Since the purpose of this study is not forecasting but exploring the influence of x on a binary dependent variable, the problem of forecasts of LPM not restricted to the (0, 1) interval is not the primary concern in this study. Instead, the more important problem is endogeneity bias. Endogenous explanatory variables are binary and Heckman and MaCurdy (1985) indicated that LPM is a simple alternative specification when dummy endogenous explanatory variables are present in a binary choice model.

2.3.2 Variables and Descriptive Statistics

Table 1 presents the definitions and descriptive statistics of variables pertaining to the final sample. The dependent and key explanatory variables are considered first. To observe real changes over time and allow for a log transformation in the regression analysis, the amount of net monetary transfers was deflated by the consumer price index using the base year of 2005 and negative values, which accounted for less than 3%, were converted into zero. As a result, the average amount of net monetary transfers across all three waves was found to be 1558.184 RMB, falling within the range of 0-110,000 RMB. The percentage of older parents who reported having been in close contact with their adult children was 87.9%. Approximately 64.7% and 67.1% of the sample reported having received informal care and emotional support from adult children respectively. The majority of the sample (71.76%) co-resided with their children, while 25.26% lived alone (or with spouse) with children in the same city. Approximately 28.58% of older parents changed their living arrangements across all three waves. Interestingly, approximately 69.90% of older parents reported that they preferred a different living arrangement from the one they were currently in. More specifically (data not reported in the table), Chinese older people expressed a desire to live more independently, with 61.83% and 10.60% identifying co-residence and living further away from their children as their preferred choice of living arrangement respectively, compared to the actual ratios of 71.76% and 2.98%. Approximately 42.36% of the sample reported that they preferred living alone even though they currently co-resided with children while 10.91% and 8.17% reported that they

preferred co-residence when in fact they lived alone, with children in different cities and with children in the same city respectively.

The table shows time-varying characteristics, which are included in the analysis. Time-varying parental characteristics include the respondent's age (*AGE*), a dummy variable representing whether the respondent was married (*MARR*), whether his/her location of residence was in a rural area (*RUAL*), and the number of household members excluding the respondents themselves (*CORES*). The table suggests that, within the range of 65-116, the average age of the sample was 83.969, with 47.4% being married and 54% living in a rural area. With the minimum and maximum values of 0 and 32, the mean number of co-residents was 2.771. To capture the socioeconomic status, two variables are included. *PDWK* is a dummy variable representing whether the respondent was engaged in paid work. The other variable is *INCM*, which is the annual household income per capita in the last 12 months in 2005 RMB. Approximately, 5% of the sample reported currently working and the average household income per capita was 15,897.250 RMB, with the minimum and maximum values being 0 and 98,888 RMB. Variables capturing health include *ADL* and *IADL*, which represent the number of limitations regarding activities of daily living and instrumental activities of daily living ranging between 0-6 and 0-8 respectively.[4] *CHRDS*, which is a dummy variable representing the presence of chronic diseases, is also considered. The average numbers of ADL and IADL limitations were 0.544 and 3.012 respectively, and 39.3% of the sample reported having

4 ADLs include bathing, dressing, indoor transferring, toileting, eating and incontinence. IADLs include the ability to visit neighbors, to go shopping by oneself, to cook a meal by oneself, to wash clothing by oneself, to walk 1km by oneself, to lift 5kg, to crouch and stand 3 times, and to take public transportation.

chronic diseases. These statistics indicate reasonably good health. Finally, time-varying children's characteristics include the shares of children living nearby (*CLN*) and children living in different cities (*CLD*). The table suggests that 67.9% and 9.1% of adult children of respondents in the sample lived in the same or in different cities as their parents respectively.

Finally, Table 1 contains time-invariant characteristics, which are not included in the analysis but are presented to provide a better description of the sample. They are *SEX* (gender, equal to 1 if the respondent was female), *EDU* (years of completed schooling), *ETHNIC* (ethnicity, equal to 1 if the respondent was Han Chinese), *CHILD* (the number of children), *AGRI* (the respondent's occupation before the age of 60, equal to 1 if it was agriculture, forestry, animal husbandry, and fishery), and *MCHL* (share of male children). Approximately, 54.6% of the sample were female, 93.6% were Han Chinese and 64.6% worked in agriculture before the age of 60. Within the range of 0-25, the average level of education in the sample was 2.398 years. The mean number of children was 4.54 and approximately, 56.3% of those children were male. The minimum and maximum numbers of children were 1 and 16 respectively.[5]

It should be pointed out that the household identifier was unique in the final sample and none of the respondents had migrated out of their cities during the three waves of the survey, suggesting that household-level and city-level fixed effects are not required. Overall, Table 1 shows that behaviors and characteristics of the sample were consistent across waves and their slight variations in terms of magnitude support the use of

5 The respondents were older than to be subjected to the one-child policy, which was introduced in 1980.

panel data in order to capture the dynamics of transfer behaviors over time.

Table 1 Descriptive Statistics and Definitions of All Variables by Survey Wave

Variable	Definition	Survey Wave			
		2005	2008	2011	All Waves
1. Dependent Variables					
IGTF$^{(1)}$=*NMIF*	Net monetary transfers from children (in 2005 RMB)	1336.515	1638.057	1677.345	1558.184
		(4056.237)	(3691.449)	(4939.288)	(4189.734)
IGTF$^{(2)}$=Contact	Contact from children (=1)	0.862	0.881	0.893	0.879
		(0.345)	(0.323)	(0.309)	(0.326)
IGTF$^{(3)}$=	Informal care from children (=1)	0.625	0.651	0.663	0.647
Informal Care		(0.484)	(0.477)	(0.473)	(0.478)
IGTF$^{(4)}$=Emotion Support	Emotional support from children (first talk, first share or first help=1)	0.662	0.682	0.666	0.671
		(0.473)	(0.466)	(0.472)	(0.470)
2. Explanatory Variables					
Key Explanatory Variables					
ALA	Actual living arrangement				

ALA(1)	=1 if living alone (or with spouse) with all children in different cities (Reference group)	3.55%	2.78%	2.70%	2.98%
ALA(2)	=1 if living alone (or with spouse) with at least one child in same city.	24.81%	24.72%	26.50%	25.26%
ALA(3)	=1 if co-residing with children.	71.64%	72.50%	70.80%	71.76%
DLA	= 1 if actual and preferred living arrangements inconsistent.	0.718	0.714	0.656	0.699
		(0.450)	(0.452)	(0.475)	(0.459)
Parental Characteristics					
A. Demographics					
*SEX**	Female (=1)	0.542	0.551	0.543	0.546
		(0.498)	(0.497)	(0.498)	(0.498)
AGE	Age (years)	81.232	84.732	85.601	83.969
		(11.218)	(11.649)	(11.246)	(11.547)
MARR	Married (=1)	0.504	0.454	0.471	0.474
		(0.500)	(0.498)	(0.499)	(0.499)
*ETHNIC**	Han Chinese (=1)	0.931	0.937	0.939	0.936
		(0.253)	(0.243)	(0.239)	(0.245)

RUAL	Rural (=1)	0.589	0.588	0.422	0.540
		(0.492)	(0.492)	(0.494)	(0.498)
*EDU**	Education (years)	2.407	2.347	2.464	2.398
		(3.676)	(3.619)	(3.657)	(3.647)
*CHILD**	Number of children	4.629	4.548	4.461	4.546
		(2.138)	(2.115)	(2.018)	(2.095)
CORES	Number of co-residents	2.817	2.702	2.827	2.771
		(1.816)	(1.793)	(2.093)	(1.892)
B. Socioeconomic Status					
*AGRI**	Agriculture (=1)	0.629	0.647	0.664	0.646
		(0.483)	(0.478)	(0.473)	(0.478)
PDWK	Paid work (=1)	0.062	0.053	0.032	0.050
		(0.241)	(0.225)	(0.176)	(0.217)
INCM	Income (in 2005 RMB)	4979.040	17850.225	24653.762	15897.250
		(6863.659)	(16294.885)	(21374.344)	(17635.488)
C. Health					
ADL	# of ADL limitations	0.304	0.499	0.851	0.544

		(0.964)	(1.318)	(1.659)	(1.357)
IADL	# of IADL limitations	2.371	3.162	3.437	3.012
		(2.876)	(3.194)	(3.264)	(3.155)
CHRDS	Chronic diseases (=1)	0.364	0.378	0.444	0.393
		(0.481)	(0.485)	(0.497)	(0.488)
Children Characteristics					
*MCHL**	Male children (%)	0.565	0.565	0.560	0.563
		(0.264)	(0.263)	(0.261)	(0.263)
CLN	Children living nearby (%)	0.665	0.675	0.699	0.679
		(0.302)	(0.301)	(0.295)	(0.300)
CLD	Children living in different cities (%)	0.100	0.088	0.086	0.091
		(0.201)	(0.191)	(0.188)	(0.193)
	Observations	4,752	68,96	4,744	16,392

Sources: CLHLS, 2005, 2008 and 2011.

Note: Variables with * are time-invariant and excluded from the empirical analysis.

2.4 Empirical Results

Prior to performing the empirical analysis, several tests are conducted to ensure that the models used are appropriate. First, the collinearity problem is tested using a correlation matrix and variance inflation factors (VIF). The results suggest that none of the correlation coefficients among all time-varying explanatory variables exceeds 0.65, and the maximum VIF value for any variable in any model is 2.34, much less than the suggested cut-off of 10. This chapter concludes that there are no collinearity problems. Second, Breusch-Pagan Lagrange Multiplier (BP-LM) and Hausman tests are performed on all models[6]. At the 1% level of significance, the BP-LM tests suggest that panel data techniques are appropriate and the Hausman tests suggest that fixed-effects modeling is more appropriate than the random-effects one for all models, regardless of which dependent variable and which living arrangement variable are considered. Finally, the use of the three IVs is also justified. Over-identification tests are performed, using Sargan tests based on residual terms in the second stage of each model. The excluded instruments are shown to be uncorrelated with each of the error terms, suggesting that the instruments are valid. Detailed test results are available upon request.

Tables 2 and 3 present results of fixed-effects (FE) linear modeling in the case of net monetary transfers and linear probability modeling in the case of the other three dichotomous dependent variables, with

6 For each dependent variable, there are 3 models. Since there are 4 dependent variables. The total number of regressions is 3*4 = 12.

heteroskedasticity-adjusted standard errors.[7] The value of 1 is added to the amount of net monetary transfers before the variable is log-transformed to ensure that respondents whose net monetary transfers are equal to zero are kept in the estimation sample. The exercise does not significantly change the results; dropping or keeping such respondents produce very similar estimates.

Only coefficient estimates of the main explanatory variables are shown to conserve space. In each table, Panel A shows FE estimates without endogeneity correction, while Panel B shows results from the FE model that incorporates all three instrumental variables discussed above (FE-IV). For each outcome of interest, three models are estimated. Model 1 considers actual living arrangements, with living alone with all children in different cities (i.e., no children in the same city) being the reference category. Model 2 considers only the discordance between actual and preferred living arrangements, while Model 3 includes both the actual living arrangements and the discrepancy. All models pass the overall significance F-test at the 5% level and include time fixed effects. In general, it can be seen that the three models provide consistent results. With the exception of emotional support, for each type of intergenerational transfers considered, variables that are statistically significant in Model 1 or 2 are also statistically significant in Model 3 and maintain the same sign.

7 This study has also conducted fixed-effects logit models with IVs and found that they produce conclusions that are consistent with fixed-effects LPM with IVs. Estimation results are available upon request.

Table 2 Fixed-Effects Linear Regression Results for Log Net Monetary Transfers

Variables	Model 1	Model 2	Model 3
Panel A: FE w/o IV			
$ALA^{(2)}$	-0.04217		-0.0679
	(0.0786)		(0.0794)
$ALA^{(3)}$	0.0132		-0.0139
	(0.0934)		(0.0941)
DLA		0.0553*	0.0747**
		(0.0319)	(0.0328)
Panel B: FE w/ IV			
$\widehat{ALA}^{(2)}$	0.0415***		0.0382**
	(0.0097)		(0.0085)
$\widehat{ALA}^{(3)}$	-0.379***		-0.2971***
	(0.0085)		(0.0075)
$\widehat{DLA}$		0.0404***	0.0298*
		(0.0120)	(0.0155)
Time-varying characteristics		Yes	
Time fixed effects		Yes	
Overall significance F-test (5% level)		Yes	
N		13,628	

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

Tables 2 and 3 consistently show that the FE and FE-IV models (Panels A and B) produce different estimates and suggest that, without endogeneity correction, the regression analysis could be misleading. With regard to net monetary transfers, the preferred FE-IV models show that, compared to living alone with all children in different cities, co-residence

and living alone with children in the same city negatively and positively influence net monetary transfers respectively. They also show that the difference between the living arrangement that older parents actually had and that which they would have preferred is positively associated with the receipt of monetary transfers from adult children.

Table 3 pertains to the presence of close contact, the receipt of informal care, and the receipt of emotional support. The three outcomes represent different forms of time transfer from adult children to older parents. The FE-IV models demonstrate that co-residence statistically and positively impacts all three types of time transfer. Living alone with children in the same city positively affects the probability of contact but is not statistically different from the reference category of living alone with children in different cities regarding informal care. The discrepancy between actual and preferred living arrangements is positively associated with contact and negatively associated with informal care. The associations between living alone with children in the same city and the discrepancy, on the one hand, and emotional support, on the other, are inconclusive as they are inconsistent across specifications.

Overall, the results suggest that the relationship between living arrangements and intergenerational transfers is complex. While co-residence is negatively associated with transfers of money and positively associated with transfers of time, the reverse is true for living alone with all children in different cities. On the other hand, living alone with children in the same city is positively associated with transfers of money, but its effects are not consistent across different types of time transfers. The comparison suggests that transfers are differentially associated with

living arrangements and the differences may be explained by the idea of transaction costs.

Transaction costs of providing contact and emotional support depend on living arrangements. They are likely to be lower if adult children and parents live in close proximity, compared to if they live further apart. This chapter shows that co-residence and independent living with children in the same city lead to comparable probabilities that older parents would be in close contact with and receive emotional support from adult children, and these probabilities are statistically higher than those associated with living alone with children in different cities. The finding is consistent with Zimmer (2005), who found that co-resident parents have ample opportunities to interact with adult children and are able to receive emotional support more easily, and with Chen et al. (2017), who demonstrated that, to Chinese adult children, living in the same city as one's parents is a close substitute with co-residence, affording them an opportunity to offer support when needed.

Informal care is different from the other types of time transfers. This chapter finds that the only living arrangement that is consistently positively associated with informal care is co-residence. Living alone with children nearby, which is positively linked with emotional support and close contact, is no longer consistently statistically significant here. The difference may be explained by the nature of informal care vis-à-vis contact and emotional support. The former involves an intense level of time provision and a strong emotional connection, necessitating co-residence, while the latter does not.

With the prevalence of banking and information technology, transaction costs of monetary transfers are likely to similarly low, regardless of the geographical distance between the recipient and the donor, and therefore living arrangements should not drastically impact monetary transfers. The fact that monetary transfers are strongly and negatively associated with co-residence and positively associated with living alone with children in the same city implies that transaction costs may not be the main driving force behind the finding. Instead, it is possible that, in a household with many children, there is a division of labor among adult children regarding support for older parents; Lei et al. (2012) observed a tendency for Chinese adult children to substitute monetary transfers with co-residence and vice versa.

Finally, the above results suggest that the discrepancy between actual and preferred living arrangements is a potential determinant that should be further explored in future studies. Based on the sparse literature (Guan et al., 2015; Kim & Rhee, 1997; Sereny & Gu, 2011), the variable represents the inability of older parents to have their preferences realized and may imply reluctant reliance on adult children, which in turn influences their receipt of transfer.

Table 3 Fixed-Effects LPM Regression Results for Contact, Informal Care, and Emotional Support

Variables	Dependent Variable: Contact			Dependent Variable: Informal Care			Dependent Variable: Emotional Support		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Panel A: FE w/o IV									
$ALA^{(2)}$	0.00962		0.00830	0.0255		0.0240	-0.021		-0.0375
	(0.0122)		(0.0123)	(0.026)		(0.026)	(0.021)		(0.031)
$ALA^{(3)}$	-0.00223		-0.00347	0.182***		0.178***	0.0515**		0.0466
	(0.0145)		(0.0146)	(0.027)		(0.030)	(0.025)		(0.035)
DLA		0.00679	0.00457		0.0391***	0.0319***		0.0506***	0.0505***
		(0.0047)	(0.0049)		(0.009)	(0.0008)		(0.010)	(0.001)
Panel B. FE w/ IV									
$\widehat{ALA}^{(2)}$	0.4103**		0.5150**	0.290*		0.4239	-0.294*		0.2436**
	(0.1616)		(0.1671)	(0.1707)		(0.3458)	(0.1786)		(0.1503)
$\widehat{ALA}^{(3)}$	0.3387**		0.4223**	0.282***		0.3358***	0.265**		0.236**
	(0.1489)		(0.1365)	(0.0607)		(0.0479)	(0.1669)		(0.1537)

$\widehat{DLA}$	0.4890***	0.3897**	-0.132***	-0.1165***	-0.258**	0.2136
	(0.1407)	(0.1448)	(0.026)	(0.027)	(0.1515)	(0.1705)
Time-varying X	Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes	
F-test (5% level)	Yes		Yes		Yes	
N	13,580		13,620		13,450	

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

2.5 Concluding Remarks

Using three waves of the nationally representative CLHLS conducted in 2005, 2008-2009, and 2011-2012, this chapter investigates the effect of living arrangements on intergenerational transfers in China. Outcomes of interest include net monetary transfers, contact, informal care and emotional support that adult children provide to older parents and the main explanatory variables include actual living arrangements as well as the discrepancy between actual and preferred living arrangements. Different measures of living arrangements and intergenerational transfers are used to test the robustness of their relationship. Furthermore, endogeneity bias is explicitly accounted for through fixed-effects instrumental-variable regression modeling.

This chapter offers several conclusions. First, it is found that co-residence serves as a substitute of monetary transfers and is positively linked to all forms of time transfers (i.e., contact, informal care and emotional support). The conclusion is consistent with existing studies, which suggest that transaction costs of time transfers are lower under co-residence than other living arrangements (Bengtson & Roberts, 1991; Silverstein et al., 2007; Witvorapong, 2015). Second, living alone with children residing in the same city positively affects net monetary transfers and contact but does not exert statistically significant effects on informal care. A plausible explanation is that the three outcomes are different. Monetary transfers and contact represent forms of old-age support that are predominantly material, requiring limited emotional interactions between parents and adult children. On the other hand, informal care involves non-material exchanges (e.g. spiritual connection, communications, and attention) that take place frequently. Compared to

children living further away, children living close to but separately from parents may find it less costly to provide monetary transfers and contact but the same cannot be said regarding informal care. Finally, the chapter demonstrates that the discordance between actual and preferred living arrangements is an important determinant of intergenerational transfers. It is found to be positively associated with the receipt of monetary transfers and contact and negatively associated with that of informal care. As discussed earlier, the discordance mostly reflects the desire of aged Chinese parents to live independently when, in actuality, they rely on adult children (Meng & Luo, 2008; Sung, 1998). The variable's negative association with informal care may indicate the physical ability of older parents who prefer living independently and its positive associations with monetary transfers and contact may indicate the lack of resources to follow through with the plan.

Overall, this chapter illustrates that family support remains crucial to the wellbeing of older people in China, even though the country has undergone drastic socioeconomic transitions and family values are changing (LaFave, 2017; Zhan, 2012). Amidst ongoing social security reforms and concerns regarding the availability of long-term care (Dorfman et al., 2013; Peng, 2011; Wong & Leung, 2012), it is important to understand the role of the family and what determines its intensity, as it should be factored into the policy design. This chapter identifies living arrangements as an important determinant of intergenerational transfers in China and illustrates that their relationships are complex and vary with types of transfer considered. It also shows that there is already a desire for independent living among Chinese older people, suggesting that, in the near future, the family may not be as predominant a source of old-age

wellbeing and that the government may need to accelerate the process of social security reforms.

Chapter 3 Impacts of health insurance on health care utilization and health behaviors among older people in China

3.1 Introduction

China is rapidly aging. According to the 2010 census, approximately 13.26 percent of the population were 60 years or older (China National Bureau of Statistics, 2011). In 2050, this figure is expected to reach 30 percent, which would amount to 437 million older people (Population Division & The Department of Economic Social Affairs, 2013). The growth of the aged population coincides with socioeconomic transitions, which have brought about changes in health and lifestyles of the Chinese population. In the past three decades, there has been a shift toward a more widespread prevalence of non-communicable diseases (NCDs) (Cook & Dummer, 2004) in parallel with a substantial reduction in the rate of mortality, with life expectancy rising from 67.9 years in 1981 to 72.5 years in 2012 (World Health Organization, 2013) .

The shift toward NCDs is attributable primarily to unhealthy behaviors among adults, which carry over to when they become older (Shi et al., 2008). For example, in 2018, 26.6% of the Chinese adult population (aged 15 and above) were smokers and the prevalence among the aged population (aged 65 and older) was around 23.1% (Hu et al., 2019). Also, approximately 11.4% of Chinese older adults were reported to consume alcohol excessively (World Health Organization, 2016). One of the consequences is increased health care needs throughout the life course. Consistent with the global experience, national health expenditures in China have been rising more than proportionately with national income (Gerdtham & Jönsson, 2000; Newhouse, 1992). During

1978-2008, the average annual growth rate of per capita health expenditure stood at 10.35% while the average annual growth rate of per capita income was 8.61% (China National Bureau of Statistics, 2010). From 1978 to 2017, the total health expenditure (THE) increased in nominal terms by 476 times and accounted for 6.36% of the country's GDP in 2017 (Zheng et al., 2020) .

However, out-of-pocket health expenditures (OOP) appear to have been declining in China (China National Bureau of Statistics, 2018; China National Health Development Research Centre, 2015). The ratio of OOP payment relative to THE decreased from 60% in 2001 to 28.4% in 2019 (China National Health Development Research Center, 2020). The Chinese government has conducted a series of health reforms with a view to providing affordable health care for all (Liang & Langenbrunner, 2013). Different types of public health insurance have been launched. The three main schemes are Urban Employee Basic Medical Insurance (UEBMI), which is financed by payroll taxes, and Urban Resident Basic Medical Insurance (URBMI) and New Rural Cooperative Medical Scheme (NRCMS), which are funded through government subsidies. The UEBMI is a mandatory insurance program for employed individuals in the formal sector (Huang & Gan, 2017; Zhou et al., 2021). Enrollment in the URBMI and NRCMS schemes is voluntary (Li & Zhang, 2013). The former covers urban residents without formal employment, including children, the elderly as well as unemployed urban residents, while the latter covers the population living in all rural districts (Liu & Zhao, 2014).

The above discussion suggests the presence of complex interrelationships among health insurance, medical care utilization and health behaviors among the population in general and the aged population

in particular. Older people in China have been observed to engage in unhealthy habits, have substantial risks of illnesses, and bear a large burden of health care costs (Prince et al., 2015). While there is evidence that the introduction of public health insurance has improved access to health services and income equality for older people in China (Liu et al., 2012), it remains unclear whether insurance coverage also induces changes in health care utilization and health behaviors in such a way that it may partially offset the positive effects of health insurance on population health. More specifically, the economics literature has emphasized the possibility that insurance coverage may lead to increased use of (more expensive) health services as well as reduced consumption of preventive care and a shift toward less healthy lifestyles, which increase the probability that one would fall ill (Jowett et al., 2004).

In this chapter, using three waves of the nationally representative Chinese Longitudinal Healthy Longevity Survey (CLHLS) in 2005, 2008, and 2011, health behaviors and health care utilization among older people are examined with health insurance as the key independent variable. Existing studies on the topic based on older people in China are limited (Gao et al., 2007; Liu et al., 2015; A. Zhang et al., 2017), and only few studies investigate the impact of health insurance on both health behaviors and health care utilization (Dong et al., 2018). Also, although the literature has grown in recent years, most studies are based on non-representative and/or cross-national data (Li & Zhang, 2013; You & Kobayashi, 2011). This chapter uses richer, nationally representative panel data and explores both health behaviors and health care utilization.

The chapter is structured as follows. Section 2 describes the literature review. Section 3 introduces the data and empirical model. Section 4 presents the results and section 5 presents concluding remarks.

3.2 Literature Review

The economics literature has extensively explored the impacts of health insurance on health behaviors and health care utilization. Dave and Kaestner (2009) examined the effects of Medicare on health behaviors of older people in the US, and found strong evidence for ex-ante moral hazard for men but not for women, where ex-ante moral hazard is defined as the fact that health insurance coverage leads to lower investments in self-protective behaviors (prior to policyholders becoming sick) (Jowett et al., 2004). However, Card et al. (2008) investigated the influence of Medicare on preventive behaviors, such as weight, exercise and smoking, among older people in the US and concluded the relationship was not statistically significant.

Reducing financial barriers, health insurance coverage also leads to changes in health services utilization, which is often represented by total health expenditure (*THE*) and out-of-pocket health expenditure (*OOP*) in the literature. The evidence is inconsistent globally. In general, existing studies find that, for high-income countries, individuals with health insurance have lower total health expenditures and out-of-pocket expenditures than their uninsured counterparts (Waters et al., 2004), while the evidence is less clear-cut in the context of low- and middle-income countries where insurance benefits tend to be less generous (Asgary et al., 2004; Trujillo et al., 2005; Wagstaff & Lindelow, 2008).

For example, Newhouse (1993) showed that the level of insurance coverage was positively associated with health care spending in US. On the other hand, Erlangga et al. (2019) found that public health insurance had no statistically significant effect on *OOP* in Indonesia, while Axelson et al. (2009),Wagstaff (2010) and Nguyen (2012), all of which explored Vietnam's Health Care Fund for the Poor, provided conflicting conclusions regarding the Fund's impact on *OOP*.

The influence of health insurance on health behaviors and health care utilization has been explored in China. Van Dalen (2006)found a positive association between health insurance and healthy behaviors in China but did not conclude that the relationship was causal, suggesting the potential existence of a positive self-selection in the demand for health insurance whereby those having healthier lifestyles are also more likely to have health insurance. Fan et al. (2015), on the other hand, found no association between health insurance and health behaviors, demonstrating that personal attributes, e.g. gender, education, urban residence and household income, were more significant predictors of lifestyles. With respect to health care utilization, Liu and Zhao (2014) examined the effects of the Urban Resident Basic Medical Insurance and showed that it did not reduce OOP expenditures. Wagstaff and Lindelow (2008) demonstrated that social health insurance coverage led to higher OOP expenditures among older people in China. Finally, Jung and Liu Streeter (2015) suggested that public health insurance reduced OOP spending by 44.38% in China, and the effect was even larger in the earlier years when health insurance plans were more generous and became weaker in recent years.

There remain gaps in the literature. First, although studies on health insurance among older people in China exist (Gao et al., 2007; Liu et al., 2015; C. Zhang et al., 2017), only few studies explore whether health insurance impacts health expenditures and health behaviors at the same time (L. Cheng et al., 2015). Second, most studies in China are not based on longitudinal data and therefore the causal relationships among health insurance, health care expenditure and health behaviors may not be well established (Li & Zhang, 2013; You & Kobayashi, 2011); exceptions include L. Cheng et al. (2015), Wagstaff and Lindelow (2008) and Liu et al. (2015). Finally, statistical models pertaining to health expenditures vary in the literature, from Heckman sample selection (You & Kobayashi, 2011) and two-part models (Li & Zhang, 2013) to linear regressions, and only few insurance studies have explored the extent to which results are sensitive to the methodological choice (Jung & Liu Streeter, 2015).

3.3 Methods

In this chapter, the outcomes of interest are health care utilization and health behaviors. Health care utilization is represented by two variables. The first variable, THE, represents total health expenditures. It is a continuous variable and defined as the amount of money spent on medical costs, inclusive of inpatient and outpatient care, last year. The second variable, OOP, represents out-of-pocket expenditure. It is a continuous variable that is based on the question: “How much medical costs were paid by your family (self, spouse, children, etc.) last year?”. It should be noted that it is not possible to break THE or OOP down into outpatient and inpatient medical expenses as the 2005 and 2008 waves of the CLHLS do not contain the information.

Health behaviors are represented by three variables. The first variable, HB(1), represents smoking. It is based on the question: “Do you smoke at present?” It takes the value of 1 if the respondent reported currently smoking and 0 otherwise. The second variable, HB(2), represents alcohol drinking. It is a dummy variable that is based on the question: “Do you drink alcohol at present?”. It takes the value of 1 if the respondent reported being a current alcohol drinker, and 0 otherwise. The final variable, HB(3), is a measure of exercise, based on the question: “Do you exercise regularly at present?”. It takes the value of 1 if the respondent reported exercising regularly, and 0 otherwise.

Two groups of empirical analyses are performed. First, panel-data analyses involve fixed-effects regression modeling. Since THE and OOP are continuous variables (and logged in the analysis), linear modeling with individual and time fixed effects is adopted. For HB(1), HB(2), and HB(3), which are binary variables, logistic modeling with individual and time fixed effects is adopted. All standard errors are heteroskedasticity-adjusted. The specification for health care utilization is shown in Equation 3 and that for health behaviors in Equation 4.

$$HE_{it}^{(k)} = \beta_0 + \beta_1 HI_{it} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \qquad (3)$$

$$HB_{it}^{(k)*} = \beta_0 + \beta_1 HI_{it} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \qquad (4)$$

Superscript *k* corresponds to each of the two measures of *HE* and each of the three measures of *HB*, referring to total health expenditures, out-of-pocket expenditures, smoking, drinking and regular exercising by the i^{th} individual at time *t* respectively. In the analyses, the *HE* variables are logged and converted into units of 2005 Renminbi (RMB). The term HB^{*} in Equation 4 refers to that the variable is latent. The primary

explanatory variable is health insurance, *HI*, which is a dummy variable that takes the value of 1 if the respondent reported being enrolled in any basic public health insurance programs. The variable is not defined as a categorical variable because the data are inconsistent across waves and it is not possible to classify respondents into the main insurance progams. For example, in the 2005 and 2008 waves, there was no information on NRCMS (as it had only recently been launched in 2003). *X* is a vector of other, time-varying explanatory variables and, it includes age, marital status (dummy variable with married=1), location of one's residence (dummy variable with rural=1), co-residents (dummy variable with co-residing with family=1), household income per capita, number of chronic illnesses and functional health (dummy variable with no functional health limitations=1). The choice of *X* is consistent with existing studies (Wagstaff and Lindelow, 2008; Zhang et al., 2017; Nguyen, 2012; Dave and Kaestner, 2009). Individual fixed effects, α_i, and time (survey-wave) fixed effects, λ_t, are also included to control for unobserved time-invariant and time-specific characteristics. Finally, ε_{it} represents the error term.

In addition to the panel-data analyses, cross-sectional analyses are also undertaken and they serve as robustness checks. In particular, Equations (3) and (4) above are run for each of the three survey waves. The impacts of health insurance on health care utilization and health behaviors should be the same in panel-data settings as they are in cross-sectional settings, if the relationships are robust. For the continuous health expenditure variables, two-part models are performed in place of linear OLS models, following existing studies regarding health

expenditures (Li & Zhang, 2013; You & Kobayashi, 2011). For the dichotomous health behavior variables, logistic regressions are used.

The use of two-part models is based on the presence of a non-negligible number of observations with missing health expenditures in the data. The number of missing observations for *THE* was 1,249 in 2005; 1,703 in 2008 and 1,423 in 2011 respectively, while the numbers of missing observations for *OOP* in 2005, 2008, and 2011 were 1,523; 2,056 and 1,619 respectively. The exclusion of observations that did not report medical expenses, which would be the case in simple OLS modeling, could thwart the assumption of a normal distribution of the error terms (Duan et al., 1983) and produce biased estimates. A more detailed discussion can be found in Madden (2008).

For each of the two-part models, the first part involves using a probit regression for the dichotomous event of whether the respondent had positive medical expenses (THE and OOP). The second part involves linear modeling of logged positive medical expenses. The covariance of the first and second parts of the model is assumed to be zero. The specifications for the two parts are the same and include age, gender, marital status, number of children, education, co-residence, residential location, household income per capita, number of chronic illnesses and functional health (Li & Zhang, 2013; Seshamani & Gray, 2004).

Here, Heckman sample selection models may alternatively be considered (Chen & Jin, 2012; L. Cheng et al., 2015; Lei & Lin, 2009; Liu et al., 2015). Based on a maximum likelihood approach, they involve estimating (1) a selection equation of whether medical treatment was sought and positive medical expenses (*THE* and *OOP*) were incurred,

using a probit regression, and (2) an outcome equation of logged positive medical expenses, using OLS. Contrary to the two-part models, the error terms of the two equations are assumed to be correlated. Nevertheless, no variables in the data qualify as valid exclusion restrictions for the selection equation. Following Huang and Gan (2010), a possible contender is co-residence with children; compared to older people who live alone, those living with family members are more likely to have easier access to medical care when they are ill. However, the variable does not represent a valid exclusion restriction here since co-residence is a choice (and therefore, not exogenous) and, as will be shown later, it statistically explains both *THE* and *OOP*. The absence of valid exclusion restrictions renders Heckman sample selection models inappropriate (Jung & Liu Streeter, 2015; Li & Zhang, 2013; Madden, 2008) and therefore they are not presented in this chapter.

The panel-data and the cross-sectional analyses differ in two important ways. First, the specifications are different. In light of fixed-effects modeling, the panel-data analyses exclude time-invariant characteristics (including gender, number of children, and education), while the cross-sectional analyses include both time-varying and time-invariant variables. Second, the models are different. Table A.1 in the appendix explains why two-part models are conducted in the cross-sectional but not in the panel-data settings. It contains results of mean-comparison t-tests and chi-2 tests of independence for all explanatory variables between observations with *THE* data and those with missing *THE* data. The table shows that the explanatory variables differ statistically between the two sub-samples for each survey wave (2005, 2008 and 2011), but they are not generally statistically different once all

three waves are considered together. In other words, compared to those with missing *THE* data in 2005-2011 (who are not part of the panel-data analyses), individuals with *THE* data (who are part of the analyses) had generally similar attributes, differing only in terms of gender and health, and therefore could represent individuals with missing data reasonably well. This suggests that, while the existence of missing *THE* data is systematic and needs to be accounted for the empirical analysis pertaining to each wave, the problem may not be as critical in the panel-data setting.

It is important to note that, in this chapter, insurance is considered to be exogenous. The literature varies in terms of their treatment of endogeneity bias of the insurance variable. While He and Nolen (2019) and Lei and Lin (2009) demonstrate the importance of identification strategies in the relationship between insurance and health care utilization in China, Chen et al. (2014), Li and Zhang (2013), and You and Kobayashi (2011) treat health insurance as exogenous. There are reasons why endogeneity may not be a serious issue here. First, while participation in URBMI and the NRCMS, which are primary programs for the elderly, is voluntary, the enrollment is done at the household level. Second, the government specifies the target population for each insurance program and the participation rates are uniformly high, with URBMI and NRCMS having the coverage rates of 73% and 92% in 2008 respectively (China National Bureau of Statistics, 2009). Altogether, the two reasons raise the question of the extent to which insurance coverage is a choice by the elderly themselves. Finally, Durbin-Wu-Hausman tests are performed and they produce inconsistent results across different outcomes of interest. More specifically, for each survey wave and for all waves combined, insurance is estimated using a linear probability model with all relevant

explanatory variables and without instrumental variables. The residual term of the insurance regression equation is plugged into all regression equations (i.e., 2 health expenditure and 3 health behavior equations) and all survey waves (2005, 2008, 2011, and all waves combined), along with the actual insurance variable itself. The results (available upon request) suggest that the statistical significance of the residual term varies and that the endogeneity problem is not consistently confirmed in the data.

3.4 Empirical Results

3.4.1 Descriptive Statistics

Table 4 presents definitions and descriptive statistics of all variables in the model. To observe real changes over time, total health expenditures (*THE*) and out-of-pocket expenditure (*OOP*) were deflated by the consumer price index using the base year of 2005. On average, *THE* and *OOP* across all three waves were 5,397.53 and 4,615.10 in 2005 RMB respectively. Missing observations for *THE* and *OOP* account for 19.21% and 23.06% of the sample respectively. Approximately 24%, 23%, and 34% of older people in the sample reported smoking, drinking and exercising regularly at present respectively.

Approximately 35% of the sample were enrolled in one of the three basic health insurance programs. The percentage increased over time due to the fact that the government was able to successfully expand the insurance coverage particularly after 2007 (Barber & Yao, 2010). There was a variation in terms of enrollment at the individual level. In 2011, among 80% of the sample who were covered by pubic health insurance, 72.96% either were enrolled in a health insurance program that was

different from that which they had been under or switched to being insured from having no insurance in the earlier waves. These changes reflected the country's socioeconomic transitions, which had weakened agricultural unions and increased costs of living in general, leading to an almost total collapse of cooperative-based medical schemes and putting into perspectives the importance of health insurance for workers in the formal sector and civil servants. Also, the government lowered insurance deductibles and improved reimbursement procedures, leading to a higher coverage in 2011.

The average age of the sample was 84.18, with 55% being female, 37% being married, and 56% living in a rural area. The majority of the sample (83%) co-resided with family members. The average household income per capita was 14,442.71 in 2005 RMB. The average number of chronic diseases was 0.56, and 39% of the sample reported having no functional limitations.

Table 4 Descriptive Statistics and Definitions of All Variables by Survey Wave

Variable	Definition	Survey Wave			
		2005	2008	2011	All Waves
1. Dependent Variables					
THE	*How much did you spend on medical costs last year? (Outpatient + inpatient)*	1235.92	1740.53	14404.32	5397.53
		(4194.46)	(5652.65)	(39791.27)	(22965.5)
% of missing observations - total health expenditure		19.04%	17.50%	21.92%	19.21%
OOP	*____yuan of which paid by family (self, spouse, children etc.)*	896.2	1160.44	13316.12	4615.1
		(2691.69)	(3725.27)	(39124.97)	(21979.30)
% of missing observations - out-of-pocket expenditure		23.22%	21.13%	25.90%	23.06%
Smoke	*Smoking at present=1*	0.33	0.22	0.18	0.24
		(0.47)	(0.42)	(0.38)	(0.42)
Alcohol	*Drinking alcohol at present=1*	0.31	0.21	0.18	0.23
		(0.46)	(0.41)	(0.38)	(0.42)

Exercise	*Exercising regularly= 1*	0.35	0.30	0.37	0.34
		(0.48)	(0.46)	(0.48)	(0.47)
2. Explanatory Variables					
Key Explanatory Variables					
HI	*Basic medical insurance at present (=1)*	0.1	0.16	0.8	0.35
		(0.30)	(0.37)	(0.40)	(0.48)
A. Demographics					
*SEX**	*Female (=1)*	0.56	0.56	0.55	0.55
		(0.50)	(0.50)	(0.50)	(0.50)
AGE	*Age (years)*	81.38	84.66	85.89	84.18
		(10.97)	(11.23)	(10.83)	(11.17)
MARR	*Married (=1)*	0.41	0.36	0.36	0.37
		(0.49)	(0.48)	(0.48)	(0.48)
RUAL	*Rural (=1)*	0.59	0.60	0.47	0.56
		(0.49)	(0.49)	(0.50)	(0.50)
CORES	*Co-residing with family (=1)*	0.84	0.83	0.82	0.83
		(0.36)	(0.38)	(0.39)	(0.38)

*CHILD**	*Number of children*	4.51	4.41	4.03	4.32
		(2.29)	(2.23)	(2.39)	(2.30)
*EDU**	*Education (years)*	2.32	2.25	2.33	2.29
		(3.62)	(3.53)	(3.54)	(3.56)
INCM	*Income (in 2005 RMB)*	4747.46	15462.02	21752.42	14442.71
		(6561.67)	(15656.72)	(20448.73)	(16841.81)
B. Health					
Chronic	*Number of chronic illnesses*	0.51	0.52	0.66	0.56
		(0.82)	(0.84)	(0.96)	(0.88)
FH	*Functional health (=1, no limitations)*	0.46	0.39	0.34	0.39
		(0.50)	(0.49)	(0.47)	(0.49)
Observations		6,560	9,729	6,845	23,134

Sources: CLHLS, 2005, 2008 and 2011.

Notes: Variables with * are time-invariant and excluded from the panel-data analyses.

Standard deviations in parentheses.

3.4.2 Estimation Results: Panel-Data Analyses

Tables 5 and 6 present results of panel-data analyses for the two health expenditure variables (*THE* and *OOP*) and the three health behaviors respectively. All models pass the overall significance F-test at the 5% level and include time fixed effects.

Table 5 shows the impact of health insurance on total health expenditures (*THE*) and out-of-pocket expenditure (*OOP*), based on fixed-effects linear regressions. The analyses demonstrate that health insurance is positively associated with *THE* but negatively associated with *OOP*, and the results are statistically significant. These provide evidence for the fact that insurance improves access to health care, leading to increased health care utilization as reflected by its positive association with *THE*, and reduces financial barriers of health care, as shown by its negative association with *OOP*.

It can also be seen that the presence of chronic diseases is positively associated with *THE* and *OOP*. Age, co-residence and per capita household annual income are positive and statistically significant factors for *THE* and *OOP*, indicating that health care services are normal goods. The results show that health insurance is effective in boosting healthcare utilization and offering financial protection. These results are generally consistent with more recent studies (e.g., Jung & Liu Streeter, 2015), which seem to support the view that China has been progressing toward a better healthcare system since its reforms in 2009.

Impacts of health insurance on health behaviors are presented in Table 6. The fixed-effects logistic models show that health insurance positively impacts all three types of health behaviors. In other words,

health insurance is associated with increased smoking and drinking among older people, yet it encourages older people to regularly exercise. Age is also found to positively impact all three types of health behaviors and good health status is found to promote regular exercise.

Table 5 Fixed-effects regression results for health care utilization

Variables	Log THE	Log OOP
HI	0.128*	-0.0795**
	(0.066)	(0.009)
AGE	0.0957***	0.0951***
	(0.014)	(0.014)
MARR	0.140	0.0341
	(0.117)	(0.122)
RUAL	-0.0718	0.00667
	(0.070)	(0.073)
CORES	0.274***	0.290***
	(0.102)	(0.107)
INCM	0.0439**	0.0385*
	(0.020)	(0.021)
Chronic	0.560***	0.540***
	(0.036)	(0.037)
FH	-0.751***	-0.769***
	(0.071)	(0.074)
Time fixed effects	Yes	Yes
N	20,656	20,445
F-test statistics	90.93***	70.90***

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

Table 6 Fixed-effects logistic regression results for health behaviors

Variables	Smoke	Alcohol	Exercise
HI	0.569***	0.221**	0.507***
	(0.109)	(0.089)	(0.061)
AGE	-0.527***	-0.352***	-0.035***
	(0.025)	(0.019)	(0.013)
MARR	0.291	0.168	-0.0498
	(0.179)	(0.149)	(0.103)
RUAL	0.0869	0.180**	-0.381***
	(0.113)	(0.092)	(0.063)
CORES	0.105	-0.139	-0.0607
	(0.178)	(0.142)	(0.093)
INCM	-0.112***	-0.0221	-0.00394
	(0.035)	(0.027)	(0.019)
Chronic	-0.0642	-0.0504	-0.0239
	(0.053)	(0.045)	(0.033)
FH	0.0632	0.110	0.367***
	(0.114)	(0.091)	(0.062)
Time fixed effects	Yes	Yes	Yes
N	4,522	4,992	8,106
F-test statistics	1294.84***	836.04***	164.92***

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

3.4.3 Estimation Results by Gender and education

This chapter also explores the roles of gender and education in

relation to the health insurance, health expenditure and health behaviors relationship. Here, the sample is split into two gender (male versus female) and two education (literate versus illiterate) subsamples. Fixed-effects linear regression and fixed-effects logistic models are applied to the four subsamples.

The results are presented in Table 7. The table shows that, for elderly men, health insurance statistically and positively impacts all types of health expenditure and health behaviors while, for elderly women, health insurance is negatively and positively associated with *OOP* and exercise respectively. It also shows that, among the literate sample, health insurance is significantly and positively associated with *THE*, smoking and exercising, while, for the illiterate sample, it is significantly and positively associated with *OOP* and the three types of health behaviors. These results suggest that the relationships among health insurance, health care utilization and health behaviors are not uniform across population sub-groups.

Table 7 Fixed-effects regression results for gender and education sub-samples

Variables	Dependent Variables				
	Log THE	Log OOP	Smoke	Alcohol	Exercise
Male Sub-Sample					
HI	0.176*	0.131*	0.635***	0.224**	0.392***
	(0.098)	(0.069)	(0.129)	(0.113)	(0.086)
Female Sub-Sample					
HI	0.0829	-0.118*	0.391	0.197	0.621***
	(0.009)	(0.060)	(0.213)	(0.154)	(0.087)
Literate Sub-Sample					

HI	0.134*	0.103	0.567***	0.176	0.550***
	(0.098)	(0.068)	(0.150)	(0.125)	(0.087)
Illiterate Sub-Sample					
HI	0.0846	0.140**	0.542***	0.235*	0.463***
	(0.091)	(0.062)	(0.161)	(0.129)	(0.086)

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

All of the above analyses are replicated with health insurance at time t-1 replacing health insurance at time t in the models. The results are shown in Tables A.2-A.4 in the appendix. Here, instead of investigating the contemporaneous impact of health insurance, lagged effects of health insurance are explored. This is consistent with the fact that existing studies on this topic have different model specifications and that the effect of insurance may not be immediate. For example, while Currie et al. (2008) and Hanratty (1996) investigated lagged effects of public health insurance, Wagstaff and Lindelow (2008) and Dave and Kaestner (2009) considered only the present effects. The tables show that the results are inconsistent, which may be due to the fact that the insurance system in China changed so drastically during the study period.

3.4.4 Estimation Results: Cross-sectional Analyses

Tables 8 provides wave-by-wave estimates of the two-part models for *THE* and *OOP* and logistic models for the three types of health behaviors. Each two-part model contains two equations. The first equation is selection equation. It is used to model the probability of positive medical expenditures, where the dependent variable takes the

value of 1 if *THE* or *OOP* is positive and 0 otherwise. The second equation is outcome equation, modeling the (logged) positive level of *THE* and *OOP*. By separating the estimation into two parts, the model provides a detailed explanation of the impact of health insurance on health spending, accounting for the fact that some individuals do not use health care and report zero expenditures.

For the two-part models pertaining to the 2005 and 2008 survey waves, the coefficients of health insurance are negative and significantly associated with *OOP* in the selection equation, while a positive and statistically significant relationship is detected between insurance and the logged level of *THE* and *OOP* in the outcome equations. In other words, the probabilities of having a hospital visit are found to be lower while the levels of *THE* and *OOP* expenditures are found to be higher among older people with insurance.

The reverse is true for the 2011 wave. The coefficients of health insurance are positive and significantly associated with the (logged) level of *THE* and *OOP* in the selection equation, while a negative and significant relationship is detected between insurance and the (logged) level of *THE* and *OOP*. In other words, older people with health insurance are found to have a higher probability of having a hospital visit but lower levels of *THE* and *OOP*. For the logistic models, health insurance is linked with increased probabilities of smoking and drinking for older people with insurance in 2011 and increased probabilities of regularly exercising in 2005-2007.

The differences between the first two waves and the last wave likely stem from the fact that the public health insurance coverage expanded so

drastically after 2007 and that the benefits initially were small. The 2005-2007 findings are consistent with Wagstaff and Lindelow (2008), who found that, in the early years where public health insurance was implemented in China, insurance coverage led individuals to seek more expensive treatments, being less price conscious, and therefore *THE* and *OOP* increased. You and Kobayashi (2011) suggested that the rise in *THE* and *OOP* could be attributable to adverse selection, whereby individuals with higher risks (and therefore requiring more care) were more likely to enrol into an (voluntary) insurance program, It could also be attributable to the fact that there was a practice of over-diagnosis and medicine over-prescription in China, which increased *THE* and *OOP* and would have been better tolerated among enrollees. On the other hand, the 2011 findings are consistent with Jung and Liu Streeter (2015), who used more recent data and found that *THE* and *OOP* decreased among people with health insurance. With coverage expansion in later years, the problem of adverse selection may have subsided and the proportion of people who would be seeking unnecessary care presumably shrunk. Therefore, the positive impacts of health insurance began to emerge. The differences across years justifies the use of panel-data; the results could be misleading with cross-sectional data.

Table 8 Results from two-part models: Cross-sectional analyses

Variables	Dependent Variables				
	Log THE	Log OOP	Smoke	Alcohol	Exercise
Wave: 2005					
HI - selection equation	-0.0024	-0.328***			
	(0.070)	(0.060)			

HI - outcome equation	0.066***	0.109*	0.0813	-0.165	0.618***
	(0.012)	(0.074)	(0.106)	(0.103)	(0.097)
Wave: 2008					
HI - selection equation	-0.0015	-0.077*			
	(0.975)	(0.043)			
HI - outcome equation	0.404***	0.108**	0.0590*	-0.0241	0.386***
	(0.046)	(0.047)	(0.081)	(0.082)	(0.067)
Wave: 2011					
HI - selection equation	0.142***	0.164***			
	(0.049)	(0.048)			
HI - outcome equation	-0.299***	-0.283***	0.332***	0.0102***	-0.0624
	(0.077)	(0.082)	(0.105)	(0.005)	(0.074)

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

3.5 Concluding Remarks

This chapter investigates the effect of health insurance on health expenditures and health behaviors of older people in China. Using three waves of the nationally representative CLHLS in 2005, 2008-2009, and 2011-2012, total health expenditures (*THE*), out of-pocket expenditures (*OOP*), smoking, drinking and exercising are investigated. Enrollment in any of the three major health insurance programs represents the main explanatory variable. After conducting panel-data analyses involving fixed-effects modeling and cross-sectional analyses using two-part models, this chapter finds that health insurance increases *THE* and reduces *OOP*, suggesting that insurance enhances access to health services while minimizing financial burden. It also finds that insurance leads to increased probabilities of smoking and drinking as well as

exercising. This suggests that the effects of health insurance are complex, encouraging certain unhealthy behaviors as well as certain heathy behaviors. The results vary across age and education groups as well as across time, due to the fact that the health insurance system changed significantly during the study period.

This chapter shows that health insurance is the most important contributor of health expenditures, similar to existing studies in other countries (Nguyen, 2012; Simon et al., 2017; Soni, 2020). The positive effects can be placed under the overriding principle of public health insurance which is to provide financial relief to enrollees and to improve access to health services. The relationships between health insurance and health behaviors are more complex here. The fact that health insurance is associated with increased exercising is consistent with Dong et al. (2018) and the fact that it is associated also with increased smoking and drinking, particularly among elderly men who make up the majority of smokers and drinkers in the sample, is consistent with the idea of ex-ante moral hazard discussed by Dave and Kaestner (2009).

The ambiguity of the overall effect of health insurance on health behaviors is unsurprising. The term ‘health behaviors’ encompasses different behaviors and there are several mechanisms through which they may be changed jointly or separately. Witvorapong (2018) showed that a substantial proportion of older people in Thailand had inconsistent health behaviors, drinking and smoking while engaging in exercising and keeping a healthy diet simultaneously. He attributed the phenomenon to moral licensing whereby the fact that a person undertakes a healthy behavior gives him/her a license to undertake an unhealthy behavior. Existing studies also ‘predict’ the impact of health insurance differently.

For example, Klick and Stratmann (2007) argued that health insurance only insured against financial risks of illnesses but might not incentivize healthy behaviors. Dong et al. (2018) suggested that health insurance should increase the adoption of healthy behaviors as it allowed enrollees to have more contact with physicians, which was likely to positively influence their health behaviors. On the other hand, Dave and Kaestner (2009) showed that health insurance enrollees had an incentive to invest less in preventive behaviors, leading to more unhealthy behaviors.

This chapter shows that health insurance has beneficial effects in China and they are more pronounced as the coverage expands. However, although the coverage is already quite high, the CLHLS data shows that 12% of the older population still did not have insurance in 2014. While more data are needed to better understand the reasons for not having health insurance, this chapter suggests that the government target vulnerable groups who may not be able to afford insurance premia (Zhou et al., 2021) and devise a strategy to incentivize them into being insured. The conflicting results regarding *THE*, *OOP* and health behaviors suggest that the beneficial effects of health insurance currently observed may be offset by higher prevalence rates of NCDs in the future. This highlights the need for further analysis and for decision makers to continuously evaluate the impact of ongoing health insurance reforms in China.

Chapter 4 Effects of Socioeconomic Status on Aging People's Health in China

4.1 Introduction

The relationship between socioeconomic status (SES, hereafter) and health is one of the most well-researched topics in social sciences and economics. A growing number of studies have examined whether disparities in SES impact health outcomes of the older population. Studies based on European countries and the United States have typically demonstrated that the linkage is positive, indicating that individuals with a better SES experience better health outcomes (Attanasio & Emmerson, 2003; Eikemo et al., 2008; Lee & Kim, 2008; Michaud & Van Soest, 2008; Semyonov et al., 2013).

However, there are few studies in developing countries (Anson & Sun, 2002; Kumar et al., 2016; Zimmer & Kwong, 2004). Since the environment in which older adults live in developed countries is different from developing ones, the positive health-SES relationship observed in the former might not hold in the latter. In developing countries, access to health care is more limited due to lesser availability of health resources and lack of a well-developed health insurance system (Das et al., 2007). The problem is exacerbated by increased prevalence of chronic diseases among older adults, which leads to economic costs that are disproportionately high, relative to the average household's budget. The health-SES nexus may also be complicated by the nature of employment in developing countries, whereby the informal sector dominates the formal sector (Witvorapong, 2018; Witvorapong et al., 2021). This suggests that people may continue to work well beyond the formal

sector's retirement age and indicates a lack of pension eligibility or an economic safety net for the majority of the older workforce.

Evidence on the health-SES linkage in low- and middle-income countries is mixed. While most studies have shown that more wealth and higher social class are associated with better health outcomes (Hanibuchi et al., 2012; Kumar et al., 2016; Roy & Chaudhuri, 2008), exceptions exist. Zimmer and Amornsirisomboon (2001) found a negligible relationship between SES and self-rated and functional health in Thailand. On the other hand, Chunming (1992) reported a positive relationship between SES and different types of cancer in China.

As the largest developing country with the most aging population in the world, a deeper investigation into China is warranted as it may have meaningful implications. In the past three decades, China has undergone a drastic transition. According to the 2016 China Statistical Yearbook, the country has witnessed a sharp decline in the population growth rate (from 14.4% in 1970 to 0.52% in 2015) and has shifted toward an aged society, with people aged 65 or older accounting for 8.8% of the population in 2010. Despite rapid economic growth following market-oriented economic reforms in the 1980s, a significant portion of Chinese older adults still face financial difficulties. The demographic transition leading to shrinking family size has weakened the traditional support system for elderly people (Zimmer & Kwong, 2004) and the pension system remains largely absent especially in rural areas (Pei & Pillai, 1999).

This chapter investigates the influence of socioeconomic status on health among older adults in China. It uses three waves of the nationally representative Chinese Longitudinal Healthy Longevity Survey

conducted in 2005, 2008-2009, and 2011-2012. It explores two dependent dummy variables of self-reported health and functional health and employs subjective and objective measures of socioeconomic status. Based on two-stage fixed-effects linear probability modeling where the potential endogeneity of socioeconomic status is accounted for, this chapter finds that socioeconomic status positively affects both functional health and self-rated health of older people in China. The positive impact holds true across gender and age groups, but it is sensitive to the choice of health and SES measures, where the subjective measure of economic status produces statistically significant estimates in a more consistent manner, compared the objective measure.

Although the influence of SES on health has been investigated, this chapter provides several contributions. First, it adds to the sparse literature on China. According to Kumar et al. (2016), Zimmer and Kwong (2004), and Zimmer et al. (2010), studies related to the health-SES linkage in China are limited, despite the fact that the country is experiencing a rapid growth in the size of the aged population and ever-widening health and socioeconomic disparities. Second, this chapter adopts a broad range of measures for health and SES. Most existing studies concentrate on a limited set of indicators and few test the extent to which their results are sensitive to the measures used. While this chapter considers both subjective and objective measures of health and SES, existing studies often explore either objective or subjective measures alone (Duncan et al., 2002; Hanibuchi et al., 2012; Kumar et al., 2016; Zimmer et al., 2010). Third, this chapter uses relatively recent panel data and is able to capture the dynamics the health-SES relationship, attributing changes in health to changes in SES over time. Finally, this

chapter addresses the reverse causality problem, which, combined with the use of panel data, means that it is able to credibly establish a causal relationship between health and SES. Most existing studies employ cross-sectional data and do not account for potential endogeneity bias (Kumar et al., 2016; Semyonov et al., 2013; Zimmer & Kwong, 2004; Zimmer et al., 2010).

4.2 Related literature

Despite the fact that the health-SES relationship has been extensively explored, knowledge gaps remain. This section presents a literature review that highlights the difficulties of studying the topic (which may not be adequately addressed in existing studies). The review here also serves as a conceptual framework and a platform on which the empirical strategy is built.

Measurement of health outcomes and SES

One of the major difficulties of exploring the health-SES relationship lies with how to operationalize the terms ‘health’ and ‘SES’. Health is multi-faceted. It is composed of both physical and mental health, and, even when only physical health is considered (as is the case in this chapter), it involves three components: subjective, social, and medical (Blaxter, 1989). Several operational definitions are available. The first measure of health outcomes is self-reported health. It refers to the scale with which the individual rates his/her own health (Hanibuchi et al., 2012; Lee & Kim, 2008; Smith & Goldman, 2007; Zimmer & Kwong, 2004). The second measure is functional health. Representing the social

component, it captures the individual's ability to perform daily living activities and indicates the extent to which they require help from others (Adams et al., 2007; Semyonov et al., 2013; Woo et al., 2008; Zimmer & Kwong, 2004; Zimmer et al., 2010). Finally, the last measure of health outcomes involves the medical component, often proxied by the presence of chronic conditions (Eikemo et al., 2008; Lantz et al., 1998; Michaud & Van Soest, 2008) as well as health-related quality of life (Woo et al., 2008). It should be noted that the last two measures are objective, in contrast with the first measure which is subjective.

Socio-economic status (SES) is also multi-faceted and to measure SES fully requires a combination of variables. SES is typically measured is through social class identifiers, i.e. variables that indicate the status of a person relative to the society. For the older population (the majority of whom have stopped working), the literature has used a wide variety of measures. Examples include income (Beydoun & Popkin, 2005), pension eligibility (Zimmer & Kwong, 2004), financial hardship or economic independence (Angel et al., 2003), wealth or property ownership (Cagney & Lauderdale, 2002; Muntaner et al., 1998), consumption (Eikemo et al., 2008) as well as self-perceived social status (Singh-Manoux et al., 2003). Consistent with the measurement of health, SES measures may be classified into two broad groups: subjective (represented by self-perceived social status) versus objective (represented by the other operational definitions).

Causality between SES and health

The second difficulty of investigating the health-SES relationship lies with the cause and effect determination. The causality identification requires the use of panel data, as opposed to cross-sectional data (whereby only correlation but not causation may be established) (Halleröd & Gustafsson, 2011). It also requires an understanding of how SES and health are theoretically and empirically linked.

Michaud and Van Soest (2008) demonstrate that SES and health are intertwined in three dimensions: the fact that SES causes health, the fact that health causes SES, and the presence of common unobserved factors that drive SES and health jointly. The causal effects of SES on health may be explained through a health production framework. Here, income represents an input into the health production, allowing individuals to purchase health-improving goods and services. The framework has been studied extensively in economics (Adams & Buckle, 2003; Frijters et al., 2005; Lee & Kim, 2008; Smith, 2005). The causality running from health to SES, on the other hand, may be explained through a labor productivity framework. Here, health outcomes represent a form of human capital that affects wages and labor supply at the intensive and the extensive margins, thus driving retirement decisions and, consequently, the accumulation of retirement savings (Michaud & Van Soest, 2008; Smith, 2005). Finally, both health and SES may be contemporaneously influenced by common unobserved factors. Adams and Buckle (2003), Barker (1997) and Ravelli et al. (1998) illustrate that health in early childhood, health of the parents or genetic heterogeneity are some of the key factors that are usually not observed in the data, yet have a lasting impact on health and the ability to work.

The theoretical indication of reverse causality suggests that an endogeneity-correction approach should be employed when the health-SES relationship is investigated. It should be pointed out, nevertheless, that most studies (especially in the public health literature) have treated health and/or SES as exogenous and, among studies that account for potential endogeneity bias, the difficulty of identifying valid instrumental variables is well noted (Lee & Kim, 2008).

Age and gender differences in the health–SES relationship

The final difficulty of investigating the health-SES relationship is the fact that the relationship is influenced by age and gender differences. The literature suggests that the relationship is not constant throughout the life course and that it is not homogenous across the sexes.

The health-SES relationship is known to vary with age. However, the evidence is mixed at best. While most studies find that SES-based differences in health widen as age increases (Beydoun & Popkin, 2005; Smith & Goldman, 2007; Zimmer & Kwong, 2004), there exist studies that draw a different conclusion. Elo and Preston (1996), for example, show that the effect of SES on health diminishes at older and oldest ages in United States.

The health-SES relationship is also gender-based. The fact that SES and health levels differ between males and females reflects the interplay between biological and social dimensions within each of the two sexes (Bird & Rieker, 1999). In other words, men and women are so genetically and socially different that it is not realistic to expect them to have the same SES or health outcomes, all else being equal. In general, empirical

evidence seems to suggest that the SES gradient on health is stronger for women than for men (Duncan et al., 2002; Koskinen & Martelin, 1994).

The SES-health relationship is more complex once age and gender differences are both accounted for. Again, the literature offers mixed evidence. While Anson and Sun (2002) , McDonough et al. (1997), Roy and Chaudhuri (2008), and Smith and Goldman (2007) find that gender gaps in health and SES persist into old age, with signs that they may be narrowed as age advances, Duncan et al. (2002) show that the directions of gender differences in the SES-health relationship do not just vanish but may, in fact, be reversed in old age.

In light of the above complexities, we attempt to fill the gap e by re-investigating the health-SES relationship, using panel data from China and exploiting an instrumental-variable approach to address potential endogeneity bias. We contribute by considering different operational definitions of SES and health and test whether the health-SES relationship is sensitive to the measurement. We also account for age and gender differences explicitly, performing sub-samples analyses that are based on age and gender.

4.3 Methods

The dependent variable is health (HLTH) represented by two variables, subjective health (SBH) and functional health (FH). SBH is self-reported health drawn from the following question: “How do you rate your health at present?”. It is defined as a dummy variable, equal to 1 if very good or good health was reported, and 0 if otherwise. FH is a measure of functional limitations based on 14 questions related to

activities of daily living and instrumental activities of daily living.[8] It is also defined as a dummy variable, equal to 1 if there were no functional limitations, and 0 if there were one or more functional limitations. Since both dependent variables, SBH and FH, are binary variables and panel data are used, linear probability modeling (LPM) with individual fixed effects and heteroskedasticity-adjusted standard errors is adopted.

The regression model can be described as follows:-

$$HLTH_{it}^{k} = \beta_0 + \beta_1 SES_{it}^{f} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \quad (5)$$

The variable $HLTH_{it}$ represents health outcomes of individual i at time t, where *HLTH* can be either *SBH* or *FH*, indexed by k. The primary explanatory variable, denoted by SES_{it}, is the socioeconomic status of individual i at time t. It is defined in two ways, indexed by f. The first measure is subjective SES (*SBES*). It is based on a question in the survey where respondents were asked to financially compare themselves with others in the same residential area. *SBES* is defined as a dummy variable, equal to 1 if being above average was reported and 0 otherwise. The second measure of SES is objective (*INCM*), represented by logged real household income per capita (i.e., divided by household size) last year. It is a continuous measure.[9] X_{it} is a vector of individual and household characteristics. Time fixed-effects, λ_t, are also included to capture temporal variations in health outcomes. The term α_i represents individual

8 Respondents were asked to indicate whether they had difficulty performing the following activities: bathing, dressing, going to the toilet, indoor transfer, continence, eating, visiting neighbors, going shopping, cooking a meal, washing clothes, walking 1 kilometer, lifting a weight of 5 kilograms, crouching and standing three times, and taking public transportation.

9 Household income (as opposed to individual income) is appropriate when older individuals are considered, as most older individuals no longer work and derive income from other family members (Frijters et al., 2005; Zimmer & Kwong, 2004).

fixed-effects to control for unobserved time-invariant characteristics and ε_{it} is the error term.

Since both measures of SES are likely to be endogenous, an instrumental-variable approach is adopted. The instrumental variables (IVs) include education of the respondent's father, occupation of the respondent's father during the respondent's childhood, and the number of refrigerators per 100 households in the respondent's area of residence. These IVs represent the intergenerational transmission of SES and community-level wealth that affect the respondent's SES but do not directly affect his/her health. Refrigerators are used because, compared with other household assets, they are not common possessions in China and therefore may better capture community-specific economic well-being.[10] These IVs are imperfect as they may not be strictly exogenous. Attributes of an individual's father can shape his/her preferences and early childhood outcomes, which may subsequently impact his/her health and economic status in later life. Similarly, the rate of refrigerator ownership reflects residential location choices, which may affect health and SES through community-specific characteristics that are unobserved in the data. The validity of these IVs is examined using weak-instrument tests and tests of overidentifying restrictions.

A two-stage approach is employed. The first-stage is to separately regress the two SES measures on the IVs mentioned above by using a fixed-effects LPM/ linear model. The second stage is to use the predicted

10 According to the National Bureau of Statistics, China, it has been estimated that only 1.2% and 67.3% of Chinese households were in possession of a refrigerator in 1990 and 2012, respectively. Tao & Yu (2011) indicated that these rates were much lower in rural areas.

values of SES, $\widehat{SES}$, from the first stage to replace their actual values in Equation (5) and estimate the following equation: -

$$HLTH_{it}^{k} = \beta_0 + \beta_1 \widehat{SES}_{it}^{f} + X_{it}^{'}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}. \quad (6)$$

Results from Equation (6) are endogeneity-corrected and will be the primary focus of the discussion below. The two-stage LPM model is applied to the entire sample as well as two gender subsamples (male and female) and three age subsamples (the young elderly aged 65-74, the middle elderly aged 75-84, and the oldest elderly aged 85 and above). Altogether, 28 regressions are estimated.[11]

Although LPM has a problem where its forecasts may fall outside the [0,1] probability interval, the choice of LPM is justifiable here. First, according to Aldrich and Nelson (1984), LPM and the competing discrete-choice models of logit and probit provide qualitatively consistent results in terms of statistical inference. Second, the empirical strategy involves endogenizing one continuous variable (*INCM*) and one dummy variable (*SBES*) in models where the dependent variables are binary. Angrist (2001) shows that LPM based on the two-stage endogeneity correction approach provides a reasonable method of estimating a binary choice model with dummy or continuous endogenous regressors. Finally, an important advantage of LPM is that it can be estimated using the standard two-stage linear IV method, similar to 2SLS, while the approach is known to lead to inconsistency in logit and probit models (Carrasco, 2001). Witvorapong et al. (2021) represent an empirical study that

11 They are 4 regressions without IV (2 HLTHs×2 SESs) + 4 regressions with IV (2 HLTHs×2 SESs) + 8 regressions for genders (2 HLTHs×2 SESs×2 genders) + 12 regressions for levels of aging (2 HLTHs×2 SESs×3 age groups).

demonstrates similarities of LPM and discrete-choice modeling with endogenous dummy regressors.

The regression specification is based on the literature review. In addition to the SES measures, the other explanatory variables include age (years), age-squared, marital status (dummy, with married=1), number of co-residents, the location of one's residence (dummy, with rural=1), and health insurance (dummy, with presence of insurance=1). All of these characteristics are time-varying and are known to influence health (Beydoun & Popkin, 2005; Eikemo et al., 2008; Hanibuchi et al., 2012; Kahn & Fazio, 2005; Witvorapong, 2018; Zimmer et al., 2010). Certain important characteristics, including gender, race, education, occupation, wealth, and household structure, are not part of the analysis because they are time-invariant and therefore are captured in the individual fixed effects.

The definitions and descriptive statistics of all variables for the entire sample and each of three survey waves from the CLHLS are presented in Table 9. It is shown that 49.5% of the sample have *SBH*=1, meaning that very good or good self-reported health was reported. Approximately 38.2% of the sample reported not having any limitations in performing activities of daily living (ADLs) and instrumental activities of daily living (IADLs). Most of the households had a relatively low income, yet 83.4% reported *SBES*=1, meaning a very good/good subjective economic status. Approximately 62.6% were eligible for public health insurance.[12] The other explanatory variables seem to be

12 Although the coverage of public health insurance in China is currently almost universal, the receipt of health insurance in the sample (covering the period 2005-2011) was not universal. The two main public health insurance schemes known as the New Rural

consistent across survey waves. The mean age was 84.224 years and the mean number of co-residents was 2.7. About 54% of the sample were registered in rural areas and approximately 37% were married.

Table 9 Descriptive Statistics and Definitions of All Variables by Survey Wave

Variable	Definition	Survey Wave			
		2005	2008	2011	All Waves
1. Dependent Variables					
SBH	Very good or good self-reported health (=1)	0.533 (0.499)	0.496 (0.500)	0.454 (0.498)	0.495 (0.500)
FH	No ADL or IADL limitations (=1)	0.455 (0.498)	0.371 (0.483)	0.326 (0.469)	0.382 (0.486)
2. Explanatory Variables					
INCM	Real log income in RMB: household income per capita	7.822 (1.413)	9.081 (1.400)	9.324 (1.728)	8.775 (1.627)
SBES	Above average subjective economic status (=1)	0.836 (0.370)	0.832 (0.374)	0.835 (0.372)	0.834 (0.372)
AGE	Age (years)	81.405 (10.847)	84.960 (11.173)	85.978 (10.803)	84.224 (11.127)
AGE2	Age-squared /100	67.444 (18.048)	73.430 (19.098)	75.089 (18.802)	72.175 (18.967)
MARR	Married (=1)	0.406 (0.491)	0.354 (0.478)	0.358 (0.479)	0.370 (0.483)

Cooperative Medical Scheme and the Urban Residents Basic Medical Insurance were initiated in 2003 and 2007, respectively, with the former covering rural residents and the latter covering non-employed urban residents. The descriptive statistics of the health insurance variable (shown in Table 9) reflect the fact that not all older people were eligible for public health insurance at the time of the survey and that the take-up of NCMS and URBMI had been slow.

CORES	Number of co-residents	2.772 (1.804)	2.676 (1.791)	2.819 (2.078)	2.746 (1.884)
RUAL	Rural (=1)	0.590 (0.492)	0.583 (0.493)	0.429 (0.495)	0.540 (0.498)
HINS	Having public health insurance (=1)	0.290 (0.454)	0.707 (0.455)	0.845 (0.362)	0.626 (0.484)
	Observations	7,101	10,231	7,120	24,452

4.4 Empirical results

4.4.1 Model Justification

Prior to the discussion of the results, it is necessary to examine whether the use of two-stage fixed-effects linear probability modeling is appropriate. Several tests are performed. First, as shown in Appendix A.6, Breusch-Pagan Lagrange Multiplier and Hausman are performed and they suggest that panel data techniques are appropriate and that fixed-effects LPM is more appropriate than the random-effects one, regardless of which dependent variable and *SES* variable are adopted. Second, as shown in Appendices A.7 - A.8, multicollinearity tests are undertaken. The absolute values of pairwise correlation coefficients of most explanatory variables are less than 0.5. The only exception is the correlation between age and age-squared, yet the variables are not linearly dependent by construction. Variance inflation factors (VIF) for each explanatory variable and the mean VIFs are low, indicating that multicollinearity is not a problem. Third, Durbin-Wu-Hausman, weak-instrument and overidentification tests are performed for all fixed-effects models in this chapter. As shown in Appendix A.9, the results suggest that there is evidence at the 10% level that the SES variables are

endogenous. They also show that the excluded instruments are not weak and are exogenous. Finally, the credibility of linear probability modeling is tested. In Appendix A.10, coefficient estimates of logistic regressions and fixed-effects LPM, both using the two-stage approach, are compared and it is found that they produce qualitatively similar results. Overall, these tests suggest that the models presented below are econometrically valid.

4.4.2 Full Sample Estimation Results

Table 10 presents selected results from fixed-effects LPM models based on the entire sample as well as the gender and age subsamples. This chapter only discusses the estimates for the primary explanatory variable, *SES*, which is defined in two ways: *INCM* (Model 1) and *SBES* (Model 2). The complete estimation results of all 28 regressions are provided in Appendices A.11-13.

Results of the fixed-effects LPM without considering the endogeneity problem are shown in Panel A of Table 10. Only the subjective measure of *SES*, i.e. *SBES*, is statistically associated with *HLTH*, regardless of whether *FH* or *SBH* is used. The objective measure of *SES*, i.e. *INCM*, is found not to be statistically associated with *HLTH*. The finding indicates that the association between *SES* and *HLTH* is sensitive to the choice of variables used to represent *SES* and suggests that a better self-reported economic status is linked with an increased probability of having both good functional health and good self-reported health.

Results of the fixed-effects LPM where the problem of endogeneity is explicitly accounted for are shown in Panel B of Table 10. The IVs used include education and occupation of the respondent's father as well as the community-specific number of refrigerators per 100 households. Consistent with previous studies, *SES* in general has a statistically significant and positive influence on *HLTH*. The results are sensitive to the definitions of *SES* and *HLTH*. The positive influence is statistically significant when *SBES* is used to represent *SES*. However, when *INCM* is used to represent *SES*, the positive influence is found only for *FH*, but not for *SBH*. The estimates with IVs and without IVs are markedly different but seem to be consistent. This chapter thus concludes that a better self-reported economic status can increase the probability of having good functional health and self-reported health. However, a higher household income per capita can only increase the probability of having good functional health but not self-reported health.

Table 10 Estimation Results of Fixed-Effects LPMs

	HLTH=FH		*HLTH=SBH*	
	Model 1	Model 2	Model 1	Model 2
	SES=INCM	*SES=SBES*	*SES=INCM*	*SES=SBES*
Panel A. Fixed-Effects LPMs without IV				
SES	-0.006	0.054 ***	0.009	0.216 ** *
	(0.005)	(0.015)	(0.006)	(0.021)
N	24,452	24,452	24,452	24,452
Log Likelihood	-1611.05	-1938.70	-2557.31	-1003.18
Panel B. Fixed-Effects LPMs with IV				
$\widehat{SES}$	0.035 **	0.413 ***	-1.1×10^{-4}	0.280 **
	(0.015)	(0.101)	(0.019)	(0.122)

N	24,452	24,452	24,452	24,452
Log Likelihood	-817.84	-899.47	-1125.51	-1221.10
Panel C. Fixed-Effects LPMs with IV for Males				
$\widehat{SES}$	0.024	0.219 **	0.017	0.206
	(0.015)	(0.111)	(0.018)	(0.136)
N	10,914	10,914	10,914	10,914
Log Likelihood	-423.29	-461.20	-533.02	-574.56
Panel D. Fixed-Effects LPMs with IV for Females				
$\widehat{SES}$	0.033 **	0.609 ***	0.014	0.407 *
	(0.014)	(0.198)	(0.019)	(0.232)
N	13,538	13,538	13,538	13,538
Log Likelihood	-377.48	-420.20	-588.35	-643.41
Panel E. Fixed-Effects LPMs with IV for Young Elderly				
$\widehat{SES}$	0.034 *	0.470 **	-0.006	-0.075
	(0.019)	(0.196)	(0.023)	(0.233)
N	7,709	7,709	7,709	7,709
Log Likelihood	-311.16	-339.12	-409.26	-422.53
Panel F. Fixed-Effects LPMs with IV for Middle Elderly				
$\widehat{SES}$	0.048 *	0.940 **	-0.019	-0.093
	(0.025)	(0.375)	(0.027)	(0.343)
N	5,926	5,926	5,926	5,926
Log Likelihood	-255.13	-282.74	-269.60	-293.98
Panel G. Fixed-Effects LPMs with IV for Oldest Elderly				
$\widehat{SES}$	0.035 ***	0.322 ***	0.057 ***	0.572 ***
	(0.013)	(0.105)	(0.020)	(0.156)
N	10,817	10,817	10,817	10,817
Log Likelihood	-245.66	-270.58	-453.22	-496.58

Time-varying characteristics as well as time fixed effects are controlled for in all models.

All standard errors in parentheses are heteroskedasticity-adjusted.

* p< 0.1.** p < 0.05. *** p < 0.01.

4.4.3 Estimation Results by Gender

This chapter discusses the roles of gender and aging in relation to the health-SES relationship. Here, the sample is split into two gender subsamples and three age subsamples. Fixed-effects linear probability modeling using the same IVs is applied to all five subsamples.

Estimation results for the male and female subsamples are presented in Panels C and D of Table 10, respectively. According to Panel C, it is demonstrated that, for elderly men, the only situation in which *SES* has a statistically significant and positive influence on *HLTH* is where *HLTH* is represented by *FH* and *SES* is represented by *SBES*. Elderly men will have a higher probability of having good functional health if they have a better self-reported economic status.

The finding for elderly women is consistent with the entire sample. According to Panel D, *SES* defined as *INCM* has a statistically significant and positive influence only on *HLTH* defined as *FH*. However, *SES* defined as *SBES* has a statistically significant and positive influence on *HLTH*, regardless of whether *FH* or *SBH* is used to represent health outcomes. In other words, a better self-reported economic status increases the probability that elderly women have good functional health and good self-reported health. However, a higher household income per capita only increases the probability that elderly women have good functional health. These results suggest that the health-SES relationship among elderly men

is different from that among elderly women. It is stronger, more consistent and more robust for the latter group.

4.4.4 Estimation Results by Age

To investigate the differential impacts of SES on health across different age groups, the sample is divided into three subsamples: the young elderly (aged 65-74), the middle elderly (aged 75-84) and the oldest elderly (aged 85 and above). The results are presented in Panels E, F, and G, respectively. In general, a positive influence of *SES* on *HLTH* is found across all age groups, if *SES* is represented by *SBES* and *HLTH* is represented by *FH*. However, this impact is statistically insignificant when *SES* is represented by *SBES* and *HLTH* is represented by *SBH*, except for the oldest elderly subsample. It is worth noting that, for the oldest level of aging, the positive influence of *SES* on their *HLTH* is statistically significant and consistent across all measures of *HLTH* and *SES*. The sensitivity of the health-SES relationship to the measurement of both variables is well noted in both of the subsample analyses .

4.4.5 The Mundlak-Chamberlain approach

In addition, as a robustness check, the Mundlak (1978) and Chamberlain (1980) approach (M-C, henceforth) is used as an alternative to fixed-effects modeling. Here, in addition to the time-varying characteristics included in the fixed-effects model, the M-C regression includes time-invariant characteristics (e.g. sex, education and occupation) and the individual-specific means (across time periods) of the time-varying variables that are likely to be correlated with the unobservables.

The inclusion of these individual-specific time-averaged variables implies that the estimation is based on deviations from the individual-specific means, which makes the Mundlak-Chamberlain method similar to fixed-effects modeling.

Accounting for endogeneity bias using the same IVs as above, Table 11 presents results from the Mundlak-Chamberlain approach. The results suggest that household income is significantly associated with only self-reported health status, but not functional health. Subjective SES, on the other hand, is no longer significant in any of the equations.

Table 11 Regression Coefficients from Linear Probability Models Estimated with the Mundlak-Chamberlain Approach

Variables	Model 1	Model 2	Model 1
Panel A. Outcome: functional health			
Ln (income)	0.006		-0.025
	(0.016)		(0.038)
Subjective economic status (=1)		0.215	0.623
		(0.241)	(0.417)
N	17941	19739	17898
Panel B. Outcome: self-reported health			
Ln (income)	0.066 ***		-0.010
	(0.014)		(0.046)
Subjective economic status (=1)		0.215	0.247
		(0.325)	(0.527)
N	17898	18421	16705

Time-varying characteristics as well as time fixed effects are controlled for in all models.

All standard errors in parentheses are heteroskedasticity-adjusted.

*p< 0.1.** p < 0.05. *** p < 0.01.

4.5 Concluding Remarks

This chapter investigates the effect of SES on health outcomes of older people in China. Three waves of the nationally representative CLHLS conducted in 2005, 2008-2009 and 2011-2012 are used. This chapter explores two dependent dummy variables of self-reported and functional health and employs subjective and objective measures of SES, represented by self-reported economic being and log household income per capita respectively. Based on two-stage fixed-effects linear probability modeling where the reverse causality problem is accounted for, this chapter finds that, in general, better SES increases the probability that an older adult in China would have good health outcomes. This conclusion is consistent with the existing literature, which also finds a positive association between health and SES among older adults in China and elsewhere (Kumar et al., 2016; Roy & Chaudhuri, 2008; Strauss et al., 2010; Witvorapong, 2018).

The chapter also demonstrates that the positive SES gradient is sensitive to measures of SES and health used and is not uniform across gender and age groups. While the subjective SES measure is found to be a strong predictor of both functional health and self-reported health for the Chinese aging population for the entire sample, its impact on self-reported health on the male, the young elderly, and the middle elderly subsamples is not statistically significant. On the other hand, the objective SES measure, represented by household income per capita, increases only the probability of having good functional health but not self-reported

health. This is true for the entire sample and almost all of the sub-samples, with the exception of the oldest elderly group. Overall, the chapter indicates that the SES-health nexus among the aged population in China is strongest, when the measures used are subjective SES and (objective) functional health, and suggests that the SES gradients on health for females and the oldest elderly are stronger than for males and younger elderly people. The Mundlak-Chamberlain approach shows different results yet still provides evidence (albeit weak) in support of the SES-health positive relationship overall.

With regard to the choice of measure, this chapter adds to the literature in two ways. First, it provides a more systematic way of operationalizing SES and health, categorizing them into subjective versus objective measures and exploring all possible pairs of outcomes. This is in contrast with existing studies that consider either objective or subjective measures alone (Hanibuchi et al., 2012; Kumar et al., 2016; Zimmer et al., 2010). Second, even though the sensitivity of the health-SES linkage to the choice of measure is well documented (Duncan et al., 2002; Koskinen & Martelin, 1994; Zimmer & Kwong, 2004), existing studies are correlational. This chapter demonstrates that the sensitivity persists, even when endogeneity bias is minimized and causality is considered. Altogether, the chapter confirms that subjective and objective measures are indeed different. It is possible that subjective measures capture a comparative sense of well-being that is derived from personality traits and preferences in a way that objective measures do not.

The fact that female older adults and the oldest elderly display a stronger health-SES relationship suggest that their health is more susceptible to changes in economic wellbeing, compared to the other

subgroups. With regard to gender, a similar finding is observed in Duncan et al. (2002) and Strauss et al. (2010) based on US and Chinese data respectively, but the opposite is found in Koskinen and Martelin (1994) using Finnish data. With regard to age groups, the finding here is inconsistent with Smith and Goldman (2007), based on a sample of Mexican older adults. In light of differences between this chapter and the literature, an investigation into the allocation of health-related resources across gender and age groups at the national as well as the household level represents an important extension that is left for future studies.

This chapter suggests that there is a need to address SES-linked inequality in health among older adults in China. The positive health-SES relationship implies not only that a method of improving health in old age is to improve SES, but also that financially vulnerable older adults need to be protected from severe health risks. A more generous pension program and an expansion of old-age security schemes should be considered (Kumar et al., 2016; Pei & Pillai, 1999). Additional support may be targeted at older women and the oldest elderly, who would benefit the most from social security programs. Also, with the increasing aging population and the shrinking family size, the need for long-term care services is likely to intensify in the future. This directly impacts functional health of older adults who are childless and/or who are unable to afford such services. Further investments in health infrastructure and the removal of financial barriers to long term care services are required to ensure healthy aging in China.

Chapter 5 Conclusions and Discussion

5.1 Conclusions

This thesis has utilized a panel data set using three waves of the nationally representative Chinese Longitudinal Healthy Longevity Survey in 2005, 2008-2009, 2011-2012 to examine the relationship between living arrangements and intergenerational transfers, to test whether the health insurance have influence on health expenditures and health behaviors and to analyze the effect of socioeconomic status on health outcomes of older people in China.

Chapter 2 investigates the effect of living arrangements on the receipt of different types of intergenerational transfers, including net monetary transfers, contact, informal care and emotional support. The main explanatory variables include actual living arrangements as well as the discrepancy between actual and preferred living arrangements. Endogeneity bias is explicitly accounted for through fixed-effects instrumental-variable regression modeling. The chapter demonstrates that co-residence serves as a substitute of monetary transfers and is positively linked to all forms of time transfers (i.e., contact, informal care and emotional support). Living alone with children residing in the same city positively affects net monetary transfers and contact but does not exert statistically significant effects on informal care. The discordance between actual and preferred living arrangements is also found to be an important determinant of intergenerational transfers and should be explored further in future studies.

Chapter 3 investigates the effect of health insurance on health expenditures and health behaviors of older people. Total health

expenditures (THE), out of-pocket expenditures (OOP), smoking, drinking and exercising are investigated. Enrollment in any of the three major health insurance programs represents the main explanatory variable. Panel-data analyses involving fixed-effects modeling and cross-sectional analyses using two-part models show that health insurance increases THE and reduces OOP, suggesting that it increases access to health services while minimizing financial burden. The chapter also finds that insurance leads to increased probabilities of smoking and drinking as well as exercising. This suggests that the effects of health insurance are complex, encouraging certain unhealthy behaviors as well as certain heathy behaviors. The results vary across age and education groups as well as across time.

Chapter 4 investigates the effect of socioeconomic status (SES) on health outcomes of older people. It explores two dependent dummy variables of self-reported and functional health and employs subjective and objective measures of SES, represented by self-reported economic being and log household income per capita respectively. Using two-stage fixed-effects linear probability modeling, this chapter finds that, in general, better SES increases the probability that an older adult would have good health outcomes. The chapter also demonstrates that the positive SES gradient is sensitive to measures of SES and health and is not uniform across gender and age groups. While the subjective SES measure is found to be a strong predictor of both functional health and self-reported health for the entire sample, its impact on self-reported health on the male, the young elderly, and the middle elderly subsamples is not statistically significant. On the other hand, the objective SES measure increases only the probability of having good functional health

but not self-reported health. This is true for the entire sample and almost all of the sub-samples, with the exception of the oldest elderly group. The chapter suggests that the SES gradients on health for females and the oldest elderly are stronger than for males and younger elderly people.

5.2 Policy implications

The thesis has implications for policy and practice. First, the findings of Chapter 2 suggests that it is important that, in the long run, the government increases the level of pensions or public transfers and social care for older people in rural China so that they can reduce their dependence on financial support provided by their adult children (Ning & Wang, 2015). It is also crucial that, while strengthening the pension system, the Chinese government recognizes that filial values are important mechanisms, at least in the short run (Luo et al., 2017) and should encourage adult children to visit their parents more regularly (Luo & Zhan, 2012) in order to improve wellbeing of Chinese older people.

In fact, China has tried to transform filial piety into legal obligations. The Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly stipulates that children should support their older parents. The government also encourages people, especially those in rural areas, to sign a ‘family support agreement’ stipulating the types and amount of support children agree to provide for their parents (Xu, 2001). However, due to population control policies and socio-economic transformation, it is expected that more older adults would be living with fewer children in the future. The formal care sector should therefore be developed to substitute for the roles traditionally assumed by families.

Both public and private providers are increasingly expected to play a more important role in providing affordable care to older Chinese people both now and in the future. Intergenerational monetary transfers could be converted into daily care services through local elder-care institutions and the family support mechanism would continue to function well.

Second, the findings of Chapter 3 suggest that health insurance should be strengthened as China's health care needs will increase dramatically with the aging population. For example, reimbursement policies, which impact out-of-pocket expenses incurred by patients, should be constantly evaluated and revised to provide proper incentives for enrollees (Cheng et al., 2015; X. Wang et al., 2014). Given that many older people in China have non-communicable diseases (NCDs), the government may also consider increasing the reimbursement level for treatment of NCDs.

While this thesis does not explore directly the reasons for not having a health insurance, it shows that health insurance has beneficial effects on health care access and the expansion of its coverage should be encouraged. More specifically, for people who cannot afford the insurance premium, the government should consider working on increasing subsidy or implementing medical relief policies for the elderly to help them gain access to necessary healthcare services.. It should also further educate older people on the benefits of insurance programs. Finally, health insurance benefits packages should be constantly evaluated to fit the disease profile and health expenditure pattern of the population. Preventive health services for chronic conditions such as disease screening and rehabilitation services could be included in the benefits package.

Third, according to the findings of Chapter 4 where SES is positively linked with health, economic growth and increasing prosperity are important to health of older people. Considering Chapters 3 and 4 together shows that health care demands of the elderly can be suppressed by their income. If minor illnesses are not taken care of because of income problems, then they will gradually deteriorate, resulting in even greater medical needs and becoming a burden for the family and society. If reimbursing health expenses for everyone is not feasible, then targeting more vulnerable groups such as women, the elderly, and the rural elderly should represent a valid policy option.

Also, economic factors, such as pensions and household income, can make a difference in promoting health behaviors among older adults. Wealthier older people have increased opportunities for mental exercise and social participation (Liu et al., 2019), which impact their health behaviors and their health (Witvorapong, 2018).

It is worth noting that state support has never been seen as a crucial ingredient of the security of older adults since family support has been predominant and reliable (Yuan, 1990). However, family size will likely decline in the near future, which undermine the traditional systems of support (Zimmer & Kwong, 2003). Today, old-age security in the form of pensions is almost strictly an urban phenomenon and only a small proportion of Chinese people receive pensions (Pei and Pillai, 1999). There is clearly a need to expand the pension program to include individuals in smaller organizations, those living in rural areas, and those who may have small families.

Finally, in all Chapters, the thesis has highlighted substantial differences between rural and urban areas, in terms of socio-demographic characteristics, family structures and economic activities (Luo et al., 2017; Young & Wilmott, 2013). Separate plans for health and social care for rural and urban older residents, addressing different needs, are recommended (Jiang et al., 2013; Ning & Wang, 2015). For example, community-based care services (e.g. day care centers for older people) may be effective in urban areas, while shared care from neighbors and villagers may be more realistic in rural areas (Zhu & Walker, 2018). Preferences are also changing. Future cohorts of elderly Chinese especially in urban areas may need less care by adult children because they will be better educated, wealthier and have greater access to health care (Zimmer & Kwong, 2004).

5.3 Limitations

The thesis has several limitations. First, despite the fact that panel data are used, the data are limited in some respect and can lead to omitted variable bias. Regarding Chapter 2, no information about adult children and siblings of respondents is available, including key variables, such as age and income of children and siblings. These variables may be important, as the family network should be accounted for and these unobservables may bias analyses of the determinants of living arrangements and intergenerational transfers. Regarding Chapter 3, factors related to the supply side, such as the number and characteristics of doctors, community health programs, and healthcare quality, which impact the availability and quality of health service providers and, finally, health expenditures, are not available in the data. Regarding Chapter 4,

the presence of chronic conditions and wealth (as opposed to income), which are widely used in the literature, are not considered in the chapter because they are incomplete.

Second, some variables may have measurement errors which may impact the results. For Chapter 2, one of the main dependent variables, monetary intergenerational transfers, from co-resident households may be incorrectly measured. For adult children living in the parental household, monetary transfers may include buying food or offering free accommodation, although these are in fact in-kind and not monetary transfers in the strict sense. For Chapter 3, the health expenditure variables, total health expenditures (THE) and out-of-pocket expenditures (OOP), may be subjected to recall errors as the relevant questions pertain to events that occurred in the past. For Chapter 4, household income may be incorrectly measured.

Finally, the strategies used to address endogeneity in the thesis are not perfect. The credibility of the instrumental variables (IVs) may be questioned. For example, for Chapter 2, parental education and occupation, which represent some of the IVs, may not be exogenous. Since health of older people today is a result of the health status when they were young and parental characteristics are known to impact health of people in their childhood, it is possible that parental education and occupation capture early-life health and are therefore endogenous in the lifetime-utility maximization framework.

5.4 Suggestions for further studies

Further studies may be conducted. For Chapter 2, there is a need to research whether income facilitates more independent living and less co-residence with adult children; whether independent-living parents report more utilization health services than co-resident parents; and to what extent the expansion of pension changes transfers from adult children. For Chapter 3, there is a need to research whether different insurance plans in China create disparities in health care utilization and health behaviors among older people. More outcome variables, e.g. frequency of medical care use, health expenditure per outpatient visit or inpatient spell, and health status, may be further explored as health insurance may also impact these outcomes. Finally, for Chapter 4, there is a need to consider a fuller set of SES and health indicators and to explored if the effects of SES on health are immediate or lagged.

Appendix

Table A.1: Mean comparison tests: Samples with and without THE

Variable	Test-Statistics			
	2005	2008	2011	All Waves
HI	-2.0733**	-1.2203	-2.7017***	0.2990
SEX*	-1.3703	-3.4495***	-0.9683**	-3.4814***
AGE	1.4914	-3.5373***	2.6137***	0.1129
MARR	-3.9766***	-0.1186	-1.5314	-3.0462
RUAL	1.5089	0.0244*	4.2786***	2.5890
CORES	-4.1203***	-2.4355**	-3.3888***	-5.6891*
CHILD	-2.2933**	-1.5735	-0.0655	-2.3269
EDU*	-4.4685***	0.1817	0.4231*	-1.8972
INCM	-0.0078	-2.2034**	-0.9430	-0.9886
Chronic	-18.6720***	-19.5286***	-16.2342***	-30.3235***
FH	5.6929***	9.9986***	5.8507***	12.3925***

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively.

2. T-tests are performed for continuous and dummy variables and Chi-2 tests are performed for categorical variables.

Table A.2: Fixed-effects regression results for health care utilization with lagged health insurance

Variables	Log THE	Log OOP
HI (t-1)	-0.0322*	-0.174*
	(0.018)	(0.019)
AGE	0.142***	0.116***
	(0.028)	(0.029)
MARR	0.179	0.175
	(0.252)	(0.264)
RUAL	-0.0932	-0.105
	(0.142)	(0.149)
CORES	0.272	0.483**
	(0.213)	(0.224)
INCM	-0.0147	-0.0193
	(0.041)	(0.042)
Chronic	0.440***	0.430***
	(0.072)	(0.076)
FH	-0.802***	-0.741***
	(0.144)	(0.151)
Time fixed effects	Yes	Yes
N	6,396	6,296
F test statistics	18.82***	14.67***

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

Table A.3: Fixed-effects logistic regression results for health behaviors, with lagged health insurance

Variables	Smoke	Alcohol	Exercise
HI (t-1)	0.152	0.250	-0.369**
	(0.271)	(0.226)	(0.161)
AGE	-0.0808*	0.0140	0.101***
	(0.042)	(0.038)	(0.024)
MARR	-0.00014	0.262	-0.107
	(0.339)	(0.304)	(0.214)
RUAL	0.127	0.450**	-0.125
	(0.201)	(0.180)	(0.117)
CORES	0.395	-0.208	0.00358
	(0.344)	(0.260)	(0.172)
INCM	-0.0551	-0.0217	0.0595*
	(0.056)	(0.048)	(0.034)
Chronic	-0.0266	-0.0538	-0.0366
	(0.109)	(0.101)	(0.062)
FH	0.0448	0.0640	0.437***
	(0.213)	(0.183)	(0.116)
Time fixed effects	Yes	Yes	Yes
N	660	884	2,104
F-test statistics	9.78	9.72	41.43

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

Table A.4: Fixed-effects regression results for gender and education sub-samples, with lagged health insurance

Variables	Dependent Variables				
	Log THE	Log OOP	Smoke	Alcohol	Exercise
Male Sub-Sample					
HI (t-1)	-0.111*	0.068	0.145	0.221	-0.0737
	(0.025)	(0.184)	(0.309)	(0.276)	(0.212)
Female Sub-Sample					
HI (t-1)	0.0832	-0.182*	0.281	0.148	-0.816***
	(0.269)	(0.109)	(0.618)	(0.425)	(0.254)
Literate Sub-Sample					
HI (t-1)	0.0213**	0.216*	0.0452	0.0801	-0.276
	(0.012)	(0.177)	(0.343)	(0.306)	(0.203)
Illiterate Sub-Sample					
HI (t-1)	-0.140*	-0.011	0.450	0.437**	-0.555**
	(0.028)	(0.207)	(0.463)	(0.035)	(0.267)

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

Table A.5: Results from Heckman sample selection models: Cross-sectional analyses

Wave	Log THE	Log OOP
Wave: 2005		
HI - selection equation	-0.102	-0.013*
	(0.107)	(0.024)
HI - outcome equation	0.545***	0.503**
	(0.045)	(0.102)
Wave: 2008		
HI - selection equation	-0.125*	0.044*
	(0.072)	(0.025)
HI - outcome equation	0.498***	0.675***
	(0.038)	(0.028)
Wave: 2011		
HI - selection equation	-0.210	0.061
	(0.136)	(0.038)
HI - outcome equation	0.697***	0.584***
	(0.020)	(0.030)

Notes: 1. ***, **, * = 1%, 5% and 10% significance levels, respectively

2. All standard errors in parentheses are heteroskedasticity-adjusted.

3. Co-residence is used as the exclusion restriction in the selection equation.

Table A.6: Breusch-Pagan Lagrange Multiplier Tests and Hausman Tests

Specifications	Dependent variable: *FH*		Dependent variable: *SBH*	
	BP-LM Test	**Hausman Test**	**BP-LM Test**	**Hausman Test**
Model 1: *INCM*	503.09**	64.49**	194.07**	80.71**
Model 2: *SBS*	561.34**	69.12**	224.49**	87.79**

Chi-square test statistics are presented in the table.

** $p < 0.01$.

Table A.7: Correlation Matrix of All Explanatory Variables

Variables	*SBH*	*FH*	*INCM*	*SBES*	*AGE*	*AGE2*	*MARR*	*CORES*	RUAL	HINS
SBH	1.000									
FH	0.171***	1.000								
INCM	0.055***	-0.029***	1.000							
SBES	0.185***	0.080***	0.275***	1.000						
AGE	-0.003	-0.541***	0.098	-0.025	1.000					
AGE2	-0.002	-0.533***	0.099	-0.023	0.998***	1.000				
MARR	0.008	0.332***	-0.018	0.029*	-0.482	-0.477	1.000			
CORES	0.012*	-0.107***	0.150	0.056*	0.161	0.160*	-0.282	1.000		
RUAL	-0.010	-0.003	-0.298***	-0.075***	-0.019	-0.018	-0.016**	0.075	1.000	
HINS	-0.022***	0.001	0.315*	0.055*	0.000	-0.001	0.062	-0.028	-0.071	1.000

Levels of Bonferroni-adjusted significance used.

* p< 0.1.**p < 0.05. *** p < 0.01.

Table A.8:Tests of Multicollinearity based on Variance Inflation Factor

Variables	*SBH*		*FH*	
	VIF	*1/VIF*	*VIF*	*1/VIF*
INCM	1.39	0.720	1.38	0.723
SBES	1.07	0.932	1.07	0.932
AGE	2.28	0.438	2.28	0.438
AGE2	2.27	0.441	2.27	0.441
MARR	1.51	0.664	1.53	0.656
CORES	1.15	0.870	1.14	0.875
RUAL	1.13	0.886	1.13	0.885
HINS	1.15	0.867	1.15	0.872
Mean VIF	1.49		1.49	

Table A.9: Endogeneity and Overidentification Tests

Test	*SBH*		*FH*	
	Test statistics	*P-value*	*Test statistics*	*P-value*
Durbin-Wu-Hausman Test				
Model 1: INCM				
F-Test	1.1560	p=0.069	4.8668	p= 0.049
Model 2: SBES				
F-Test	7.4974	p=0.078	3.3853	p=0.085
Weak Instrument and Overidentification Test				
Model 1: INCM				
F-Test (First-stage)	61.326	p=0.000	64.514	p=0.000
Chi2-Test (Overid)	0.814	p=0.666	1.374	p=0.551
Model 2: SBES				
F-Test (First-stage)	20.181	p=0.000	22.611	p=0.000
Chi2-Test (Overid)	1.067	p=0.587	1.949	p=0.481

Table A.10: Comparison of Logit and LPM Estimates

	HLTH=FH		***HLTH=SBH***	
Variables	**FE-Logit with IV**	**FE-LPM with IV**	**FE-Logit with IV**	**FE-LPM with IV**
SES=INCM	0.128 *	0.035 **	-0.097	-1.1×10^{-4}
	(0.029)	(0.015)	(0.030)	(0.019)
SES=SBES	0.276 **	0.413 ***	0.322 *	0.280 **
	(0.018)	(0.101)	(0.014)	(0.122)
Log Likelihood	-1002.35		-1580.26	

Time-varying characteristics as well as time fixed effects are controlled for in all models.

All standard errors in parentheses are heteroskedasticity-adjusted.

* p< 0.1.**p < 0.05. *** p < 0.01.

Appendix A.11: Estimation Results of Fixed-Effects LPMs with and without IV for Entire Sample

	Fixed-Effects LPMs w/o IV				Fixed-Effects LPMs w/ IV			
	HLTH=FH		*HLTH=SBH*		*HLTH=FH*		*HLTH=SBH*	
	Model 1 *SES=INCM*	Model 2 *SES=SBES*	Model 1 *SES=INCM*	Model 2 *SES=SBES*	Model 1 *SES=INCM*	Model 2 *SES=SBES*	Model 1 *SES=INCM*	Model 2 *SES=SBES*
SES	-0.006	0.054 ***	0.009	0.216 ***				
	(0.005)	(0.015)	(0.006)	(0.021)				
$\widehat{SES}$					0.035 **	0.413 ***	-1.1×10^{-4}	0.280 **
					(0.015)	(0.101)	(0.019)	(0.122)
AGE	0.321 ***	0.377 ***	0.126	0.142	-0.086 ***	-0.085 ***	-0.006	-0.009 *
	(0.080)	(0.073)	(0.123)	(0.113)	(0.004)	(0.004)	(0.005)	(0.005)
AGE-Square	-0.409 ***	-0.475 ***	-0.081	-0.095	0.038 ***	0.038 ***	0.004	0.006 *
	(0.092)	(0.084)	(0.145)	(0.133)	(0.002)	(0.002)	(0.003)	(0.003)
MARR	0.085 ***	0.092 ***	-0.016	-0.024	0.122 ***	0.116 ***	0.016	0.007
	(0.019)	(0.018)	(0.024)	(0.021)	(0.009)	(0.008)	(0.011)	(0.009)
CORED	-2.9×10^{-4}	-0.002	-0.001	-0.001	-0.008 **	-0.007 **	5.7×10^{-4}	0.004
	(0.003)	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)	(0.005)	(0.004)

RUAL	1.4×10^{-3}	-0.0036	0.007	0.005	0.021	0.007	0.0307	0.009
	(0.010)	(0.010)	(0.014)	(0.013)	(0.016)	(0.010)	(0.020)	(0.012)
HINS	-0.025 ***	-0.020 **	-0.031 **	-0.015	-0.003	-0.007	-0.0178	-0.012
	(0.009)	(0.008)	(0.013)	(0.012)	(0.009)	(0.010)	(0.012)	(0.012)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WAVE FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic	15.18 ***	15.92 ***	13.66 ***	13.27 ***	31.06 ***	30.08 ***	12.44 ***	13.07 ***

All standard errors in parentheses are heteroskedasticity-adjusted.

* p< 0.1.** p < 0.05. ***p < 0.01.

Appendix A.12: Estimation Results of Fixed-Effects LPMs with IV by Gender

	Male Subsample				Female Subsample			
	HLTH=FH		*HLTH=SBH*		*HLTH=FH*		*HLTH=SBH*	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	SES=INCM	*SES=SBES*	*SES=INCM*	*SES=SBES*	*SES=INCM*	*SES=SBES*	*SES=INCM*	*SES=SBES*
$\widehat{SES}$	0.024	0.219 **	0.017	0.206	0.033 **	0.609 ***	0.014	0.407 *
	(0.015)	(0.111)	(0.018)	(0.136)	(0.014)	(0.198)	(0.019)	(0.232)
AGE	-0.059 ***	-0.059 ***	-0.018 *	-0.022 **	-0.110 ***	-0.107 ***	-0.004	-0.004
	(0.006)	(0.006)	(0.009)	(0.009)	(0.005)	(0.006)	(0.007)	(0.008)
AGE-Square	0.020 ***	0.021 ***	0.011 *	0.0132 **	0.053 ***	0.051 ***	0.003	0.003
	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.005)
MARR	0.063 ***	0.062 ***	-0.001	0.004	0.07 ***	0.067 ***	1.75×10^{-4}	-0.013
	(0.014)	(0.014)	(0.017)	(0.016)	(0.014)	(0.013)	(0.017)	(0.014)
CORED	-0.005	-0.0024	0.005	0.008 *	-0.010 *	-0.013 **	-0.004	-0.002
	(0.006)	(0.003)	(0.007)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
RUAL	0.010	8.8×10^{-7}	0.029	0.011	0.026	0.006	0.033	0.010
	(0.024)	(0.017)	(0.028)	(0.019)	(0.022)	(0.013)	(0.029)	(0.016)
HINS	8.67×10^{-4}	0.012	-0.023	-0.010	-0.010	-0.035 *	-0.015	-0.024
	(0.017)	(0.013)	(0.020)	(0.016)	(0.010)	(0.018)	(0.015)	(0.021)

Individual FE	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
WAVE FE	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
F-Statistic	18.672	***	19.202	***	21.037	***	19.858	***	20.563	***	22.534	***	14.219	***	16.537	***

All standard errors in parentheses are heteroskedasticity-adjusted.

* p< 0.1.** p < 0.05. *** p < 0.01.

Appendix A.13: Estimation Results of Fixed-Effects LPMs with IV by Age

	Young Elderly				Middle Elderly				Oldest Elderly			
	HLTH=FH		*HLTH=SBH*		*HLTH=FH*		*HLTH=SBH*		*HLTH=FH*		*HLTH=SBH*	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
$\widehat{SES}$	0.034 *	0.470 **	-0.006	-0.075	0.048 *	0.940 **	-0.019	-0.093	0.035 ***	0.322 ***	0.057 ***	0.572 ***
	(0.019)	(0.196)	(0.023)	(0.233)	(0.025)	(0.375)	(0.027)	(0.343)	(0.013	(0.105	(0.020	(0.156)
AGE	0.007	0.043	-0.068	-0.101	-0.086	-0.240 **	0.048	8.3×10^{-4}	-0.158 ***	-0.144 ***	-0.028	-0.001
	(0.048)	(0.053)	(0.058)	(0.065)	(0.082)	(0.122)	(0.087)	(0.100)	(0.018	(0.018	(0.033	(0.032)
AGE-Square	-0.021	-0.045	0.045	0.068	0.038	0.133 *	-0.029	-0.001	0.077 ***	0.070 ***	0.014	1.7×10^{-4}
	(0.033)	(0.037)	(0.040)	(0.045)	(0.050)	(0.075)	(0.053)	(0.061)	(0.009	(0.009	(0.017	
MARR	0.144 ***	0.139 ***	0.021	0.022	0.142 ***	0.098 ***	0.022	0.002	0.081 ***	0.084 ***	0.031	0.035
	(0.015)	(0.014)	0.017)	(0.016)	(0.021)	(0.021)	(0.022)	(0.017)	(0.014	(0.015	(0.020	(0.022)
CORED	-0.002	0.002	0.017 *	0.011	-0.024 ***	-0.036 **	0.009	0.006	-0.009 *	-0.005	-0.020 **	-0.007
	(0.008)	(0.004)	(0.009)	(0.005)	(0.009)	(0.014)	(0.009)	(0.012)	(0.005	(0.004	(0.008	(0.006)
RUAL	-0.004	-0.008	-0.049	-0.033	0.066 *	0.035	0.056	0.036	0.041 *	0.013	0.102 ***	0.035
	(0.029)	(0.017)	(0.035)	(0.021)	(0.035)	(0.029)	(0.036)	(0.023)	(0.023	(0.014	(0.038	(0.022)
HINS	-0.002	-0.010	0.011	0.014	-0.039 *	-0.052	-0.036	-0.025	-0.002	-0.003	-0.026	-0.024
	(0.020)	(0.020)	(0.024)	(0.024)	(0.024)	(0.033)	(0.025)	(0.026)	(0.011	(0.012	(0.019	(0.020)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WAVE FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic	22.453 ***	22.355 ***	17.304 ***	18.018***	18.442 ***	19.327 ***	10.488 ***	11.270 ***	20.713 ***	20.698 ***	15.716 ***	17.018 ***

All standard errors in parentheses are heteroskedasticity-adjusted.

*p< 0.1.** p < 0.05. ** *p < 0.01.

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