Università
Ca'Foscari
Venezia

Corso di Dottorato di ricerca

in Economics

Ciclo XXX

Anno di discussione 2018

Tesi di Ricerca

Wellbeing and Ageing in China

SSD: SECS-P/01

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Table of Contents

INTRODUCTION

Population ageing is a major global demographic tendency that has started first in the developed countries since the past several decades, which entails a rapidly growing proportion of the elderly in the population. This phenomenon then spreads to the developing countries. China is one of the examples that has been experiencing significant ageing and is expected to become more serious in the upcoming years as a result of reducing mortality rate and increasing life expectancy. For instance, it is projected that around 490 million Chinese population (36.5%) will reach age 60 and over by 2050[1]. Recently, Chinese policy-makers have switched more attention to the old population and address the ageing issues in China. As the elderly is becoming a more and more important group that influences the structure and functioning of the society, their well-being is of great concern on the public policy agenda. Thus, the understanding of the well-being determinants is undoubtedly crucial because it can help us develop a set of institutions which foster social inclusion and enhance welfare of the old individuals.

The aim of this thesis is to investigate and understand different well-being determinants of the old Chinese individuals from various aspects. In particular, the thesis measures old individuals' wellbeing beyond traditional welfare measures and focuses on the long-term effect of socio-economic policies on the later life wellbeing. It also contributes to the literature on the welfare of the elderly by highlighting the importance of early life conditions in determining later-life well-being. All the analyses will be closely associated with Chinese-specific economic and social situation. The thesis is structured by three chapters.

In the 1950s, the People's Republic of China introduced a household registration system (called hukou) to keep under control the internal migration from rural to urban areas and is still in effect today. Since then, Chinese citizens are classified into either rural or urban hukou holders. Having an urban or rural hukou is a key determinant of the quality of the social policies provided to citizens and results in a great rural-urban divide in terms of various well-being indicators (i.e. Knight and Song, 1999; Liu, 2005; Ren and Treiman, 2015). The first chapter (coauthored with Agar Brugiavini and Danilo Cavapozzi) of the thesis summarizes the main features of the social policy schemes with respect to education, health care, income protection, housing and pensions that rural and urban hukou holders are eligible to

[1] World population Ageing report in 2015. Department of Economic and Social Affairs Population Division. United Nations.

and their evolution over time. This chapter presents the institutional framework in which older Chinese spent most of their lives and it is essential to understand the second and the third chapter of the thesis, which focus on the current well-being outcomes of this part of the Chinese population.

The second chapter (coauthored with Agar Brugiavini and Danilo Cavapozzi) empirically analyzes the education gradient in well-being late in life based on a representative sample of the Chinese population aged 45 or over. Data are drawn from CHARLS (China Health and Retirement Longitudinal Study). In particular, this chapter analyzes how the education gradient varies between urban and rural hukou holders in order to explore how the well-being effects of educational attainments combine with the marked differences in the social policies implemented in rural and urban China and documented in chapter one. A multidimensional well-being index based on material deprivation and health outcomes of individuals is constructed to measure individual's well-being. Our results show that higher achievements in education are found to have a positive lifetime effect on well-being. However, the education differentials in well-being are higher in the sample of urban hukou holders, who have benefited from more generous socio-economic policies during their lifetime.

The third chapter focuses on later life cognitive functioning which serves as an important determinant of the quality of life and well-being of the elderly (i.e. Banks and Oldfield, 2007; McArdle et al.,2011). Individual's cognitive ability is found to decline dramatically especially at old ages. The factors to buffer this age-related decline are however unknown. This chapter looks at whether and how childhood conditions influence later life cognition based on the same data as in chapter two. Empirical evidence shows that cognitive functioning late in life varies with individual characteristics, including education and hukou type. Further, it supports the hypothesis that, keeping everything else constant, people who experienced a better childhood environment will have a higher level of cognitive skills later in their life. Moreover, favorable childhood conditions could shave off the decline with ageing.

To sum up, since China has been ageing fast nowadays, how to improve the welfare of this increasing old population will become the key of the whole nation. This thesis explores this issue by looking from different perspectives and by applying different methods. It sheds light on the long-term effect of socio-economic policies and early life conditions in determining late-life well-being. In addition, the conclusion of this thesis also provides important implications for policies targeting the young generation.

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CHAPTER 1

Urban-rural differences in social policies: the case of the hukou system in China*

Abstract

Since 1950s, the People's Republic of China has introduced a household registration system (called hukou system) to keep under control the internal migration from rural to urban areas, which was rising disproportionately in view of the increasing industrialization of the urban areas. All Chinese citizens are classified as either urban or rural hukou holders with limited possibilities of changing their status. Social policies designed for urban hukou holders are based on the availability of higher resources and financed by the central government. Rural hukou holders are only guaranteed to basic services and infrastructures financed at the local level. There is a wide literature showing that China presents stark differences between rural and urban areas in well-being indicators and these differences always suggest better quality of life in urban areas. This chapter investigates the determinants of these differentials by documenting the different social policies individuals with rural and urban hukou are eligible to. In particular, we will pay attention to the evolution of these schemes over time. Explaining current socioeconomic and health differences between rural and urban hukou holders cannot neglect the social policy features that they have faced throughout their life.

Key words: hukou system, socio-economic policies

* This is a joint work with Agar Brugiavini and Danilo Cavapozzi. This paper will be published as follows: Brugiavini A., Cavapozzi D., Pan Y., Urban-Rural Differences in Social Policies: the Case of the Hukou System in China. In China's Global Political Economy (eds. Robert Taylor and Jacques Jaussard), Routledge. Forthcoming.

1.1 Introduction

In the second half of the 1950s the People's Republic of China introduces a household registration system to keep under control the internal migration from rural to urban areas, which was rising disproportionately in view of the increasing industrialization of the urban areas in the country. In 1949 households living in the urban area account for 10.6% of the overall population, while in 1956 this percentage increased by more than one third and reached 14.6% (China Statistical Yearbook, 2004). Due to an excess labor influx from rural agriculture sector to urban industrial sector, the State introduces a household registration system to establish a strict control over the migration from rural to urban areas in order to reduce unemployment in urban areas. This makes it possible to guarantee enough grain production from the agriculture sector to support urban workers through a strict food rationing system.

This registration system is called hukou system. Although it was formally introduced in 1951, it has been shaped as a strict regulation system in 1958 and its features remain overall unaltered at least until the beginning of the 2000s. According to the 1958 regulations, all Chinese citizens' are classified into either urban or rural hukou based on their place of residence at that time. Newborn babies' hukou status have to follow their mother's hukou status (Chan and Zhang, 1999). The State allowed the change in the hukou type only in very special cases. Even nowadays, changes of the hukou type are uncommon and allowed by the State in limited circumstances. This classification is particularly relevant for Chinese citizens' well-being since it determines individual's entitlements to social policies, which are hukou-type specific.

Having a urban or rural hukou becomes a key determinant of the quality as well as the generosity of the social policies provided to citizens with respect to education, health care, income protection schemes, housing and pensions. Social policies designed for urban residents are based on the availability of higher resources, while rural hukou holders are only guaranteed to the basic services and infrastructures. The main reason for this is that the State takes the responsibility of financing urban hukou social policies and decentralizes the organization and the financing of the social policies for rural hukou households at the local level. Clearly, the amount of resources and credit access that rural local communities have at their disposal are much lower than those that the State can invest to develop urban areas social infrastructures, such as schools and hospitals, or to finance pension systems for urban workers. This tremendous imbalance in available resources

produces wide differentials in the effectiveness of social policy schemes and jeopardizes their inclusiveness. Official statistics describing health care system in rural and urban areas provide a clear snapshot of this heterogeneity. In 2013 there are 33.45 number of beds in medical institutions in rural areas every 10,000 individuals. This number more than doubles for urban citizens and it is equal to 73.58. Moreover, in the same year the per-capita health expenditure amounts to 1,274.44 yuan in rural areas and to 3,234.12 yuan in urban areas (China Statistical Yearbook, 2015).

After almost 70 years from the introduction of the hukou system, China presents starking differences between rural and urban areas in well-being indicators with respect to a variety of dimensions and they always suggest better quality of life in urban areas. In 2013 newborn mortality rate is 3.7‰ in urban areas and 7.3‰ in rural areas (China Statistical Yearbook, 2015). On average, almost 15 children out of 1000 die before age 5 in rural areas, this number reduces to 6 out of 1000 in urban areas. In 2000 the life expectancy at birth is 75.21 years of age for those born in urban areas but it shrinks to 69.55 for rural areas (Pan and Wei, 2016). In addition, the access to education appears to be higher in urban areas. As documented by Zhang et al. (2015), in the period 2010-2012, only 88% of rural children completed primary schools, this percentage is equal to 100%. Of those who entered junior high schools in rural areas, only 70% completed this cycle of study. Likewise before, this percentage is equal to 100% for urban areas. Finally, only 2% of rural children access tertiary education (college or university). This is an extremely disappointing outcome as compared with the percentage of 54% found for the urban population. Analogous patterns are found when considering household income per-capita. In 2013 its average for rural households was about one third of that found for their urban counterparts (China Statistical Yearbook, 2015).

This chapter contributes to the literature that investigates the reasons underlying these wide differentials by summarizing the different social policies individuals with rural and urban hukou types are eligible to. We will offer an introduction to the main features of the social policy schemes with respect to education, health care, income protection schemes, housing and pensions that rural and urban individuals deal with. In particular, we will pay attention to the evolution of these schemes over time. Explaining current socioeconomic and health differences between individuals with rural and urban hukou types cannot neglect the social policy features that they have faced throughout their whole life.

The rest of the paper is structured as follows. First, we provide an overview of the hukou system over time. Then, in the next five sections, we will present the main

features of the education system, health care system, income protection schemes, housing policies and pension systems available to rural and urban hukou holders. Finally, the last section discusses our main findings.

1.2 An overview of the hukou system

Since the mid-1950s, Communist party leaders in China introduced a strictly enforced residential permit (hukou) system to separate urban and rural residents as an important administrative tool for relieving the demographic pressures in the course of rapid industrialization (Chan, 1994). Hukou system then has come into effect in China for more than half of a century. It has influenced various aspects of life for hundreds of millions of Chinese people and is closely related to the Chinese economic development policies. Residents were classified into the "rural" and "urban" hukou (or "agriculture" and "non-agriculture" hukou)[3]. Holding a different hukou type makes a pronounced distinction between rural and urban residents, determining the social-economic entitlements they are eligible to as well as invisibly shaping the order of social classes of the country. Social welfare policies a Chinese citizen is eligible to are designed differently according to whether she/he is an urban or rural hukou holder. Urban hukou holders get the access to better education resources, health care, housing subsidies, unemployment insurance as well as pensions while rural counterparts are only guaranteed to basic services and infrastructures. Although the rural-urban distinction has characterized the hukou system since the beginning, the degree of rigidity of hukou conversion, referring to change from the rural to urban hukou, varies. One important aim of this chapter is to emphasize and document the evolution of the hukou system over time.

There is extensive literature that gives an explicit introduction to the history and development of hukou system in China. For instance, Cheng and Selden (1994) discuss the origins and social consequences of hukou system until 1990s into details. Chan and Zhang (1999) study the role of hukou system in internal migration and how the policies changed since the late 1970s. Chan (1994) reviews the history of hukou system from a socio-political point of view and examines its influence on the country's industrialization, urbanization, and social and spatial stratification.

[3] There are two classifications in the Chinese household registration system. The first is the type of registration (hukou leibie), which classified residents into the "rural" and "urban hukou (or "agriculture" and "non-agriculture" hukou). The second is the place of registration (hukou suozaidi) based on the individuals' permanent residence. Only one regular residence can be registered for each citizen (Chan and Zhang, 1999). In addition, a person is not entitled to permanent urban hukou even if married with a person who has urban hukou (Whyte and Parish, 1984).

Many papers regard the hukou system as a barrier to development and modernization as well as an obstacle to social equality and free flow of labour market (i.e. Wang, 2003[a]; Liang, 2013).

The long history of hukou system can be broadly divided into three phases.

The first phase is before 1958 ("free mobility period"). Before the establishment of the People's Republic of China (PRC) in 1949, a similar population registration system collecting and managing demographic statistics for the purpose of taxation and conscription already existed in the Chinese history. With the exception of the years during the Second Sino-Japanese War (1937-1945), this system was used as an infrastructure to provide public certificates, such as citizen's cards (Liangmin zheng) in Japanese-occupied Shanghai (Wang, 2006) and identity cards (shenfen zheng) in Kuomintang-ruled post-war Shanghai (White, 1978). Generally, for the pre-1949 era, the system did not impose any rigid social-economic control between urban and rural people and its main function was to collect residents data. After the establishment of the PRC, the hukou system was first introduced in 1951 to record urban population and was extended to rural areas in 1953. The main purpose was "to maintain social peace and order, safeguard the people's security, and protect their freedom of residence and movement" (Cheng and Selden, 1994). The first Chinese constitution adopted in 1954 guaranteed the freedom of residence and movement for citizens.

The second phase is between 1958 to 1978 ("strict control period"). The 1958 regulations represent the only national legislation on migration and residence promulgated by the National People's Congress, which still remains in effect today. Each Chinese citizen is included in the hukou system since then (Zhu, 2003; Cheng and Selden 1994) and classified as being either a rural or an urban hukou holder based on their place of residence at that time. This status cannot be changed easily during life. Newborn babies' hukou status have to follow their mother's hukou status (Chan and Zhang, 1999). Hukou type was linked to a variety of economic and social welfare policies to the greatest extent. Free mobility no longer existed. Instead, rigorous measures to prevent migration from rural to urban areas were imposed in order to reduce the pressures on urban cities. Regardless of being assigned to a rural or an urban hukou, the public services that the hukou system made eligible to could be provided only in the place of residence. The hukou system crystallized the rural and the urban population by binding citizens to their place of residence and offering limited possibilities of changing their hukou type.

The reasons underlying the introduction of these mobility limitations were rooted in the consequences of Chinese economic policies implemented at that time. China

followed the Marxist tradition and mimicked the Soviet-era's economic development, which put a higher emphasis on the heavy industry. The big push to industrialization (or "traditional socialist development strategy") resulted in a considerable gap between urban-industrial and rural-agriculture sector (Chan, 1994). A large influx of rural people started to leave the villages to reach the cities at the beginning of the establishment of the PRC. This flows made the cities under a great demographic pressure. China's urban population increased from 10.6% in 1949 of total population to 14.6% in 1956, where rural migrants accounted for almost 60% of the total increase (Kirkby, 1985). Due to limited resources in cities and over-supply of labor force, the State built up a great barrier on the rural-urban migrants through hukou system in order to preserve the demographic stability and reduce unemployment in urban areas. Morevoer, this measure was needed to guarantee enough grain production in agriculture sector to support urban workers through a strict food rationing system.

The third phase is from 1979 until now ("opening-up period"). Since 1978, China has started to transfer from a planned to a market economy, characterized by the privatization of many State-owned companies. A more flexible hukou system has been adopted to facilitate rural-urban migration (Seeborg et al., 2000; Wu and Yao, 2003). One major change was the introduction of two special types of residential registration, administered by local governments. The first is the "Interim Provisions on the Management of Transient Population in Cities" act published in 1985, which supported the integration of rural workers in urban cities by allowing them registering as temporary residents in urban areas, but without assigning them any urban hukou and all related rights and benefits. The new provisions cancelled the rule that restricted temporary residents to stay no more than three months in urban cities but still did not allow them to change their hukou status (Yusuf and Saich, 2008). For rural workers, job access in cities became easier than before. As a result, a large influx of rural workers into cities has been experimented. Noticeably, systematic abuses, such as selling false urban registration cards to rural peasants, have been detected (Yan, 2008). In response, the State published "A Notice on Strictly Controlling Excessive Growth of ‘Urbanization’" in 1989 to manage migration flows towards urban areas, which again restricted rural people to get access to State-funded programs.

The second special type of residential registration is the so-called "blue-stamp" hukou. The pool of blue-stamp hukou holders consists of investors, property buyers and professionals, who were originally assigned to a rural hukou. The “blue-stamp” hukou makes them eligible to most of the social benefits of regular urban hukou

holders, conditional on the payment of a very high one-time entry fee (Chan and Zhang, 1999). These two types of residential registration were temporary and have been faded away gradually after 2000.

In addition to these two acts, several reforms have been implemented to redesign the hukou system. Newborns can choose to follow their father's or mother's hukou status since 1998. Furthermore, the hukou conversion process (nongzhuangfei process), which is needed to legally switch from rural hukou to urban hukou status, was much harder to obtain before the 1980s. Since the 1980s, the regular channels for rural-urban hukou conversion have been made more flexible and include the recruitment by State-owned enterprises (zhaogong), enrollment in higher education institutions (zhaosheng), promotion to senior administrative positions (zhaogan), joining the army (canjun), land acquisition by government and other personal migration reasons (Chan and Zhang, 1999; Chan, 2009). The quota of Chinese migrants allowed to switch their hukou from rural to urban is annually set by the central government. As an example, between 1989 and the beginning of the 2000s the annual quota of rural hukou holders allowed to switch their hukou to the urban type lied between 0.15 and 0.2 percent of the population of urban hukou holders in the city in which they want to live (Chan, 2009). These restrictions have been recently relaxed but remain strict. Overall, the government will allow 100 millions of rural hukou holders to change their hukou between 2014 and 2020 in order to promote urbanization[4]. This amounts to say that on average the annual quota of the current rural citizens allowed to change their hukou amounts to approximately 2%[5]. In general, current hukou conversion policy is clearly still strict, mainly allowing the rich and the highly educated people to change their hukou type (Zhang, 2010).

As rural workers found it easier to move to cities for jobs, one important consequence is an increasing movement of rural peasants to urban areas. For the internal migration in China, movement and citizenship can be totally separated. For instance, someone can move to a new place but might not obtain the access to various social welfare policies supplied there. People who move from rural areas to urban cities but do not obtain urban hukou are called "floating population" or "mobile population" (liudong renkou), meaning they are not de jure residents although they are de facto residents. Although they live in urban areas, these

[4] "Announcement on the plan of pushing 100 million of non-urban hukou holders to settle down in urban cities" ("guo wu yuan ban gong ting guan yu yin fa tui dong 1 yi fei hu ji ren kou zai cheng shi luo hu fang an de tong zhi") by the State Council, 30th of September, 2016.
(http://www.gov.cn/zhengce/content/2016-10/11/content_5117442.htm)

[5] Calculations of the authors based on China Statistical Yearbook, 2015.

Chinese citizens face an administrative barrier that makes them impossible to exploit the public services supplied to urban hukou holders. Only those who can successfully convert to urban hukou through the above-mentioned channels are permitted to use the resources and services as the other urban hukou holders. The size of floating population has increased rapidly from a few millions in the early 1980s to about 150 millions in 2011 (Chan, 2011). In 2013, floating population reached 18% of total Chinese population[6]. Rural-urban migrants, usually low-skilled workers, move to cities in order to obtain a better job. They struggle to integrate into urban life but because of their rural hukou type they do not obtain the same entitlements as the urban hukou holders (Solinger 1999). For example, they are not entitled to the subsidized education system, welfare programs, and community cultural activities. This barrier threatens their social inclusion. Knight and Gunatilaka (2010) find that rural-urban migrants report lower happiness scores than rural and urban hukou holders. Furthermore, migrants children were assigned to privately-run migrants schools in urban areas, many of which have limited space, worse facilities and fewer certified teachers (Dong, 2010).

Urban and rural hukou holders are eligible to social policies that widely differ with respect to their design, financing and quality. In the following sections we will discuss in detail to what extent being assigned to a rural or an urban hukou type can lead to dramatic differences in the architecture of selected social policies individuals face along their life-course. In particular, we will focus on the education system, health care system, income protection scheme, housing policy and pension system.

1.3 Education system

China pursues a two-track education system, referring to government-supported urban education track and family-supported rural education track since the pre-1949 era due to limited educational resources to guarantee full education access to the whole population (Fu, 2005). The new People's Republic of China adopted the same education model since its establishment. Hence, the State takes the main responsibility for urban education, while the management and financing of the rural education system are burdened on the local collectives[7] and rural

[6] Calculated according to the data provided by China Statistical Yearbook, 2015.

[7] Collectives are "a form of publicly owned enterprise" (Naughton, 1994). In rural China, it was quite popular, especially between 1958 and 1983, that multiple farmers ran their holdings as a joint enterprise and cooperated together in farming activities within and/or between villages. Everything was shared within the collectives.

families. Consistent with the goal of hukou system, two-track education system emphasized the importance of developing education in cities, industrializing and mining areas in order to cater for the needs of industrialization. Liu Shaoqi, chairman of the National People's Congress Standing Committee between 1954-1959, proposed the concept of "two kinds of labor and two kinds of education system" in 1958 that further reaffirmed the pursuit of two different ways of education in rural and urban China[8]. In addition, the Education Minister, Yang Hsiu-feng stressed that the principle of "selective development" in the education policy was an effective way of "utilizing reasonably our limited strength" to "popularize education simultaneously with raising standards" in 1959[9]. The reasons behind it were again due to the lack of sufficient resources and capital to fulfill the needs of the whole nation. According to the central government point of view, for a country with limited resources and capital, it was necessary to focus on a certain group of people to fast produce qualified elites for modernization and industrialization. In the case of China, public resources were mainly given to key schools[10] and urban schools to train a selected group of urban youth who was artificially chosen to be the future elites and manage the economic development. Rural children had to accept this kind of unequal education opportunity.

Two-track education system has been always in place except for a short period during the cultural revolution era (1966-1976). After the first two years of the cultural revolution, in which education at all levels was suspended, inequality between rural and urban education was eliminated radically. For example, both rural and urban children received the same primary school education (five-years primary schooling) since 1968. Secondary and higher education attendance was determined on the basis of work experience and political activism, rather than education achievements, favoring workers and peasants instead of intelligentsia (Lo, 1984). After the cultural revolution, everything was recovered. The two-track system was characterized again by government-subsidized urban schools and people-run rural schools.

The difference between rural and urban education is reinforced especially when Chinese government formally switched from centralized towards decentralized

[8] "Wo guo yingyou liangzhong jiaoyu zhidu, liangzhong laodong zhidu" (Our country should have two kinds of education and two kinds of labour system), 30, May 1958, in Liu SHoaqi xuanji (selected works of Liu Shaoqi), 2 vols. (Bejing: Renmin chubanshe, 1981-1985), xia:323-327.

[9] NCNA-English ,Peking 28 April 1959,in CB ,577(14 May 1959), 14.

[10] Key schools are selected to receive the priority in the assignment of teachers, equipment, funds and other resources. They are also allowed to recruit the best students for special training, of which 90% are in urban areas (Tsang, 1996).

fiscal system since 1980. The State remained the primary source for financing urban education like before, while in rural areas most of the expenditures was left to the sponsorship of townships or of the county-level governments replacing the local collectives. However, since local governments have limited fiscal capacity, some of education expenditures are left to the rural families to afford on their own. In 1986 the first formal nine-year compulsory education law was promulgated in China, including six-years of primary school and three-years of junior high school. The law was implemented initially in urban cities and then gradually diffused to rural areas. National Bureau of Statistics of the PRC announced that in 2014 the coverage of nine-year compulsory law has reached almost the whole nation[11].

From late 1990s and onwards, education system has been modified in order to eliminate the stark educational inequality between rural and urban areas. For instance, the State tried to reduce and even dismantle the nine-year compulsory education fees (i.e. "tax-for-fee reform", "one-fee-system", "no charge"[12]) (Tsang, 1996; Sun, 2007; Fu, 2005). Nevertheless, the gap between rural and urban education remains substantial. Most of the rural educational funds are from the local government (county/township level), whose fiscal capacity is rather limited and much lower than the central government. Urban schools are equipped with better infrastructure and allocated to better teaching resources. For instance, based on national statistics, Wang (2003[b]) calculated that in urban areas the student-teacher ratio[13] in 2001 is 19.7 for primary school and 17.9 for secondary school, while rural areas have higher ratios, 22.7 and 19.9 for primary and secondary school, respectively. Besides, the certified full-time teachers of junior secondary school in urban areas are about 92% of the total, while they are only around 85% in rural areas. Among certified teachers, 24% of those working in urban areas obtained at least a university degree, while only 9% of those in rural areas did. Hence, the quality of teachers is expected to exhibit substantial variation between rural and urban areas.

[11] NBS 2014 Statistical report on the implementation of "China National Program for Child Development (2011-2020)". Published by National Bureau of Statistics in 2015.

[12] Tax-for-fee reform: abolished all of the previous local fees and taxes except agricultural tax and agricultural tax supplements.

One-fee system: Central government set one fixed price for compulsory education for both rural and urban people.

No charge for compulsory education: By 2009, these policies have been nationwide implemented rural schools and compulsory education becomes free of charge.

[13] The student-teacher ratio shows the average number of students taught by one teacher. Everything else constant, higher values of the ratio indicate lower expected quality of the education system.

1.4 Health care system

Health care system differs between rural and urban China in terms of health care policies, administration of health service and resources.

In urban areas, health care has been supported by the State from the beginning. Two major employment-related health schemes, which were the State labor insurance scheme and the public service medical scheme, were established in 1951 and 1952, respectively (Knight and Song, 1999). All the medical expenditures of government staff and workers at State-owned companies were supported by the State and State-owned enterprises (Shi, 1993). Their immediate relatives could enjoy 50% reduction on normal medical fees. Furthermore, for most of the private sector employees, their health-care schemes were organized by many private and public companies (Knight and Song, 1999). With the exception of employees in a few small private firms and the self-employed, all urban workers have been covered by health insurance schemes, which make medical expenditures free of charge. In order to cover all the urban employees, the “Urban Employee Basic Medical Insurance” (UEBMI) was established in 1998 to replace previous working-unit based schemes and to cover the employees of both private and public sectors. As a complementary, the “Urban Resident Basic Medical Insurance” (URBMI) was introduced in 2007 to include all non-employee urban residents, such as self-employed, retirees, children and other dependents.

Rural areas lack an effective health care system until the mid-1960s. Most of rural individuals were not covered by any scheme but mainly depend on private out-of-pocket expenses. In 1965, a cooperative medical system was launched. This system was ran and financed by the communes[14], which were multifunctional organizations that directed local government and managed economic and social activities. The health care provision was based on the presence of "barefoot doctors", who were trained by urban doctors and sent to rural health clinics in order to provide medical care to peasants. By 1970, 1.2 million barefoot doctors had been trained (Knight and Song, 1999). Medical expenditures that exceeded

[14] There are three administrative units in rural areas of the People's Republic of China. During the period from 1958 to 1983 they were county (parallel to cities in urban areas), communes, brigades and teams. County was the largest one and supervised communes, while communes controlled production brigades and production teams. Except counties, communes were the highest administrative units and the largest collective units in rural areas. Communes were replaced by townships later. In particular, agriculture production was decided at the commune level and then assigned to production brigades and teams. Brigades and teams were replaced by villages afterwards. Now, the three administrative levels in rural area include county, townships, and villages (source: Administrative divisions of the People's Republic of China (Zhonghua Renmin Guoheguo Xingzheng Quhua), 15 June 2005, retrieved 5 June 2010, from www.gov.cn).

certain levels determined by local communes can be partially reimbursed (Shi, 1993).

The rural health care system changed dramatically during the post-Mao period (1979-1990s). One important change in the Chinese economic policy implemented at that time was the transfer of the production responsibility system from the collective to the household level. This was aimed at emphasizing the importance of individual efforts and responsibility in maintaining economic growth of China. Communes were no longer the cornerstone of local economic activities. The rural health care was influenced by such dissolution of the commune-centered management system. Government subsidies for health care system in rural areas became rather limited and the communes were no longer in the position of sustaining the cooperative health care system launched in the 1965 and paying barefoot doctors. As a result, cooperative health schemes collapsed and village clinics were shut down. The proportion of rural individuals covered by cooperative medical system fell from 90 per cent in 1978 to 9.5 per cent in 1986 (Shi, 1993). A fee-for-service system has replaced the previous system and barefoot doctors became private practitioners.

In addition, before 1978, the central government allotted a proportion of money to local government to support communes in financing the cooperative health care system. After 1978, due to the decentralized fiscal policy, local governments (county and township governments) are the solely responsible for managing and financing their own health care system, whereas the State directly finances national hospitals, research institutions and medical schools in urban China (Liu et al, 1995).

After 2000, the central government shifts more attention to the health care provided in rural areas. For instance, more generous subsidies were provided in order to reduce out-of-pocket expenses of rural citizens. In 2003, the government introduced the “New Cooperative Medical Scheme” (NCMS) to provide universal health care coverage for rural residents. At the beginning, the pilot has been run in some cities. The NCMS was then extended to the whole nation since 2010.

China still remains underdeveloped when considering the provision of public long-term care services to individuals with permanent chronic disabilities, especially the elderly and the disabled. Although formal care (i.e. nursing homes, elder care homes, community service) exists, informal care provided by family members is currently the main source of health care in China (Zeng, 2010; Wu, 2009). Long-term health care facilities are more developed in urban areas, while very limited services are provided in rural areas (Chu and Chi, 2008). So far, most of

formal care institutions are funded and operated by the government, whereas few of them are financed by non-government organization or private investors. The government recently started improving long-term care system and encouraging private investments in urban areas. However, the supply of these health care institutions are unable to meet the growing needs of long-term health care of Chinese population. In particular, there is not any publicly-funded national long-term care insurance program to cover long-term care expenditures in China (Feng, 2011). The long-term care expenditures of the elderly mainly depend on out-of-pocket expenses, pensions, family or other private resources. Long-term health care in China still has a long way to go.

1.5 Income support benefits

China has an unemployment insurance scheme available only to citizens with urban hukou. The first unemployment insurance system was the “Interim Provisions on Workers' Job-Waiting Insurance in State-Owned Enterprises (SOE)” and was launched in China in 1986. The State-owned companies took full responsibility of the welfare of the unemployed workers and hence workers were not required to pay contributions. Provisions were extended slightly in 1993. In 1999, the latest “Regulations on Unemployment Insurance” act was introduced and it is still in place. These new regulations indicate that enterprises, individuals and government fiscal subsidies are the three main sources of contributions to the unemployed insurance scheme and the coverage was extended to all urban workers. No unemployment insurance scheme is available for individuals with rural hukou, except for some rural workers recruited by urban enterprises.[15]

Facing an increased unemployment, low wages, inadequate pensions, and rampant inflation, the number of urban poor in China grew fast in the early 1990s (Saunders and Shang, 2001; Gao, 2006). In order to support them, the minimum income guarantee (Di bao), also known as "Minimum Living Standard Guarantee Scheme" was introduced in Shanghai in 1993 first and then became a national policy in 1999. The targeting population includes a mixed group of people in both chronic and temporary poverty, such as the unemployed, the elderly, as well as sick and disabled individuals. The aim of Di bao (DB) was to provide financial support to all registered[16] urban households whose income is below a threshold set at the

[15] See Vodopivec and Tong (2008) for more details.

[16] Registered means people with urban hukou. The internal migrants with rural hukou but living in urban cities are excluded.

municipal level (Ravallion et al., 2006). Before 1999, DB was financed by the local government only. After 1999, the central government increasingly started to subsidize the local government in financing the DB scheme.

According to the 1999 regulations on DB, only those households whose monthly income was below the threshold set by the local government can apply for DB. Furthermore, only household members with an urban hukou who reside in the same local administrative unit in which the household applies for DB are eligible for this allowance and counted in the determination of the total benefits distributed to that family. Instead, family members with rural hukou or residing in other cities or provinces were not eligible to receive DB benefits from the local government. Di bao in rural areas was started only in 2003. Participation of local governments of rural areas to DB is voluntary and depends on the availability of enough financial resources to run the scheme. The minimum income rural hukou holders could receive every month is generally lower than that available to urban hukou holders. The exact amount of monthly minimum income varies among cities and provinces since it is determined by local governments. For example, in Tianjin, the local government announced that rural people will receive 540 yuan/person, while urban people receive 705 yuan/person in 2015. In Zhenzhou, the standard monthly minimum income is 290 yuan/person for rural people, while 520 yuan/person for urban people in 2015[17]. One of the recent aims of Chinese government is to spread DB to the national level and reduce the gap between rural and urban citizens.

1.6 Housing policy

Housing policies are also found to be different between urban and rural hukou holders.

First of all, in urban China, housing system has experienced great changes from a centralized and planned economic policy to a much more market-oriented one. Under the "planning period" 1949-1979, there was no private housing market in China. The State took the main responsibility for the investment in housing according to the plan and entrusted the construction, allocation, management and maintenance of housing facilities to the place of employment or working units (danwei). The property rights of these houses were owned by the State. Usually, houses were provided at a low rental price determined to cover the maintenance

[17] Table of the overview of di bao levels in main rural and urban areas in 2015 by Li, J.L. Chinanews.com (Zhongxinwang), 8th, the July, 2015 (http://www.chinanews.com/gn/2015/07-08/7390743.shtml).

costs. The quality of the houses was guaranteed and determined by the State in advance (Zhang, 2000).

Between 1978 and 1998 the conflict between old housing system and market liberalization process forced China to change to a more-market oriented housing system. However, this process was very slow due to the controversy on the cession of State-owned land and working unit housing (Wu, 1996). However, from 1998 onwards, a market-oriented housing system has been the most prevalent. The distribution of social housing, such as rental dwelling provided by the municipality or working units at low price, was abolished. Social housing facilities were converted into private property (Deng et al., 2014). Nowadays, an increasing number of houses in urban areas are constructed by real estate development companies according to qualified standards. From 2008 onwards, urban housing policies put a stronger attention on housing affordability problems and move towards a more mixed ownership housing system. In addition, urban lands belong to the State, while residents only have the property rights and land-using rights, usually, up to 70 years (Yang and Chen, 2014). Finally, it is worth noting that the first mortgage in China was issued in 1986, funded mostly by retail deposits (Yang and Chen, 2014). Since the abolishment of the social housing in 1998, mortgage loans have become an important tool for urban households to purchase housing.

Due to the unique migration control established by the hukou system, internal migrants without urban hukou could not have an access to most of urban housing services and facilities. Many of them live in the outskirts of cities where the quality of both housing and living is relatively poorer than the standards usually guaranteed to urban hukou holders.

On the contrary, rural housing system has not changed much over time. There has never been any formal housing market in rural areas. According to government regulation, each household is allocated with a housing land but the ownership of this land belongs to the local collectives. Once their housing land is provided, rural households need to finance, construct and maintain their houses on their own. The residents own the property rights of their house and land-using rights. Non-commercial houses cannot be sold or leased. Rural land cannot be pledged.

Knight and Song (1999) find that living space per capita of rural households was twice as much as that of urban households between 1978 and 1995. They argue that the urban living space may be limited due to supply-constraints reflecting the problem of housing shortage in urban areas. However, we cannot just conclude that rural housing is superior to urban housing as quality is nevertheless important. Rural houses are mainly constructed by peasants. Hence, the quality of rural

houses varies a lot, depending on the households' socioeconomic status and their financial capability. In contrast to the urban case, in rural areas there are not either government housing subsidies or financial intermediaries supporting housing market, such as financial institutions selling mortgages.

1.7 Pension system

The proportion of people aged 65 and above is projected to increase rapidly from around 7% in 2000 to 16.5% in 2030, eventually to reach around 23.6% in 2050 (UN, 2010). Hence, how to guarantee the welfare of this rapidly growing aging population will be one of the most important policy concerns in China. Although the poverty rate of older individuals dropped a lot in China in recent years, the poverty rate in rural areas is still quite high. For instance, the poverty rate of people aged 60+ in urban areas is 4.6%, while rural areas have a poverty rate as high as 22.3% in 2010 (Lu, 2012). Compared with urban elderly, rural elderly are really at a serious disadvantage, accompanied with low income and an incomplete welfare system.

As discussed in the previous sections, much of the urban-rural divide in China was rooted in the introduction of the hukou system. A stark urban-rural division also exists in the pension system.

Tracing back to the beginning of the PRC (from the 1950s to 1978), a public pension system was implemented only for urban industrial and public sector workers, restricting pensions to individuals who contributed to the Social Security system during their working life. It covered most urban residents, while rural hukou holders were excluded from this pension system.

China's first formal pension scheme, the "Basic Old-Age Insurance System for Employees" (BOISE), was introduced in 1951 and designed for urban employees. Followed by the "Basic Old-Age Pension System for Civil Servants" (BOPSCS) in 1952, a pension scheme targeted for civil and military servants. The State-owned enterprises took main responsibility for financing the contributions of their employees. However, this system had a low coverage rate. In addition, administrative processes were inefficient. For example, workers were required to cancel their account when they changed their city of residence and had to open a new account in the new place of residence. The process of transferring individual accounts was rather complex and difficult (Lu, 2012). Besides, the replacement rate was also low and continued to decline over time (Lu, 2012).

Since 1978, due to the new era of modernization led by the paramount leader Den Xiaoping, who realized the switch from a planned to a more market-oriented economy, the State-owned enterprises observed a reduction in their market share and profits. Therefore, they had an increasingly limited financial ability in providing pensions to their urban workforce. To alleviate the financial burden on State-owned enterprises and involve private firms in the financing of the pension system, the State Council issued the "Decision on Establishing a Unified Basic Old-Age Insurance for Enterprise Employees (BOISEE)" in 1991. BOISEE was formally introduced in 1995 and originally limited to public sector workers. It has been extended to the private sector in 1997. Under BOISEE pension funds are pooled by industry sector.

Besides, BOISEE includes urban hukou holders only and hence rural migrants without urban hukou were not eligible due to their hukou type. By 2011, around 215.7 million people contributed to BOISEE (Lu, 2012). As a complementary, non-employed urban residents aged 16 and over who are not eligible for BOISEE have been assigned to "Urban Social Pension Scheme" (USPS) since 2011.

Concerning the rural hukou holders, the "Five Guarantee Schemes" (wubao, FGS)[18] was introduced in 1956 and served as a safety net for the rural poor people. The targeting population includes individuals aged above 60, the disabled and children under 16 who have "no income, no labor capacity, and no resources of family support" (Cai et al., 2012). Except FGS, rural older individuals were not assigned to any other statutory benefits until 1980s.

Between 1986 and 1991, China took the first step to introduce in rural areas a basic pension system called "Basic Scheme of Rural Pensions at the County Level". First, some pilot experiments were run at the county-level in a few provinces. They were managed by the Ministry of Civil Affairs (MoCA). Then, the system was extended to all rural areas.

This pension system was financed mainly through three ways: local governments, local collectives and individuals. However, several reasons undermined its diffusion. Local governments had the main responsibility in the design of the policies implemented at local level. This caused substantial variation in the amount of resources devoted to finance the pension system. Richer areas were better equipped, while poorer areas lagged behind. In addition, the privatization of local-level enterprises during the 1990s jeopardized the financial contribution of the employers to the system and reduced the benefit amounts paid to retirees.

[18] Five Guarantees include clothes, food, residence, health care, funeral service.

Consequently, as documented by Cai et al. (2012), the basic scheme expanded geographically to cover 31 provinces and almost 75% of counties in 1998. Nevertheless, after this peak, its diffusion declined rapidly. For example, the number of participants dropped from 80 million in 1999 to 53.78 million in 2004 (Cai et al, 2012). Again, most of rural older individuals were not guaranteed by any rural pension schemes. Only in 2009 China launched the first nationwide rural pension system after locally piloting. This system is called "New Rural Social Pension Scheme" (NRSPS). All the rural residents are eligible, their participation in the pension system is voluntary. Citizens who have contributed for at least 15 years will be eligible to receive pensions.

In 2014 rural and urban resident pension schemes have been integrated into one. The government aim is to reach a full coverage by 2020 (Cai et al., 2012). However, the national average replacement rate has dropped from 70.79% in 1997 to 45% in 2014[19], which is relatively low and questions the financial well-being of retirees.

1.8 Discussion

This chapter reviewed the history of the household registration system (hukou) introduced in China in the second half of the 1950s to control internal migration from rural to urban areas. This registration system classifies Chinese citizens in urban and rural hukou holders. Having a urban or rural hukou has dramatic consequences on the degree of inclusiveness characterizing the social policies a Chinese citizen is eligible to. This chapter documented the stark differences in education, health care, income protection, housing and pensions systems available to urban and hukou holders. Social policies designed for urban hukou holders benefit of the availability of higher financial resources, while rural hukou holders receive poorer public services. Despite some recent changes in the legislation, individuals cannot easily switch their hukou type, whose change is allowed in limited cases.

These differentials in social policy architectures shape individuals' socio-economic outcomes. Previous literature suggests that rural residents achieve lower educational attainments (Liu, 2005), have poorer health outcomes (Zurlo et al., 2014), lower income (i.e. Knight and Song, 1999; Lu and Song, 2006) and experiment lower life-satisfaction (Ren and Treiman, 2015) than urban people. Lu and Song (2006) find that local urban workers earn substantially higher hourly

[19] Report on "Strategies of rebuilding China's pension system" ("Chong Gou Wo Guo Yang Lao Jin Ti Xi De Zhan Lve Si Kao") by Professor Dong Keyong, published on China Ageing Finance Forum 50 in 2016.

wages than their counterparts with rural hukou. The well-being of rural hukou holders is impaired by the less generous social policies they face during their whole life course.

The dual hukou system in China leads to a huge inequality between rural and urban China, which is expected to slow down economic development and integration. In response to the increasing internal migration, the Chinese government is paying much more attention to relax the strict hukou system in place for more than fifty years. For example, it has been proposed to introduce a unified hukou system to all citizens, which means dismantling the differences in hukou type paradigm in order to reduce discrimination towards rural hukou holders. These reforms can produce a breakthrough towards the socio-economic integration between rural and urban areas only if the removal of the administrative rural-urban classification imposed by hukou is accompanied by reforms that redesign the architecture of the social policies that rural residents face during their life. Indeed, simply allowing them to migrate and receive in urban areas the services that urban citizens are already eligible to might bring about dangerous consequences in terms of migration rates, depopulation of rural areas, urban areas migration inflows and long-run financial sustainability of the urban social policies as well. Instead, a policy agenda fostering sustainable economic development should improve the quality of public services and infrastructures in rural China. This goal is clearly ambitious since about 700 millions of individuals (approximately one half of the whole Chinese population) reside in rural areas. Financing welfare state services for such a wide population requires a considerable amount of resources that can be collected by resorting to a combination of strategies, including the allocation of public resources by the central and local governments, as well as the stimulation of private investments in disadvantaged areas and the support to public private partnerships.

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CHAPTER 2

Education gradient in well-being late in life: the case of China*

Abstract

As the Chinese government has been increasing investments in education in the last two decades, it is policy relevant to understand the consequences on well-being of improving education access as well as whether they remain sizeable even late in life. We draw data from the China Health and Retirement Longitudinal Study (CHARLS) to investigate the education gradient in the current well-being of a representative sample of the Chinese population aged 45 or over. We analyze how the education gradient combines with the marked differences in the social policies implemented in rural and urban China. We find that higher education is associated with higher well-being levels late in life. However, the education differentials are higher in the sample of urban hukou holders. Our results imply that the more generous are the opportunities made available by the State in terms of social policies, the higher are the gains that individuals can achieve from higher education.

Keywords: education; multidimensional well-being index; rural and urban China.

*This is a joint work with Agar Brugiavini and Danilo Cavapozzi.

2.1 Introduction

Over the past two decades China has been ageing rapidly. It is indisputable that an acceleration of ageing population in China is a result of an increasing life expectancy and a reducing fertility rate exacerbated after the introduction of the one-child policy in 1979. It is projected that the proportion of people aged 65 and above will increase rapidly from around 7% in 2000 to 16.5% in 2030, eventually reach a quarter in 2050 (UN, 2010). Hence, as the prevalence of older individuals in the population increases, how to promote their well-being becomes one of the greatest challenges of the Chinese policy agenda. Understanding the well-being determinants of older Chinese can support policy makers in setting initiatives that foster their social inclusion and enhance their welfare. In this paper, we will assess the well-being differentials across education groups among the older Chinese population. Our data are drawn from the China Health and Retirement Longitudinal Study (CHARLS), which is based on a representative sample of Chinese individuals aged 45 or over and their spouses.

From a theoretical perspective, education might influence people's well-being through different channels related with the human capital and health capital production[21]. As for the human capital production, the recognized importance of education in explaining personal income distribution dates back to Mincer (1958), who shows how heterogeneity in education levels can explain inequality of labour earnings over the life-cycle. Following the model proposed by Ben-Porath (1967), education can be seen as an input of the human capital production[22] and at the same time as a determinant of the marginal product of other inputs, such as innate abilities. An extensive literature has then attempted to assess the effect of education on earnings (see Card, 2001 and Heckman et al., 2006). Although this effect can vary with the business cycle phase, the industry and the socioeconomic group considered, there is an overall consensus on the hypothesis that education improves earning capability of individuals.

However, the effect of education on well-being is definitely not confined to the human capital accumulation. Grossman (1972) show that education enters the health production function in at least two ways. On one hand, higher education improves the efficiency of health production by increasing the marginal product of

[21] Following the distinction proposed by Grossman (1972), human capital is a determinant of market and non market productivity, whereas health capital is a determinant of the total amount of time that can be spent in market and non market activities .

[22] See also Schultz (1961) and Becker (1964).

its inputs, such as medical care. Everything else constant, higher levels of education reduce the cost of producing a given stock of health. Individuals endowed with higher levels of education are able to produce the same level of health stock by using a lower amount of inputs due to the education-led efficiency gain. On the other hand, as long as wages increase with education, the higher is the wage offered to an individual, the higher is the value of the marginal product of health capital. Everything else constant, higher education attainments increase the incentives to produce health capital in order to have more healthy time available for labour market activities.

China proposes as an interesting study case to analyze well-being returns to education. From a policy point of view, Heckman (2002) pointed out the relatively low investments of China government in education at the beginning of the twenty-first century, which amounted to about 2.5% of its GDP. Figure 1 shows that in the next decade the government has ramped up its investment in education and this percentage reached 4.3% in 2012 (NBS, 2014). Our study can be of use to understand the long-run well-being effects of these education investments and how they will affect the well-being late in life of the young generations who are now exposed to the benefits of these more generous education policies.

FIGURE 1 ABOUT HERE

Moreover, in 1958 China introduced a strict household regulation system called hukou. All Chinese citizens are classified as either urban or rural hukou[23]. Newborn babies' hukou status have to follow their mother's hukou status. Changes of the hukou type are allowed in special cases. Hukou classification is particularly important for the well-being of Chinese population since it affects social policies individuals are eligible to with respect to many aspects, including education, health care, income protection schemes, housing and pensions systems. Social policies designed for urban hukou holders are much more generous and financed by the State at the central level. Instead, rural hukou holders are eligible to policies that are financed at the local or at the household level, making constraints to credit access more likely to occur. An established literature has been assessing hukou differentials in well-being dimensions. Rural hukou holders have been shown to be generally poorer, less happier and more depressed than their counterparts in the urban areas (Zurlo et al., 2014; Ren and Treiman, 2015; Sicular et al., 2007; Sun and

[23] The hukou system was formally introduced at the beginning of the 1950s but only to manage administrative services, such as civil registry. Only in 1958 it took on the characteristics relevant for our work.

Liao, 2016). These differentials in well-being outcomes are related to the differences in social policies implemented in rural and urban areas of China.

As an example, the Chinese education system has been characterized by a two-track architecture. Whereas economic activities in rural areas focus on the agriculture sector, those in the urban areas mainly embrace the industry and the service sectors. Due to limited resources at the beginning of People's Republic of China (PRC), the central government originally decided to design an education system that could foster the economic growth of the industry and service sectors by investing more resources in the education of the urban scholars. In 1986 the Chinese government enacted the nine-year compulsory education law, which has been first introduced in urban areas and only later extended to the rural ones. Even nowadays the urban-rural differences in educational attainments remain substantial and they are clearly the legacy of the two-track education system architecture. If we look at the recent evidence provided by the sixth population census (The Population Census, 2010), we find that still in 2010 there was a wide gap between rural and urban areas in terms of illiteracy rate, which was 7.26% in rural areas and only 1.90% in urban areas.

In addition, there are wide differences between rural and urban hukou holders in terms of housing policies. In rural areas housing lands are allotted to households, who then bear the sole responsibility of building and maintaining their houses. This threatens the housing quality of the poorer rural households, which might be even constrained to build their accommodations on their own. Instead, in urban areas, up to the end of the 1970s, the State financed the construction of houses and rented them to households at a low price to cover maintenance costs. In the following decades a liberalization process has opened the housing market to private enterprises. Still, even nowadays, houses in urban areas are built by professional real estate development companies according to qualified standards set by the government. Moreover, in urban areas there is a financial market that supports housing investments by offering mortgage loans. These financial products are not available in rural areas.

The history of pension schemes available to urban and rural hukou holders also differ widely. The first formal pension scheme offered to urban hukou holders was introduced in 1951. It was designed for urban employees and one year later it was supplemented by a specific scheme for military and civil servants. Instead, up to the end of the 1980s, only a safety net for older individuals without other means was available for rural-hukou holders. The first pension schemes for rural hukou holders was introduced at the beginning of the 1990s. Still, it was financed at the local level

and this causes problems for disadvantaged areas in maintaining the financial sustainability of the system. Rural and urban pension schemes have been integrated in 2014.

Aggregate data can be of help to describe the starking differences in health care policies available to rural and urban hukou holders. Table 1 shows that the number of hospital beds per 1,000 people is currently more than twice in urban than in rural areas. Again, these differentials are rooted in the past. Since the introduction of the hukou system, civil servants and workers of state-owned enterprises always had a formal health care system. In the following decades the health care system provision have been reformed to cover all the urban population. Instead, rural households did not have any health care system up to the 1965. In that year it was launched a cooperative health care system financed by local authorities. This system crumbled at the beginning of the 1980s when rural households received the responsibility to finance their health care on their own. Rural households waited until 2010 for an universal health care coverage[24].

TABLE 1 ABOUT HERE

The presence of the hukou registration system is expected to affect the well-being differentials across education groups because it shapes the standards of living of individuals over their life course and modifies the opportunities that higher education levels might produce. Even attaining the same formal level of education, urban citizens are more likely to have benefited of better schooling infrastructures and well-prepared teachers, to have a working career spent in qualified and rewarding jobs, to live in acceptable accommodations, to be covered by generous health care systems and to receive high quality medical services. Living in a disadvantaged socioeconomic context might reduce the positive effects on well-being produced by receiving higher education since the augmented human capital does not match with institutional and market features that enable to generate well-being returns. Neglecting the role played by the hukou system might lead to overestimate the well-being effects that rural hukou holders can benefit from achieving higher education. To what extent the hukou system impacts on education differentials in well-being is an empirical issue that our paper investigates by assessing education differences in well-being late in life separately by hukou status.

[24] More details related to various socio-economic policies by hukou type are available in Brugiavini et al. (forthcoming).

The rest of the paper proceeds as follows. Section 2 presents the data and descriptive statistics on the key variables for our analysis. Section 3 summarizes our main results. Conclusions are reported in Section 4.

2.2 DATA

The analysis in this paper is based on data from the China Health and Retirement Longitudinal Study (CHARLS), which is developed by a team of researchers from Peking University, the University of Southern California, and Oxford University. We use this dataset because it has several advantages over other existing Chinese micro datasets in investigating our research question. First, CHARLS is nationally representative, covering 28 provinces, while many other relevant datasets have been conducted in a more limited number of provinces. Second, it is based on a representative sample of the population of Chinese individuals aged 45 or over and their spouses. This is particularly important when addressing questions, like ours, focusing on the older Chinese population. Finally, the questionnaire administered to respondents is multipurpose and allows collecting detailed information about a variety of aspects relevant to determine their well-being, including demographics, household composition, health status and socioeconomic condition. Our main analysis is based on data drawn from the first two waves of CHARLS, which have been conducted in 2011 and 2013 respectively. Once missing values for relevant variables are dropped, our final sample reduces to 31,239 observations for the baseline model.

2.2.1 Hukou

In our analysis hukou status refers to the individuals' current hukou status, classified as rural or urban. In our sample 78% of individuals has a rural hukou, while 22% of them have an urban hukou.

2.2.2 Education

We define the highest level of education attained as a dummy variable, where 1 denotes high education for those who got an educational attainment higher than the primary school degree and 0 otherwise. We selected primary school as a threshold to distinguish between low and high education because our sample includes the individuals aged 45 and above, most of whom have relatively low education level. Overall, two thirds of the individuals in our sample have at most a primary school degree. In addition, the population of reference of the CHARLS

survey consists of individuals aged 45 or over. They have been untouched from the nine-year compulsory education law introduced in 1986. Instead, the early target of Chinese education policy was to reach the primary school level universally. Therefore, we chose primary school as a threshold in order to get enough observations for each group and keep pace with a main policy target.

Overall, 25% of the individuals in the rural sample (i.e. those with a rural hukou) attain high education levels. This percentage jumps to 65% when looking at their counterparts in the urban sample (i.e. those with a urban hukou). Figure 2 shows that if we split the sample by cohorts, obtaining an educational attainment higher than the primary school degree is found to be more widespread for more recent cohorts in both the rural and the urban population. Although the education gradient is sizeable in all cohorts, its magnitude decreases in relative terms. When looking at individuals born in 1939 or earlier in our sample, the probability of getting more than a primary school degree for rural individuals was about one tenth than the one found for their urban counterparts (3.4% vs. 35.2%). Instead, for those born in 1960 or later, it is about one half (43.7% vs. 87%).

FIGURE 2 ABOUT HERE

2.2.3 A multidimensional well-being index

In our study well-being is measured by a multidimensional index. In view of the multiple channels education can affect well-being and of the inherent multidimensional nature of the concept of well-being itself, we construct the index by considering two domains: material deprivation and health. This choice is in line with the recommendation by Sen (2004) to base multidimensional indexes on aspects of well-being that can be targets of public policies and of special importance for the population of interest.

The material deprivation domain is aimed at describing individuals' economic resources and their capability of affording standard needs. It is measured by a battery of 6 dimensions describing housing facilities, namely the availability of flushable toilet, electricity, running water, in-house shower and bath facilities, gas and heating system. For each dimension we define one indicator. All these indicators are defined as dummy variables taking on value 1 in presence of the housing facility considered and 0 otherwise. For each individual we calculated the proportion of indicators in which she is found not to be deprived. The higher is this proportion, the higher is the quality of the accommodation in which individuals live. The panel A of Table 2 shows that in both the rural and the urban sample

individuals with higher education are on average associated with significantly higher quality accommodations. In the rural (urban) sample, individuals with low education report an average percentage of material deprivation indicators in which they are not deprived equal to 37.3% (57.9%), this percentage increases to 43.1% (70.7%) in the high education group.

TABLE 2 ABOUT HERE

The health domain assesses the achievements with respect to health outcomes including activities of daily living (ADL), instrumental activities of daily living (IADL) and the presence of chronic diseases. For ADL we consider difficulties with walking 1km, getting up from a chair, climbing stairs, stooping, kneeling, crouching, reaching arms, lifting, picking up a coin, dressing, bathing, eating, getting in/out of bed, toileting, urination/defecation. For IADL we consider difficulties with doing household chores, preparing hot meals, shopping for groceries, taking medications and managing money. For each of these aspects we defined one binary indicator taking on value 1 in absence of difficulties and 0 otherwise. Overall, we defined 13 dimensions for ADL and 5 for IADL. We also consider the following 14 chronic diseases: hypertension, dyslipidemia, diabetes, cancer, chronic lung diseases, liver disease, heart attack, stroke, kidney disease, stomach disease, psychiatric disease, memory-related disease, arthritis and asthma. For each of these chronic diseases we defined one binary indicator taking on value 1 in absence of it and 0 otherwise. The panels B, C and D of Table 2 show that individuals with high education are characterized by higher average achievements, regardless of being in the urban or in the rural sample. All these differences are statistically significant. However, unlike the material deprivation case, the differences between the rural and the urban sample appear to be quite limited. For instance, as for activities with daily living, the outcomes obtained by low and the high education groups in the rural and urban sample are extremely close. For instance, both low education individuals in the rural and the urban samples are on average not deprived in 84% of the ADL dimensions. Those with high education in about 92%. However, we do not think that this evidence reduces the importance of including the health domain in our empirical exercise as it can be explained by differences in the age composition between the rural and the urban sample. Table 3 reported selected characteristics of the age distribution. We noticed that the average age in the rural sample is lower and the same pattern is found when looking at the age distribution quartiles. These differences remain statistically significant even after controlling for birth

cohort and a set of individual and household characteristics[25]. This descriptive evidence supports the hypothesis that rural individuals experience health limitations similarly to their urban counterpart but at an earlier stage of their life-cycle and suggests rural-urban differentials in mortality rate.

TABLE 3 ABOUT HERE

In order to aggregate the indicators considered for the material deprivation and health domains in a single index, a weighting scheme is needed. The choice of the weighting scheme is not univocal. Cavapozzi et al. (2015) show that the results of analyses based on multidimensional well-being indexes might be influenced by the weighting scheme adopted. To account for such heterogeneity, we decided to base our analysis on a battery of 4 alternative weighting schemes.

The first weighting scheme is a purely equal weighting scheme that assigns the same weight to each dimension, regardless of being in the material deprivation or in the health domains. However, the dimensions in the material deprivation domain are 6, whereas those in the health domain are 32. Such a weighting scheme assigns a disproportionate higher relevance to the health dimensions simply due to the extensive battery of health indicators used in our investigation. In order to assess whether our results are tenable also after a reshuffle of the overall weight assigned to the material deprivation and health domains, we propose an alternative equal weighting scheme. The second weighting scheme we use assigns the same overall weight to each domain and then the same weight to each dimension in each domain. This way, regardless of the number of the indicators considered, the material deprivation and health domains received an overall weight equal to one half. In addition, we use the frequency weighting scheme proposed by Desai and Shah (1988). Each dimension receives a weight equal to the corresponding proportion of the non-deprived in the sample. Finally, we define an alternative weighting scheme based on the principle component analysis. Recent work has started using PCA to construct a single index as it is computationally easier and not suffering from many problems of measurement errors and recall bias (Filmer and Pritchett, 2001; Mazzonna, 2014). The first principal component explains 19% of the total variance. Consistent with the previous studies, they usually consider results which report a percentage below 30%. Each dimension receives a weight equal to the corresponding factor loading in the first principal

[25] We control for cohort dummies, gender, marital status, number of children, household size and region dummies.

component. These factor loadings are defined to aggregate indicators in a single linear index that is able to explain the highest proportion of the total variance generated by the battery of dimensions considered. Both the frequency weights and those derived according to the principal component analysis are standardized to sum up to one[26]. Decancq and Lungo (2013) provides a clear summary about advantages and disadvantages of each weighting method. Table 4 summarizes the weights assigned to each dimension according to the alternative weighting scheme considered.

TABLE 4 ABOUT HERE

The well-being index is computed at the individual level by taking the weighted summation of the individual achievements with respect to the battery of indicators defined for the material deprivation and health domains. The well-being index lies between 0 and 1 by construction due to weight standardization and the binary nature of the indicators used.

Table 5 summarizes selected characteristics of the distribution of the four well-being indexes considered. In both the rural and the urban sample, on average, individuals with high education rank higher than their low education counterparts. Depending on the well-being index considered, the education differential in well-being ranges from 5% to 9% for the rural sample and from 6% to 13% for the urban sample. All these differentials are statistically different from 0. Their variability across indexes witnesses the importance of not basing the analysis on only one weighting scheme. Overall, analogous conclusions are drawn when looking at quartiles. Individuals with higher education are characterized by significantly higher levels of the first, second and third quartile of the well-being distribution in both the urban and the rural sample. The next section will be devoted to assess whether these differentials remain significant after controlling for individual and household characteristics.

TABLE 5 ABOUT HERE

2.3 RESULTS

2.3.1 Baseline specifications

[26] Both types of equal weights are standardized to sum up to 1 by construction.

We estimate linear regression models by OLS in which the dependent variable is the logarithm of the multidimensional well-being index and the main explanatory variable is the education dummy discriminating those with at most and those with more than a primary school degree. The set of right-hand-side variables also includes cohort dummies, a second order polynomial of age, gender, marital status, number of children, household size, region dummies and a constant term. Table 6 shows the summary statistics of the explanatory variables used in the regressions. We estimate our models separately by hukou groups. This way the relationship between well-being index and a given explanatory variable is allowed to vary between urban and rural individuals[27].

TABLE 6 ABOUT HERE

The panel A of Table 7 reports the point estimates and their standard errors for the coefficient on the education dummy. Regardless of the well-being index considered, individuals with higher education are always expected to have higher levels of well-being late in life, both in the rural and in the urban sample. If we look at the first well-being index, high education is associated with an increase by 2.3% (=(exp(0.023)-1)*100) in the rural sample. Instead, this variation more than doubles for the urban sample and it becomes equal to 5.23%. The difference between these two variations is statistically significant[28]. Overall, our results suggest that high education investments are always associated with a significant increase in the well-being late in life. However, the well-being returns to education are higher if the individual could benefit of more inclusive social policies. Although the size of the variation changes, these results are found for all the well-being indexes considered.

TABLE 7 ABOUT HERE

[27] Our sample may include cohabiting partners. We account for the presence of within-household correlation in the error term of our estimating equations by clustering standard errors at the household level.

[28] We tested the significance of the difference between these two parameters by running a Chow test. We pooled the rural and the urban sample together and regressed the well-being index on a dummy for the hukou status, all the other explanatory variables considered in our analysis (including education) as well as a full set of interactions between the hukou dummy and explanatory variables. We tested the significance of the parameter on the interaction between the hukou and the education dummy.

We repeat our empirical exercise by using quantile regressions. Our aim is to investigate whether the relationship between education and well-being late in life changes along with the well-being distribution. Individuals who rank differently in the well-being distribution might have different characteristics with respect to parental background, innate abilities, family ties and social networks that might alter the association between education and well-being. As an example, a richer and more educated parental background might make less prominent the role of education in preserving well-being late in life. Instead, for individuals coming from more disadvantaged households, education might act as the main tool to support their well-being over the life-course. We ran first quartile, median and third quartile regressions by using the same set of explanatory variables considered before. The results are summarized in the panels B, C and D of Table 7 respectively. Our previous findings are overall confirmed. Receiving high education is associated with significant improvements of well-being late in life for both urban and rural hukou holders. If we consider the equal weighting index (i.e. the first index), the well-being distribution of the high education individuals in the urban sample is shifted to the right as the first quartile, the median and the third quartile are respectively 5.7%, 4.5% and 2.9% higher than their low education counterparts. An analogous pattern, albeit less marked, is found in the rural sample. Consistently with the OLS results, the gain that urban hukou holders get from education are significantly higher.

The utilization of the quantile regressions allows to assess whether and how the role of education might change along the well-being distribution as a consequence of the heterogeneity in unobserved individual characteristics that are relevant determinants of the socioeconomic and health status, such as genetics, skills, motivations and social networks. Our results clearly point out the education gradient in well-being decreases as we consider higher quartiles of the distribution. The panel E) of Table 7 reports the difference in the education gradient between the third and the first quartile of the well-being distribution (i.e. the difference between the coefficients on the education dummy in the corresponding quantile regression specifications). With the exception of one case, in both the rural and the urban sample this difference is always negative and statistically significant. The general message conveyed by these statistics is that the education gradient at the first quartile is significantly higher than the one at the third quartile. Within both the rural and the urban sample individuals who rank worse in the well-being distribution are those who are expected to benefit more from higher educational attainments.

2.3.2 Early-life conditions

A wide empirical literature is assessing the effect of early-life conditions on socioeconomic outcomes late in life (see for instance, Cunha and Heckman, 2007 and Cunha et al., 2010). The quantity and the quality of goods and time provided by parents can enter the human and health production functions of children affecting their outcomes over the whole life course. As an example, highly educated parents could lead to higher educational achievements of children because of either superior genetic abilities passed to the offspring or more efficient use of the time spent with children in stimulating their abilities (Leibowitz, 1977). Moreover, the higher is the wealth of parents, the higher is the probability for children of not facing credit constraints in financing education and health care needs. Brunello et al. (2017) use SHARE (Survey of Health, Ageing and Retirement in Europe) to assess the effect of education on lifetime earnings in a sample of older male individuals living in nine European countries. They show that returns to education widely vary with childhood conditions and in particular they are lower for individuals who had few books at home during childhood. The availability of more books at home can be an indicator of a more educated and richer parental background and these conditions can positively affect skill formation and increase the positive effect of education on earnings over the life time. Mazzonna (2014) draws data from SHARE to investigate the role of childhood socioeconomic status on health, cognition and household income late in life. His results are consistent with the hypothesis that better early life conditions improve the well-being of the elderly along these domains.

In view of this evidence, early life conditions can act as confounders in our framework and produce a spurious relationship between education and well-being. Growing up in richer and better educated households might affect education attainments by reducing the occurrence of credit constraints to finance education or by inducing a positive effect on the ability formation process. However, we cannot claim that the effect of early life conditions on well-being occurs via education only. Brunello et al. (2017) show that a better parental background can boost the returns to education and then affect the life-time income profile of an individual. The same educational attainment can produce a different effect on life time earnings depending on individuals early life conditions. Mazzonna (2014) shows that early life conditions affect positively cognitive abilities late in life, which are important determinants of financial well-being by making individuals more able to use properly more sophisticated financial products (Jappelli and Padula, 2013), manage their economic resources more wisely over the life cycle (Van Rooij et al.,

2011) and avoid financial mistakes (Lusardi and Tufano, 2009). Finally, in line with Mazzonna (2014), a richer and more educated family background can facilitate health care investments (e.g. vaccinations, regular medical visits) and promoting healthier life styles that are expected to produce long lasting effects on health. This is consistent with Grossman (1972), who formally shows that higher investments in the production of health in a given period increase the stock of health in all future periods.

It should be noted that splitting the sample by type of hukou is already in line with the necessity of controlling for heterogeneity in early life conditions given the sharp differences in social policies between urban and rural hukou holders documented in the Introduction. However, we take advantage of CHARLS data to introduce a further set of controls in our specifications to balance early-life conditions heterogeneity across respondents within hukou-groups. Given the focus of our work, we focused on socioeconomic characteristics referring to the period between 0 and 5 years of age in order to consider factors that cannot be classified themselves as consequences of the education process and that can be considered as pre-determined with respect to it. More specifically, we included in our specifications one dummy for each parent indicating whether she/he was alive when the respondent was 5 years old and one further dummy for each parent to indicate whether she/he has an educational attainment higher than the primary school degree. We also defined one dummy to identify individuals who did not experience hunger up to age of 5. Finally, we defined two dummies to identify individuals who up to the age of 5 live in a house with clean water and energy, respectively. As reported in Table 6, the distribution of some of these indicators markedly differ across hukou types. For instance, the probability of having spent the first five years of life in an accommodation with clean water is 1% in the rural sample and 14% in the urban sample. Only 10% of rural respondents have a mother with a primary school degree or higher. This percentage jumps to 23% in the urban sample. Respondents in the rural sample are about 10 percentage points more likely to have experienced hunger in their first five years of life. The sample size reduces as some of these variables are taken from the third wave of CHARLS (CHARLSLife), which is a retrospective survey on the life of CHARLS respondents aimed at reconstructing the main events occurring in their lives. Table 8 documents our results. Even after controlling for our early life condition indicators, individuals with higher education enjoy higher well-being late in life. Well-being differentials across education groups are always significant but they tend to be higher in the case of urban hukou holders. Finally, it is worth noticing that the conclusions that

can be drawn from the comparison of the education differentials at the third and the first quartile are totally in line with the baseline case. The educational gradient in well-being is significantly higher for individuals who rank worse in the well-being distribution. The gains from educational investments are wider for more disadvantaged urban and rural Chinese. Our results appear not to be driven by spurious correlation induced by inequalities in early life conditions.

TABLE 8 ABOUT HERE

2.3.3 Changes in the hukou status

CHARLS data allows recovering hukou changes occurred over the life course. In particular, in addition to the current hukou, the CHARLS questionnaire asks the first hukou in life. The data show that changing the hukou-type is not widespread. Only 11% of those who have a first rural hukou are classified as urban hukou holders at the time of the interview. As expected, almost all those who have a first urban hukou have maintained it up to the time of the interview. In 2013 only 2% of the sample (38 individuals) are found to have switched their first urban hukou to the rural type. However, it might be argued that, everything else constant, the well-being returns to education might be more penalized for individuals who have always been entitled to a rural hukou than for those who became urban hukou holders at some point of their life or from those who have always been urban hukou holders. To ascertain whether this is actually the case, we split the sample in three groups: those who maintain their rural hukou over time, those who switch their rural hukou to the urban type and those who maintain their urban hukou over time. Given the very small sample size of the group of individuals who switch their hukou from urban to rural, we discard it. We then estimated our OLS and quantile regressions in the remaining three subsamples. Results are reported in Table 9. All our results indicate that higher education is always associated with higher well-being. Even in the group of individuals who have held a rural hukou during their whole life, the education differential in well-being is sizeable and statistically significant. Moreover, the gains from education in this group appear to be overall significantly lower than those found in other groups. If we look at the first weighting scheme, we notice that for individuals who have always had a urban hukou, the well-being index of those with high education is on average 5.13% higher. This education gradient in well-being remains stable when considering those who switch from rural to urban hukou but it reduces to 2.33% for those who have always been rural hukou holders. The inspection of the Panel E) of Table 9

shows results that fully align with our previous findings. Regardless of the group considered, the educational gradient at the third quartile of the well-being distribution is significantly lower than at the first quartile.

TABLE 9 ABOUT HERE

2.4 Robustness checks

2.4.1 Differentiating educational attainments

Figure 3 (in Appendix) shows the distribution of the educational attainments in our sample. There are sharp differences in the education level distribution between urban and rural hukou holders. As noted earlier, the percentage of individuals with at most a primary school degree more than doubles in the rural sample. On the contrary, the percentage of rural hukou holders with a middle school degree is slightly higher than one half than that of their urban counterparts and the percentage of those with at least a high school degree is about one sixth. Building upon this evidence, it might be argued that the wider increase in well-being levels of highly educated individuals found for urban hukou holders is not related to their hukou type, but it is generated by the fact that urban individuals placed in the high education category according to our binary classification of education levels are likely to be more educated than those in the rural sample classified in the same category.

To assess whether this is actually the case, we define a more refined set of education dummies distinguishing four mutually exclusive educational attainments: illiterate (i.e. no education), at most primary school degree, at most middle school degree and at least a high school degree. This alternative classification dramatically reduces the heterogeneity of education levels across hukou holders placed in the same category and allows a tighter comparison of the well-being differentials between urban and rural areas. In our regression we keep literate individuals with at most primary school degree as baseline group. The panel A) of Table 10 (in Appendix) reports the results obtained by running OLS regressions. In both the rural and the urban sample, having a middle school degree or a high school degree is associated with higher levels of well-being. Still, such increases in well-being are found to be significantly higher for urban hukou holders. As an example, if we keep focusing on the first weighting scheme, having a middle school degree in the urban sample is associated with an increase by 3.8% in well-being, in the rural sample this percentage shrinks to 1.5%. The difference between these two variations is

statistically significant. Instead, being illiterate is associated with a reduction in well-being levels with respect to the baseline group that does not significantly vary across hukou types. This pattern is invariant across weighting schemes.

The panels B) – D) of Table 10 document that analogous results are obtained when using quantile regressions to model the first, second and third quartile of the well-being distribution. Overall, the results produced by a tighter classification of the educational attainments are consistent with those produced by our original and more parsimonious binary classification. In both the rural and the urban sample individuals with higher education enjoy higher levels of well-being late in life. Moreover, the well-being gains from receiving higher education are larger for urban hukou holders, in particular at the first quartile and at the median of the well-being distribution.

2.4.2 Selected mortality rate

Last but not least, we address the point of selected mortality rate of the sample. It might be possible that mortality rates are different between rural and urban hukou holders. Differences in mortality rates can lead to a selection bias of the survivors which can be different between two groups of people. Hence, we re-do the analysis of the baseline model but excluding people age above 75 years old. Sample size reduces to 28,981 observations. Results are reported in Table 11 (in Appendix). Panel A) to D) presents the results of OLS regressions and quantile regressions while differences between the first and the third quartile is shown in Panel E). Our results after restricting to a younger sample are very similar to the baseline model in terms of both the estimated coefficients and its significance. Conclusions are robust across different weighting schemes.

2.5 CONCLUSIONS

China proposes as an interesting study case to analyze the education differentials in well-being late in life. Since the Chinese government has been increasing investments in education in the last two decades, it is policy relevant to understand the consequences on well-being of improving education access as well as whether they remain sizeable even late in life. Chinese population is ageing and the proportion of individuals aged 65 or over is expected to attain 25% in 2050. Fostering their well-being is becoming a key-point in the policy agenda. In addition to this, China is a worth considering context in which assessing education differentials due to the duality of its social policies. At the end of the 1950s the

Chinese government introduced a strict regulation system called hukou that splits Chinese in rural and urban citizens and allows limited possibility to change the original assignment. The hukou system reserves to urban hukou holders much more inclusive and generous social interventions in many respects, such as education, housing, pension system and health care. Only very recently the government has started to overcome this duality in social policies.

Education can affect well-being according to multiple channels. For instance, higher educational attainments can improve human capital and health capital formation. Nevertheless, the socioeconomic context in which individuals live might amplify or reduce the gains from education. Living in disadvantaged socioeconomic contexts might dampen the well-being gains brought about by higher education endowments since they might fail to offer the institutional and market features necessary to generate them. Analogous research questions have been previously addressed in labour economics. For instance, Kimmel (1997) shows that wage returns to education among US rural workers are lower for American Indian men and black women. Instead, Ammermüller and Weber (2005) find that over the period 1985 -2002 the returns of tertiary education are mildly lower in East Germany as compared to West Germany. Brunello et al. (2017) show that the effect of education on lifetime earnings is lower for individuals with fewer books at home, which are related to parental cultural and economic conditions as well as their investments in children skill formation.

Our main analysis draws data from the first two waves of CHARLS, which is based on a sample representative of the Chinese population aged 45 or over. Most of the lives of the individuals in our sample has been shaped by the strict hukou regulations and by the duality in social policies generated by the hukou system. We estimate OLS and quantile regressions to assess the education differentials in well-being of older Chinese as well as whether and how these differentials vary with the hukou status. Our results show that higher education is associated with higher well-being levels late in life. Higher investments in education are found to have a positive lifetime effect on well-being. However, the education differentials are higher in the sample of urban hukou holders. This evidence is consistent with the hypothesis that the more generous are the opportunities made available by the State in terms of social policies, the higher are the gains that individuals can achieve from higher education. When higher educational attainments match the opportunities provided by more qualified jobs and more generous health care provision, the well-being returns to education amplify. Comparing the education differentials in well-being at different quartiles of the well-being distribution

suggests that the role of education in shaping well-being late in life is stronger for individuals who rank worse. Indeed, the educational gradient in well-being is overall wider at the first quartile than at the third quartile of the well-being distribution. This pattern suggests a redistributive effect of financing education and promoting higher education access among individuals with less affluent parental background. Our results indicate that public investments in education access are important devices to protect Chinese well-being late in life and that their well-being returns might increase if they are accompanied by efforts to remove the duality in social policies between rural and urban hukou holders.

ACKNOWLEDGEMENTS

We thank the participants at the Joint PhD Workshop Economics and Management First Paper Presentation (2016) at the Ca' Foscari University of Venice, VIU Summer School on Ageing (2016), Ca' Foscari – University of Groningen PhD Workshop in Economics (2016), Joint NIDI-RUG Workshop: Socioeconomic Differences and Health Later in Life (2016) and at a seminar at the University of York.

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TABLES

Table 1: Hospital beds per 1000 people in rural and urban China

Year	Total	rural	urban
2007	2.83	2.00	4.90
2008	3.05	2.20	5.17
2009	3.32	2.41	5.54
2010	3.58	2.60	5.94
2011	3.84	2.80	6.24
2012	4.24	3.11	6.88
2013	4.55	3.35	7.36

(Source: NBS 2014)

Table 2: Average proportions of material deprivation indicators and health indicators, in which individuals are not deprived

	Rural		Urban	
	Low education	High education	Low education	High education
Panel A, Material deprivation indicators				
	0.373	0.431	0.579	0.707
Panel B, Limitations with ADL				
	0.841	0.916	0.843	0.921
Panel C, Limitations with IADL				
	0.892	0.960	0.894	0.962
Panel D, Chronic diseases				
	0.895	0.915	0.864	0.891

Table 3: Selected characteristics of the age distribution by hukou

	Average	First quartile	Second quartile	Third quartile
Rural	58.91	51	58	65
Urban	60.22	52	59	67

Table 4: Weights assigned to each dimension according to each weighting scheme

Dimension	Weight			
	1	2	3	4
MD: Flushable toilet	0.026	0.083	0.014	0.013
MD: Electricity	0.026	0.083	0.029	0.005
MD: Running water	0.026	0.083	0.022	0.009
MD: Bathroom	0.026	0.083	0.014	0.015
MD: Gas	0.026	0.083	0.005	0.007
MD: Heating	0.026	0.083	0.004	0.005
ADL: Walking 1km	0.026	0.016	0.027	0.045
ADL: Getting up from a chair	0.026	0.016	0.023	0.040
ADL: Climbing stairs	0.026	0.016	0.019	0.039
ADL: Stooping, kneeling, crouching	0.026	0.016	0.022	0.041
ADL: Reaching arms	0.026	0.016	0.029	0.039
ADL: Lifting	0.026	0.016	0.028	0.046
ADL: Picking up a coin	0.026	0.016	0.031	0.037
ADL: Dressing	0.026	0.016	0.031	0.048
ADL: Bathing	0.026	0.016	0.030	0.053
ADL: Eating	0.026	0.016	0.031	0.042
ADL: Getting in/out of bed	0.026	0.016	0.030	0.048
ADL: Toileting	0.026	0.016	0.028	0.049
ADL: Urination/ defecation	0.026	0.016	0.031	0.035
IADL: Household chores	0.026	0.016	0.029	0.054
IADL: Preparing hot meals	0.026	0.016	0.029	0.053
IADL: Shopping for groceries	0.026	0.016	0.029	0.049
IADL: Taking medications	0.026	0.016	0.028	0.042
IADL: Managing money	0.026	0.016	0.030	0.036

(continues)

(continued)

Dimension	Weight			
	1	2	3	4
CD: Hypertension	0.026	0.016	0.024	0.014
CD: Dyslipidemia	0.026	0.016	0.029	0.007
CD: Diabetes	0.026	0.016	0.030	0.008
CD: Cancer	0.026	0.016	0.032	0.003
CD: Chronic lung diseases	0.026	0.016	0.029	0.012
CD: Liver disease	0.026	0.016	0.031	0.004
CD: Heart attack	0.026	0.016	0.028	0.013
CD: Stroke	0.026	0.016	0.031	0.019
CD: Kidney disease	0.026	0.016	0.030	0.008
CD: Stomach disease	0.026	0.016	0.025	0.009
CD: Psychiatric disease	0.026	0.016	0.032	0.008
CD: Memory-related disease	0.026	0.016	0.032	0.018
CD: Arthritis	0.026	0.016	0.021	0.017
CD: Asthma	0.026	0.016	0.031	0.010

Note: MD stands for Material Deprivation, ADL for Activities of daily living, IADL for Instrumental Activities of Daily Living, CD for Chronic Diseases. For dimensions of MD the indicators take on value 1 if the facility is available at home and 0 otherwise. For dimensions of ADL, IADL and CD the indicators take on value 1 if the individual does not suffer of the problem and 0 otherwise. For weights, 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights.

Table 5: Distribution of the multidimensional well-being indexes.

	Well-being index			
	1	2	3	4
Rural				
Low education				
Average	0.794	0.623	0.857	0.835
First quartile	0.737	0.536	0.812	0.783
Second quartile	0.816	0.620	0.891	0.893
Third quartile	0.868	0.719	0.941	0.948
High education				
Average	0.845	0.677	0.904	0.900
First quartile	0.816	0.583	0.878	0.881
Second quartile	0.868	0.667	0.924	0.939
Third quartile	0.895	0.771	0.963	0.965
Urban				
Low education				
Average	0.816	0.720	0.862	0.843
First quartile	0.763	0.620	0.818	0.797
Second quartile	0.842	0.734	0.897	0.903
Third quartile	0.895	0.833	0.948	0.958
High education				
Average	0.882	0.811	0.915	0.916
First quartile	0.842	0.734	0.886	0.899
Second quartile	0.895	0.833	0.942	0.954
Third quartile	0.947	0.917	0.973	0.983

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights.

Table 6: Summary statistics of the variables used in the regression analysis

Variable	Description	Rural		Urban	
		Size	Average	Size	Average
Covariates included in all the specifications					
educ	dummy=1 if the R has more than a primary school degree	24,233	0.253	7,006	0.649
coh49	dummy=1 if the R was born between 1940 and 1949	24,233	0.224	7,006	0.248
coh59	dummy=1 if the R was born between 1950 and 1959	24,233	0.371	7,006	0.347
coh60	dummy=1 if the R was born in 1960 or later	24,233	0.301	7,006	0.266
age	age of the R	24,233	58.91	7,006	60.2
age2	squared of the age of R	24,233	3568.2	7,006	3728.9
female	dummy=1 if the R is a woman	24,233	0.531	7,006	0.481
married	dummy=1 if the R has a cohabiting partner	24,233	0.877	7,006	0.884
children	number of children	24,233	2.716	7,006	2.10
hhsize	household size	24,233	4.276	7,006	3.781
west	dummy=1 if the R lives in the West of China	24,233	0.338	7,006	0.284
east	dummy=1 if the R lives in the East of hina	24,233	0.321	7,006	0.276
central	dummy=1 if the R lives in the Centre of China	24,233	0.290	7,006	0.278
Early life conditions indicators					
alive_mother	dummy=1 if the mother of R was alive when she/he was 5	15,144	0.973	4,047	0.984
alive_father	dummy=1 if the father of R was alive when she/he was 5	15,144	0.954	4,047	0.964
educ_mother	dummy=1 if the mother of R has more than a primary school degree	15,144	0.098	4,047	0.232
educ_father	dummy=1 if the father of R has a more than a primary school degree	15,144	0.358	4,047	0.552
not_hunger	dummy=1 if the R does not experience hunger between 0 and 5 years of age	15,144	0.619	4,047	0.710
water	dummy=1 if the R had clean water in the accommodation between 0 and 5 years of age	15,144	0.010	4,047	0.138
energy	dummy=1 if the R had electricity in the accommodation between 0 and 5 years of age	15,144	0.057	4,047	0.290

Table 7: Education differentials in well-being late in life, by hukou status. High vs. low education group comparison. Baseline group: individuals with at most a primary school degree.

	Well-being index			
	1	**2**	**3**	**4**
Panel a) - OLS regressions				
Urban	0.051***	0.104***	0.033***	0.051***
	(0.005)	(0.007)	(0.005)	(0.007)
Rural	0.023***	0.044***	0.017***	0.023***
	(0.003)	(0.004)	(0.002)	(0.004)
Difference	0.028***	0.061***	0.016***	0.028***
U-R	(0.006)	(0.008)	(0.005)	(0.008)
Panel b) - First quartile regressions				
Urban	0.055***	0.132***	0.038***	0.055***
	(0.007)	(0.016)	(0.005)	(0.008)
Rural	0.024***	0.032***	0.019***	0.029***
	(0.004)	(0.006)	(0.003)	(0.004)
Difference	0.031***	0.099***	0.018***	0.026***
U-R	(0.008)	(0.018)	(0.007)	(0.010)
Panel c) - Median regressions				
Urban	0.044***	0.102***	0.026***	0.029***
	(0.005)	(0.013)	(0.004)	(0.004)
Rural	0.016***	0.046***	0.012***	0.014***
	(0.002)	(0.006)	(0.002)	(0.002)
Difference	0.028***	0.056***	0.014***	0.015***
U-R	(0.007)	(0.014)	(0.004)	(0.004)
Panel d) - Third quartile regressions				
Urban	0.029***	0.072***	0.014***	0.016***
	(0.004)	(0.007)	(0.003)	(0.002)
Rural	0.015***	0.036***	0.010***	0.007***
	(0.002)	(0.005)	(0.001)	(0.001)
Difference	0.014***	0.036***	0.005	0.009***
U-R	(0.004)	(0.009)	(0.003)	(0.003)
Panel e) – Differences between the third and the first quartile				
Urban	-0.026***	-0.060***	-0.023***	-0.039***
	(0.006)	(0.011)	(0.004)	(0.007)
Rural	-0.009***	0.003	-0.010***	-0.022***
	(0.003)	(0.005)	(0.002)	(0.003)

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights. Specifications control for cohort dummies, a second order polynomial of age, gender, presence of a cohabiting partner, number of children, household size and region dummies. Standard errors are clustered to account for intrahousehold correlation in the error term. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Education differentials in well-being late in life, by hukou status. Controlling for early life conditions. High education vs. low education group comparison. Baseline group: individuals with at most a primary school degree.

	Well-being index			
	1	**2**	**3**	**4**
Panel a) - OLS regressions				
Urban	0.048***	0.081***	0.034***	0.058***
	(0.007)	(0.010)	(0.006)	(0.009)
Rural	0.022***	0.037***	0.017***	0.022***
	(0.003)	(0.005)	(0.003)	(0.005)
Difference	0.026***	0.045***	0.017***	0.036***
U-R	(0.007)	(0.011)	(0.007)	(0.011)
Panel b) - First quartile regressions				
Urban	0.050***	0.109***	0.034***	0.062***
	(0.009)	(0.017)	(0.007)	(0.011)
Rural	0.027***	0.033***	0.022***	0.034***
	(0.004)	(0.007)	(0.004)	(0.005)
Difference	0.023***	0.076***	0.011	0.028**
U-R	(0.009)	(0.020)	(0.008)	(0.012)
Panel c) - Median regressions				
Urban	0.039***	0.078***	0.025***	0.032***
	(0.006)	(0.013)	(0.005)	(0.005)
Rural	0.016***	0.037***	0.012***	0.014***
	(0.002)	(0.007)	(0.002)	(0.002)
Difference	0.023***	0.042***	0.012***	0.018***
U-R	(0.008)	(0.014)	(0.005)	(0.005)
Panel d) - Third quartile regressions				
Urban	0.026***	0.057***	0.013***	0.016***
	(0.005)	(0.010)	(0.003)	(0.003)
Rural	0.014***	0.031***	0.009***	0.007***
	(0.002)	(0.006)	(0.002)	(0.001)
Difference	0.012**	0.027**	0.004	0.009***
U-R	(0.005)	(0.012)	(0.004)	(0.003)
Panel e) – Differences between the third and the first quartile				
Urban	-0.024***	-0.052***	-0.021***	-0.046***
	(0.006)	(0.013)	(0.006)	(0.008)
Rural	-0.013***	-0.002	-0.014***	-0.026***
	(0.003)	(0.006)	(0.003)	(0.004)

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights. Specifications control for cohort dummies, a second order polynomial of age, gender, presence of a cohabiting partner, number of children, household size, region dummies, parental living status at the age of 5, parental education, having not experienced hunger before age 5, living in accommodation with clean water and energy before age 5. Standard errors are clustered to account for intrahousehold correlation in the error term. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Education differentials in well-being, by hukou status. Splitting the sample by groups defined according to first and current hukou type. High education vs. low education group comparison. Baseline group: individuals with at most a primary school degree.

	Well-being index			
	1	**2**	**3**	**4**
Panel a) - OLS regressions				
Urban-Urban	0.050***	0.116***	0.031***	0.052***
	(0.007)	(0.010)	(0.006)	(0.010)
Rural-Urban	0.053***	0.093***	0.038***	0.053***
	(0.008)	(0.010)	(0.007)	(0.012)
Rural-Rural	0.023***	0.044***	0.017***	0.023***
	(0.003)	(0.004)	(0.002)	(0.004)
Difference	0.027***	0.073***	0.013**	0.029***
U-U vs R-R	(0.007)	(0.011)	(0.007)	(0.011)
Difference	0.030***	0.049***	0.020***	0.030**
R-U vs R-R	(0.008)	(0.011)	(0.008)	(0.012)
Panel b) - First quartile regressions				
Urban-Urban	0.056***	0.145***	0.033***	0.057***
	(0.008)	(0.017)	(0.007)	(0.012)
Rural-Urban	0.058***	0.126***	0.040***	0.049***
	(0.012)	(0.023)	(0.009)	(0.013)
Rural-Rural	0.024***	0.032***	0.019***	0.029***
	(0.004)	(0.006)	(0.003)	(0.004)
Difference	0.033***	0.113***	0.013*	0.027**
U-U vs R-R	(0.010)	(0.020)	(0.008)	(0.012)
Difference	0.034**	0.094***	0.021**	0.020
R-U vs R-R	(0.015)	(0.023)	(0.010)	(0.013)

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(continued)

	Well-being index			
	1	**2**	**3**	**4**
Panel c) - Median regressions				
Urban-Urban	0.044***	0.110***	0.024***	0.029***
	(0.007)	(0.013)	(0.005)	(0.006)
Rural-Urban	0.047***	0.091***	0.030***	0.031***
	(0.008)	(0.016)	(0.006)	(0.006)
Rural-Rural	0.016***	0.046***	0.012***	0.014***
	(0.002)	(0.006)	(0.002)	(0.002)
Difference	0.028***	0.064***	0.012**	0.015**
U-U vs R-R	(0.007)	(0.014)	(0.006)	(0.006)
Difference	0.032***	0.045**	0.018***	0.017***
R-U vs R-R	(0.008)	(0.018)	(0.006)	(0.006)
Panel d) - Third quartile regressions				
Urban-Urban	0.029***	0.077***	0.012***	0.014***
	(0.005)	(0.009)	(0.004)	(0.003)
Rural-Urban	0.032***	0.068***	0.019***	0.018***
	(0.005)	(0.009)	(0.004)	(0.003)
Rural-Rural	0.015***	0.036***	0.010***	0.007***
	(0.002)	(0.005)	(0.001)	(0.001)
Difference	0.014**	0.041***	0.003	0.008**
U-U vs R-R	(0.006)	(0.010)	(0.004)	(0.003)
Difference	0.017***	0.032***	0.009**	0.011***
R-U vs R-R	(0.005)	(0.010)	(0.004)	(0.003)
Panel e) – Differences between the third and the first quartile				
Urban-Urban	-0.028***	-0.068***	-0.021***	-0.042***
	(0.007)	(0.013)	(0.006)	(0.009)
Rural-Urban	-0.025***	-0.058***	-0.022***	-0.032***
	(0.009)	(0.016)	(0.007)	(0.011)
Rural-Rural	-0.009***	0.004	-0.010***	-0.023***
	(0.003)	(0.005)	(0.002)	(0.003)

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights. Specifications control for cohort dummies, a second order polynomial of age, gender, presence of a cohabiting partner, number of children, household size and region dummies. Standard errors are clustered to account for intrahousehold correlation in the error term. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Education differentials in well-being late in life, by hukou status. Alternative classification of educational attainments. Four education levels considered: illiterate, primary school degree, middle school degree, high school degree or higher. Baseline group: literate individuals with at most a primary school degree.

	Well-being index			
	1	**2**	**3**	**4**
Panel a) – OLS regressions				
Illiterate				
Urban	-0.012	-0.036***	-0.006	-0.019
	(0.010)	(0.013)	(0.009)	(0.015)
Rural	-0.026***	-0.048***	-0.021***	-0.039***
	(0.003)	(0.004)	(0.003)	(0.005)
Difference	0.013	0.012	0.015	0.020
U-R	(0.010)	(0.014)	(0.010)	(0.016)
Middle school				
Urban	0.037***	0.079***	0.024***	0.034***
	(0.006)	(0.009)	(0.006)	(0.009)
Rural	0.015***	0.029***	0.011***	0.011**
	(0.003)	(0.004)	(0.003)	(0.004)
Difference	0.023***	0.049***	0.013**	0.023**
U-R	(0.007)	(0.010)	(0.006)	(0.010)
High school or university				
Urban	0.057***	0.113***	0.039***	0.059***
	(0.006)	(0.008)	(0.005)	(0.008)
Rural	0.020***	0.035***	0.014***	0.018***
	(0.004)	(0.007)	(0.004)	(0.006)
Difference	0.038***	0.078***	0.024***	0.041***
U-R	(0.007)	(0.011)	(0.007)	(0.010)

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(continued)

	Well-being index			
	1	**2**	**3**	**4**
Panel b) – First quartile regressions				
Illiterate				
Urban	-0.012	-0.054*	-0.008	-0.034
	(0.018)	(0.029)	(0.013)	(0.029)
Rural	-0.030***	-0.050***	-0.026***	-0.042***
	(0.005)	(0.006)	(0.004)	(0.006)
Difference	0.018	-0.003	0.018	0.008
U-R	(0.018)	(0.032)	(0.014)	(0.027)
Middle school				
Urban	0.044***	0.106***	0.029***	0.041***
	(0.008)	(0.015)	(0.006)	(0.010)
Rural	0.014***	0.018***	0.013***	0.016***
	(0.004)	(0.006)	(0.003)	(0.004)
Difference	0.029***	0.088***	0.016**	0.025**
U-R	(0.009)	(0.015)	(0.007)	(0.010)
High school or university				
Urban	0.059***	0.140***	0.039***	0.056***
	(0.007)	(0.015)	(0.006)	(0.009)
Rural	0.022***	0.018*	0.018***	0.030***
	(0.005)	(0.010)	(0.005)	(0.005)
Difference	0.037***	0.122***	0.021***	0.025**
U-R	(0.010)	(0.019)	(0.007)	(0.011)
Panel c) – Median regressions				
Illiterate				
Urban	-0.017*	-0.039**	-0.012	-0.017*
	(0.009)	(0.017)	(0.007)	(0.009)
Rural	-0.020***	-0.049***	-0.016***	-0.024***
	(0.003)	(0.005)	(0.002)	(0.003)
Difference	0.003	0.010	0.004	0.007
U-R	(0.009)	(0.018)	(0.008)	(0.009)
Middle school				
Urban	0.033***	0.075***	0.021***	0.024***
	(0.006)	(0.011)	(0.004)	(0.004)
Rural	0.009***	0.030***	0.007***	0.008***
	(0.002)	(0.006)	(0.002)	(0.002)
Difference	0.024***	0.044***	0.014***	0.016***
U-R	(0.006)	(0.013)	(0.004)	(0.005)

(continues)

(continued)

	Well-being index			
	1	**2**	**3**	**4**
High school or university				
Urban	0.045***	0.115***	0.026***	0.030***
	(0.006)	(0.013)	(0.004)	(0.004)
Rural	0.013***	0.038***	0.009***	0.011***
	(0.004)	(0.010)	(0.003)	(0.002)
Difference	0.032***	0.077***	0.017***	0.019***
U-R	(0.007)	(0.016)	(0.005)	(0.005)
Panel d) – Third quartile regressions				
Illiterate				
Urban	-0.012*	-0.019*	-0.003	-0.008*
	(0.007)	(0.011)	(0.005)	(0.004)
Rural	-0.013***	-0.047***	-0.008***	-0.009***
	(0.002)	(0.006)	(0.001)	(0.001)
Difference	0.001	0.028**	0.005	0.001
U-R	(0.007)	(0.013)	(0.006)	(0.004)
Middle school				
Urban	0.022***	0.051***	0.011***	0.012***
	(0.004)	(0.007)	(0.003)	(0.002)
Rural	0.010***	0.024***	0.007***	0.004***
	(0.002)	(0.005)	(0.001)	(0.001)
Difference	0.012**	0.028***	0.004	0.007***
U-R	(0.005)	(0.009)	(0.003)	(0.003)
High school or university				
Urban	0.032***	0.083***	0.015***	0.015***
	(0.004)	(0.008)	(0.003)	(0.002)
Rural	0.014***	0.034***	0.010***	0.007***
	(0.003)	(0.007)	(0.002)	(0.001)
Difference	0.018***	0.049***	0.006	0.009***
U-R	(0.005)	(0.010)	(0.004)	(0.003)

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights. Specifications control for cohort dummies, a second order polynomial of age, gender, presence of a cohabiting partner, number of children, household size and region dummies. Standard errors are clustered to account for intrahousehold correlation in the error term. *** p<0.01, ** p<0.05, * p<0.1.

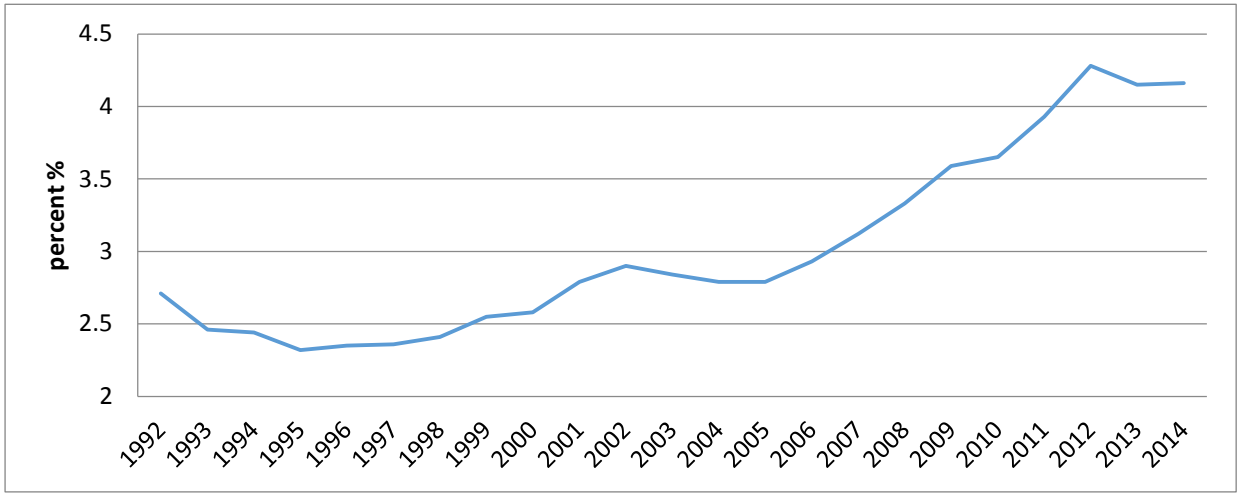
Table 11 Education differentials in well-being late in life, by hukou status, for sample aged 75 and below. High education vs. low education group comparison. Baseline group: individuals with at most a primary school degree.

	Well-being index			
	1	**2**	**3**	**4**
Panel a)- OLS regressions				
Urban	0.048***	0.102***	0.031***	0.047***
	(0.005)	(0.008)	(0.005)	(0.007)
Rural	0.023***	0.044***	0.018***	0.025***
	(0.003)	(0.004)	(0.002)	(0.004)
Difference	0.025***	0.057***	0.013**	0.022***
U-R	(0.006)	(0.008)	(0.005)	(0.008)
Panel b)-First quartile regressions				
Urban	0.053***	0.133***	0.035***	0.052***
	(0.007)	(0.019)	(0.005)	(0.008)
Rural	0.025***	0.032***	0.020***	0.030***
	(0.004)	(0.006)	(0.003)	(0.004)
Difference	0.028***	0.101***	0.015**	0.022**
U-R	(0.008)	(0.021)	(0.007)	(0.009)
Panel c)- Median regressions				
Urban	0.040***	0.104***	0.024***	0.029***
	(0.005)	(0.013)	(0.004)	(0.004)
Rural	0.016***	0.046***	0.013***	0.014***
	(0.002)	(0.006)	(0.002)	(0.002)
Difference	0.024***	0.057***	0.011***	0.014***
U-R	(0.006)	(0.015)	(0.004)	(0.004)
Panel d)- Third quartile regressions				
Urban	0.028***	0.071***	0.013***	0.014***
	(0.006)	(0.007)	(0.003)	(0.002)
Rural	0.015***	0.035***	0.010***	0.007***
	(0.002)	(0.005)	(0.001)	(0.001)
U-R	0.013***	0.036***	0.003	0.007***
	(0.005)	(0.009)	(0.003)	(0.002)
Panel e)- Differences between the third and the first quartile				
Urban	-0.025***	-0.062***	-0.022***	-0.038***
	(0.005)	(0.011)	(0.004)	(0.006)
Rural	-0.010***	0.003	-0.010***	-0.023***
	(0.003)	(0.004)	(0.002)	(0.003)

Note: 1 equal weights, 2 domain-equal weights, 3 frequency-based weights, 4 factor loading weights. Specifications control for cohort dummies, a second order polynomial of age, gender, presence of a cohabiting partner, number of children, household size and region dummies. Standard errors are clustered to account for intrahousehold correlation in the error term. *** p<0.01, ** p<0.05, * p<0.1.

FIGURES

Figure 1: Government expenditures for education over GDP



(Source: NBS,2014)

Note: Government expenditures include public budgetary fund for education, taxes and fees collected by government at all levels that are used for education purpose, enterprise appropriation for enterprise-run schools, income from school-run enterprises and social services that are used for education purpose and other national appropriations for education.

Figure 2: Proportion of individuals with more than a primary school degree

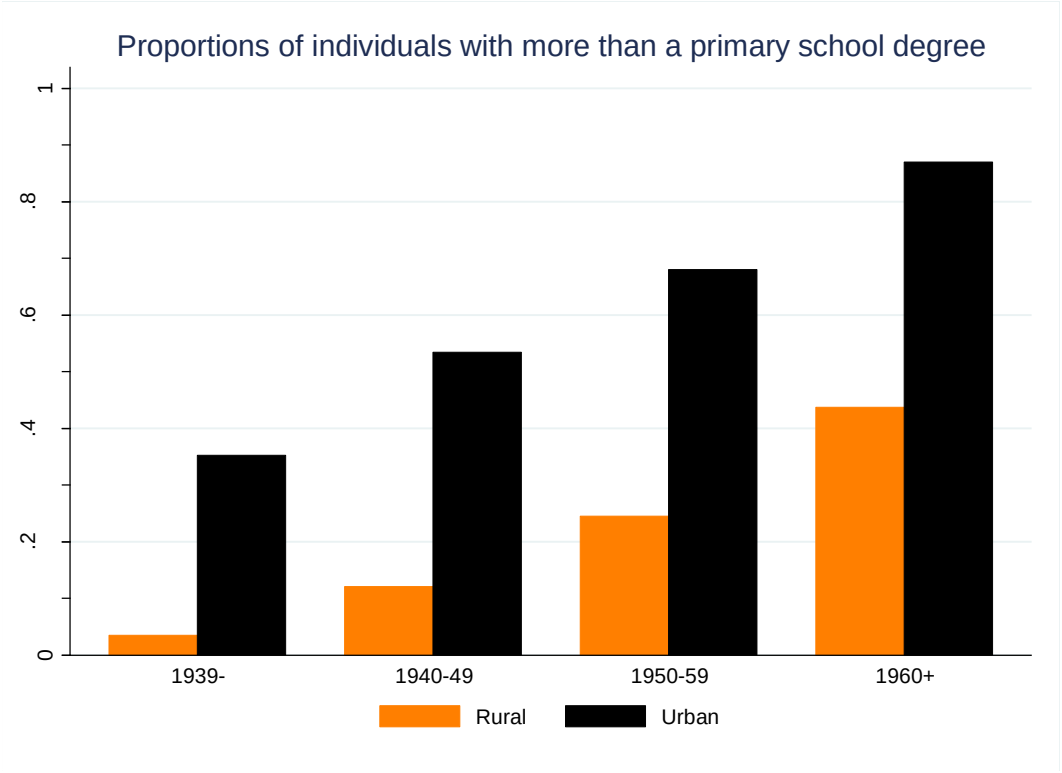
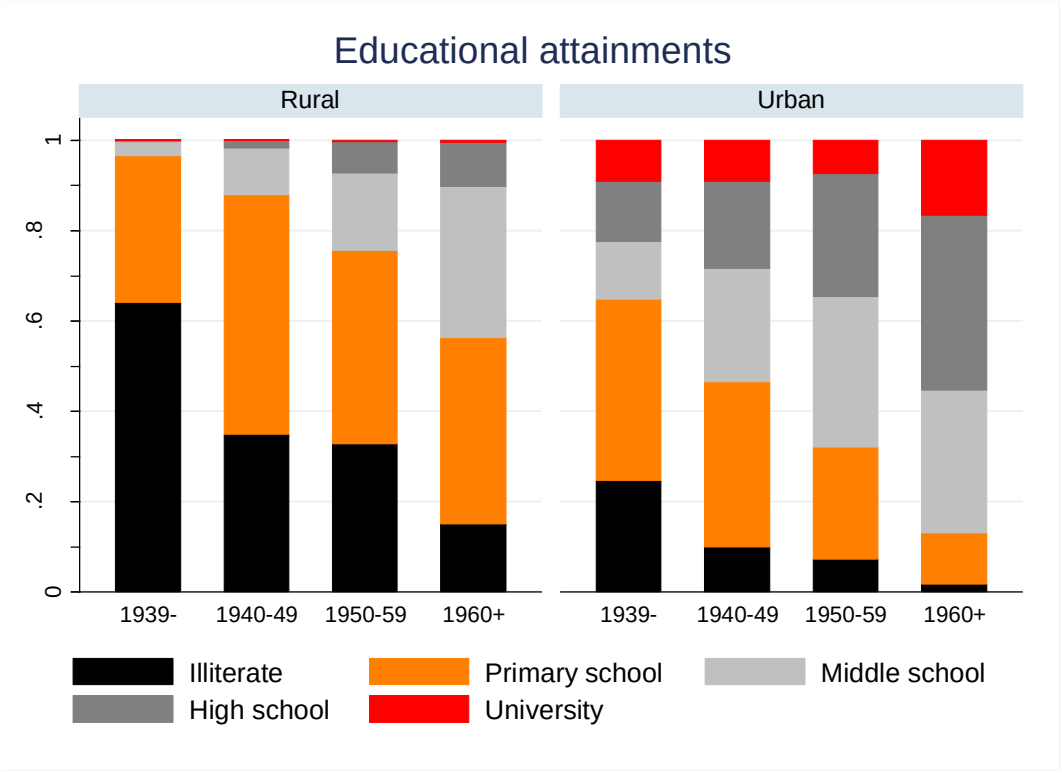


Figure 3: Distribution of educational attainments



CHAPTER 3

Late-life cognition: Do childhood conditions play any role?

Abstract

Individual's cognitive ability tends to reduce with ageing. Recently, whether and how to buffer this age-related decline is one of the greatest concerns. One well-established hypothesis argues that early life conditions play a particularly crucial role in developing individual's cognitive skills by embedding directly as an input. People who grew up in good conditions are more likely to reach a higher level of cognitive stocks and are more efficient producers of cognitive skills. In this paper, we address this issue by analyzing the impact of childhood conditions on the individuals' later life cognitive functioning and whether favorable childhood conditions can slow down the age-related cognitive decline based on the China Health and Retirement Longitudinal Study (CHARLS) data. Our empirical evidence supports that people who experienced better childhood conditions will obtain a higher level of cognitive skills later in their life. Advantageous childhood conditions can also shave off the rate of decline with ageing in the case of the fixed effect analysis.

Key words: childhood conditions, ageing, cognitive functioning

3.1 Introduction

Individual's cognitive functioning involves perception, memory, thinking, and creation of imagery (Levy, 1994). It is commonly accepted that cognitive skills are of great importance for both the individuals and the society. They are closely related to tackling information in daily life, making decisions on saving, health and retirement, as well as the ability to live independently, which could further determine the entire quality of life.

However, cognition is associated with a decline at old ages. Mazzonna and Peracchi (2012) adapted a health capital model by Grossman (1972). They show that an individual's life-time utility depends on the cognitive investment and consumption, constrained by the life-time budget. An increase of the cognitive investment for a given period will raise the stocks of cognitive capital along the entire life cycle. Simultaneously, cognitive capital suffers from a natural deterioration rate over the time without investing in any cognitive-repair activities, which indicates a fall in cognition accompanied with age. Their model also suggests that some factors such as early investment in education could lead to a lower deterioration rate of cognitive abilities.

In addition, several theoretical evidence demonstrates that early life conditions can influence cognitive development and abilities. According to the skill production function by Todd and Wolpin (2003, 2007), child development is a cumulative process depending on the history of inputs invested by families and schools as well as on children’s inherited endowments. An increase in the investment of families during childhood can be considered as a way to accumulate stocks of cognitive skills during life, resulting in a higher cognitive achievement.

As an extension, Cunha et al. (2010)'s model presents an evolution of both children's cognitive and non-cognitive skills at different phases of life cycle. They emphasize the importance of early life interventions for developing the subsequent evolution of cognitive skills, where family inputs and parental characteristics are treated directly as an input into the accumulation of their children's cognitive skills. Cognitive skills obtained in a given period not only increase the total stocks but also raise the productivity of developing subsequent skills of the following periods. In other words, a higher cognitive skills you attain now, the more efficient you will be in producing cognitive skills and a higher level will be achieved in the future. They also point out that investment in early stage of childhood is particularly important for the formation of adult cognitive skills. Cunha and Heckman (2010) predict that the effect of parental inputs on child's cognitive ability is stronger especially before 10 years old. Therefore, considering early life conditions, in particular, the period of childhood contributes greatly to the development of life-time cognitive functioning.

According to the theoretical models, early life conditions can affect late-life cognitive functioning through two channels. First, an increase in investment into the development of cognitive skills accumulates the total stocks of cognitive skills over the entire life and results in a higher level of cognitive achievements. Second, it will impact on the efficiency of producing subsequent cognitive skills and the rate of deterioration with age. This implies that if conditions early in life were favorable, a higher level of cognitive abilities tends to be achieved and the age-related cognitive decline at old ages might be mitigated. If this is true, it may be worth focusing on the monitoring those who were born under worse conditions. Providing social interventions to those children at disadvantage might be satisfactory as it is equivalent to improve the efficiency of care for cognitively impaired individuals. Usually the costs of care for those individuals are quite high and are expected to increase in the upcoming decades. It helps enhance the average cognition at national level as well.

Therefore, this paper addresses this issue by assessing empirically how the age decline of cognitive functioning posited by the theory and documented in empirical works (i.e. Schaie, 1989) is influenced by the childhood conditions. In particular, the paper will emphasize to what extent the effect of childhood conditions could offset the effect of age on later-life cognition. Then, we will inquire the role of childhood conditions on age-related cognitive decline. Specifically, it looks at whether the age decline of cognition for individuals who experienced different early life conditions follow different trajectories (i.e. smoother or steeper). This issue is particularly relevant for the elderly in a country such as China, which is facing an increasing ageing population and a decreasing role of families as a source of health care. Moreover, individuals make a decision in lack of professional guide when government-supported health care and pension system are not mature enough to cover all the population. Only until recently has it received particular attention to the research of the cognition of the elderly in China, partly due to the improvement of the collection of data. However, whether and how we can delay or mitigate cognitive decline with ageing is still poorly understood[29]. Focusing on China, we draw the data from the China Health and Retirement Longitudinal Study (CHARLS) in 2011 and 2013 as well as the wave on life history to explore research questions. We will focus on the childhood conditions at an early stage in life, which shows to influence the development of cognitive skills more than later stages (i.e. Cunha and Heckman, 2010). Consistent with the prior theory, we can see the results with better childhood conditions leading to a higher level of cognition later in life. In addition, we find

[29] Few examples of work on the cognition of the elderly in China include Hu et al. (2012) which looks at the effect of social activities on the older Chinese individuals' cognitive functioning and Lei et al. (2014) which examines the gender differences in cognition and the role of community, environment and economic development.

robust evidence to support that people with favorable childhood conditions benefit from a higher level in cognition at old ages. By using fixed effect analysis, we also observe that individuals experienced advantageous childhood conditions enjoy a lower rate of cognitive decline.

The rest of the paper will be organized in four additional sections. Section 2 provides a brief review of the empirical literature. Section 3 will discuss the data and variables. The main results and robustness checks will be presented in Section 4 and 5. Finally, Section 6 will provide the conclusions, policy implications and potential for further researches.

3.2 Literature review

Empirical work to study the role of childhood conditions on adulthood cognition and other health outcomes has been explored extensively (i.e. Cerhan et al., 1998; Kaplan et al., 2001; Aizer et al., 2016; Hoynes et al., 2016). However, literature on the topic of childhood characteristics and cognition at old ages is rather limited and the relationship between them is mixed.

First, Everson-Rose et al. (2003) explore the impact of childhood socio-economic status on the cognitive abilities of the individuals aged 65 and above in the U.S based on the Chicago Health and Aging Project data. Childhood socio-economic status is measured by a mean score of four questions concerning father's and mother's education, father's occupation, self-reported family financial status during childhood as well as childhood cognitive stimulating activities. Findings by Everson-Rose et al. (2003) support that advantageous socioeconomic and cognitive conditions during early life result in a higher absolute level of cognitive skills but they do not find any relationship between the rate of decline and cognitive functioning at old ages.

The second example from Case and Paxson (2009) looks at whether exposure to disease during childhood is related to the cognitive abilities later in life in the U.S. They argue that early disease environment may influence cognition at old ages indirectly through adult health outcome or directly through cognitive outcome such as the influence of infections on the brain development, later-life cardiovascular health or the effect of inflammation on adult neurogenesis. This study matched the regional-level mortality data of the first half of the twentieth century, including a variety of infectious diseases and total infant mortality, with the individual-level information on the individual cognitive function of older Americans followed by the Health and Retirement Study (HRS) between 1996 to 2004. They prove that early disease environment has a significant impact on the late-life cognitive performance of the elderly, such as on delayed word recall and counting backwards.

Furthermore, individuals born in poor families are less likely to have opportunities to go to school and acquire knowledge (Case et al., 2005), which could further influence their ability to deal with negative life events later in life as found by Van den Berg et al. (2010). They consider the role of early life economic conditions measured by the business cycle at birth on the cognitive functioning of the elderly and analyze whether an access to beneficial early life economic conditions mitigate the effects of adverse events later in life on cognition using Dutch longitudinal data between 1992 to 2006. In this study, the index of cognition is constructed based on the Mini Mental State Examination (MMSE) score (Folstein et al. 1995), ranging from 0 to 30. They included a series of adverse life events such as diseases, loss of family members, financial problems and so on. Results confirm that the negative effects of suffering from the stroke and the death of family members on the cognitive abilities are stronger for those who were born in a recession than those individuals born in years with a favorable business cycle.

Another recent work by Mazzonna (2014) finds a strong relationship between family socio-economic status (SES) during childhood and later life cognition across 11 European countries based on the Survey of Health, Ageing, and Retirement in Europe (SHARE). His childhood SES index is built upon rooms per capita in one's accommodation, facilities in household during childhood, number of books as well as the occupation of the breadwinner.

Empirical studies suggest that childhood conditions may play an important role in shaping cognitive functioning throughout the whole life and it has a long-term consequence on the later-life cognition. However, results are mainly from the U.S. or European countries while literature on the developing countries is scarce. Hence, we contribute to the literature first by extending this topic to the case of China. Moreover, childhood conditions are measured restricting to some specific aspects. A potential question might be raised whether more routine childhood experiences may also affect economics and health outcomes late in life. We include a richer set of childhood conditions by constructing a childhood index. In addition, very fewer papers directly explore different path of age-related cognitive decline due to different types of cognition. Cognitive abilities are generally divided into two categories: fluid cognitive ability and crystallized cognitive ability. The former includes learning performance and processing of new knowledge such as memory when recalling some past events, which tends to decline with age. The latter involves knowledge and skills obtained in the past which are hard to lose and less sensitive to age-related decline (Schaie, 1994;Peterson et al., 2002; Bäckman et al., 2005). Salthouse (2000) argues that dimensions of cognitive functioning such as orientation, memory, and numeracy are a combination of both fluid and crystallized cognitive

abilities, and he suggests that different dimensions of cognition should be used for measuring an individual's cognitive functioning. Hence, results can be dissimilar due to different types of cognitive abilities. Following Salthouse's suggestion, we will include two key measures of cognition, which are word recall and mental intactness to capture both types of cognitive abilities. Last but not least, previous literature usually just examines the direct relationship between early life conditions and the level of cognition late in life. Little is known about the differential effect of age on the late-life cognitive functioning between those experiencing advantageous and disadvantageous early life conditions. Therefore, we intend to fill in this research gap by explicitly assessing whether favorable early life conditions could buffer the cognitive decline in terms of both level and rate at old ages.

3.3 Data and variables

We use the data from the China Health and Retirement Longitudinal Study (CHARLS) to analyze cognitive decline at old ages, which collects information on health, household composition, demographics and social economic conditions. The CHARLS survey is nationally representative, including 28 provinces in China. It is based on a representative sample of the population of Chinese individuals aged 45 or over and their spouses. A pilot survey for CHARLS was conducted in two provinces in 2008 on 2,685 individuals. Based on the pilot survey experience, the main national baseline survey has been conducted in year 2011 and 2013 as well as a retrospective wave on the life history collected in 2014. Our measures of cognition are based on the main survey in 2011 and 2013, in which individuals are asked to do a cognition test every two years. Measures of childhood conditions came from the life history survey where respondents were asked to answer retrospective questions in their life course events. However, retrospective questions might suffer from a recall bias or less information can be extracted as memory fades. A handful of studies like Garrouste and Paccagnella (2011), Havari and Mazzonna (2015), Brunello et al. (2017) provide validation of retrospective data from The Survey of Health, Ageing, and Retirement in Europe (SHARE). The design of the survey and the method of data collection guarantees that respondents can recall life course events: respondents are helped to mark down the important events along the time line and questions are asked starting from domains that are more easily to remember. CHARLS has followed the same protocols and methods of SHARE and other worldwide ageing data. Hence, we expect that similar conclusions can be reached about the usage of retrospective data in CHARLS.

Considering that differences in mortality rates can lead to differences in selection bias of the survivors between groups, we excluded the oldest-old individuals (age

above 80). We also excluded proxy answers because they do not provide valuable information for our purposes. We only included panel samples which individuals answered questions in two waves. The final sample of each model varies according to the dependent variable we use: 13,992 observations for the models with dependent variable of word recall and 11,006 observations for the models using mental intactness as a dependent variable.

3.3.1 Cognition

The main dependent is individual's cognitive functioning. Following Salthouse (2002)'s suggestion, we use two different measures of cognition. In CHARLS, cognition is measured by simple tests such as word recalls, orientation in time, numeracy, drawing a picture and so on. The first measure is called "word recall", which has been used largely in most of previous papers to capture individual's episodic memory[30] and is included in the fluid ability. After hearing a complete list of words only once, respondents are asked to immediately repeat 10 words (immediate word recall) in any order and to recall the same list of words in a few minutes (delayed word recall). Following the previous literature (i.e. Mazzonna, 2014), word recall is computed as the total number of immediate and delayed recalled scores, ranging from 0 to 20. The second important measure of cognitive functioning is constructed on several mental status questions from CHARLS designed on the Telephone Interview of Cognitive Status (TICS) battery[31], in order to measure intactness or mental status of individuals (Lei et al., 2014). Mental intactness measure consists of three items- serial 7 subtraction from 100 (up to five times), whether the respondent used paper and pencil or any other aid, and whether the respondent can redraw a picture shown to the respondent. All of these items are eventually summed up to a single score, varying from 0 to 7. On average, respondents can recall 7 words out of 20 while the mean score of mental intactness is around 5.35. Figure 1.1 and Figure 1.2 indicate a clearly declining pattern of cognition over time in terms of both measures. However, word recall drops more dramatically between 45 and 75 years of age. Unlike word recall, mental intactness shows a more stable pattern as age rises. This is consistent with the previous studies that different measures of cognition have different sensitivity to the age decline.

FIGURE 1.1 AND FIGURE 1.2 ABOUT HERE

[30] According to Tulving (1972), episodic memory is defined as an information processing system that receives and stores information about temporally dated episodes or events and retains various aspects of this information and upon instructions transmit specific retained information to other systems.

[31] TICS are widely used as measures of cognitive functioning that can either be administered over the telephone or face-to-face interviews (Brandt et al.,1988).

3.3.2 A general index of childhood condition

The main independent variable, namely individual's childhood conditions, is constructed as a single index. It consists of four dimensions: parental characteristics, childhood wealth, childhood health status and health care as well as quality of neighborhood up to age 16. The information about an individual's childhood conditions is extracted from the retrospective questions on childhood socio-economic background and other childhood information collected in the third wave of the CHARLS. Parental characteristics include paternal and maternal education level and employment status during childhood, whether father or mother suffered from depression during childhood as well as whether father or mother had any of the following bad habits (alcoholism, smoking, drug, gambling) during childhood. Parental education level and employment status reflect the level of income as well as the cultural background of parental household while the habits and mental disorders of parents could affect their children's behavior (i.e. Everson-rose et al.,2003; Bharadwaj et al., 2014). The second dimension consists of four indicators concerning facilities in the accommodation during childhood (clean water, flushable toilet, private toilet, electricity), which are often used as a proxy for assets and household long-term wealth (McKenzie, 2005; Mazzonna, 2014). Childhood health status and health care is based on five indicators: self-reported childhood health status, whether respondents confined to bed or home for more than a month because of a health problem during childhood, whether respondents stayed in the hospital for more than a month because of a health problem during childhood, whether respondents received any vaccination during childhood, and whether respondents had a usual source of health care when sick or when they needed advice about health during childhood. According to Harden et al. (2007), environment interacts with genes in producing cognitive abilities. Hence, we also include the dimension concerning the neighborhood quality, including the safety, the cleanness of neighborhood where respondent lived in, as well as the relationship with neighbors during childhood. This dimension represents the investment parents put into their children as well as the environment individuals grew up during childhood. The method of constructing multidimensional childhood index is in line with the approach by Mazzonna (2014). Given the extensive battery of indicators considered, it might produce imprecise coefficient estimates if indicators are included separately in the regressions. Hence, all of these indicators are defined as dummy variables where 1 denotes good status and 0 indicates bad status. For the main analysis, equal weights have been given to each indicator under each dimension and to each dimension (1/4). In the end, after aggregating among all indicators and dimensions, each individual will have their own childhood index,

ranging from 0 to 1. In addition, the pair wise correlation between every two dimensions does not exceed 12%, which means that each dimension contains their own information and does not completely overlap with each other (see table 1.1 and 1.2). Dimensions are positively correlated with each other, hence it partly reassures the consistency of answers between different domains of the survey. The constructed childhood index will be used to explore the effect of childhood conditions on the later-life cognition.

TABLE 1.1 AND TABLE 1.2 ABOUT HERE

Table 2.1 and Table 2.2 show the distribution of the childhood index among different percentiles. For both samples, childhood index of the baseline model varies from 0.5 to 0.8 for different percentiles. For instance, the median from the sample of word recall is about 0.675 while the one from mental intactness has a median around 0.685.

TABLE 2.1 AND TABLE 2.2 ABOUT HERE

We then plot a graph between two dependent variables and childhood index in order to provide an intuition into basic relationship. According to Figure 2.1, word recall is positively associated with childhood index which indicates that the better the childhood condition, the higher the cognition level will be achieved at old ages. The same pattern is also found for mental intactness in Figure 2.2, but the slope is much flatter. The figure also depicts that Chinese men perform better than women in terms of mental intactness on average.

FIGURE 2.1 AND FIGURE 2.2 ABOUT HERE

To test the second research question, we divided our sample into two groups: favorable childhood conditions and unfavorable childhood conditions groups. We use the median as a threshold to distinguish two groups. The favorable childhood conditions group is defined as those with the childhood index above the median value for each sample while unfavorable childhood conditions group includes those whose childhood index is equal or below the median value. For example, the mean score of word recall is 7.95 for the favorable childhood conditions group while the number drops to 7.05 for unfavorable childhood conditions group. Individuals grew up with advantageous childhood conditions recall approximately one more word than those from disadvantageous childhood condition group on average. It is the

same for mental intactness that favorable childhood conditions group has a higher average score than unfavorable childhood conditions group (5.51 vs. 5.18)[32]. Consequently, getting access to better childhood conditions is more likely to obtain a higher level of cognitive performance late in life according to the descriptive statistics.

3.*3.3 Other covariates*

For the other important covariates, age and age square have been included to model nonlinear age profile of cognitive functioning. In addition, number of children, household size, cohort dummies, gender, marital status, education level, and regions are used to control for all other household characteristics and individual socio-economic status that are likely to influence late life cognitive functioning. Notably, the Chinese specific household registration system (known as hukou system), which has started since 1950s, determines the socio-economic policies that urban and rural hukou holders can benefit from during their whole life. This leads to a great urban-rural divide in terms of various aspects of well-being in China[33]. Hence, we controlled for different hukou type (rural or urban hukou holder).

Table 3.1 and Table 3.2 (in Appendix) report the descriptive statistics for each sample of word recall and mental intactness. For example, the average age of our sample is around 58. Favorable childhood conditions group tend to have a lower proportion of rural hukou holders and illiterate individuals than their counterparts.

3.4 Main results

The descriptive statistics illustrated above have shown a strong association between childhood conditions and old age cognition. This section is divided into two parts according to two research questions. First, the entire sample is applied to investigate the direct effect of childhood conditions on later-life cognition in terms of two different measures. Second, to further understand whether the age-related decline on cognitive functioning differs between two groups of people, the whole sample is split into the advantaged childhood conditions group and the disadvantaged childhood conditions group. We intend to assess explicitly whether the individuals experienced different early life conditions follow different trajectories of age decline of cognition, and reach a different level.

[32] The differences in the average scores of word recall and mental intactness between two groups are statistically significant at the critical level 1%.

[33] For more details, please refer to the paper by Brugiavini et al. (forthcoming).

3.4.1 Childhood conditions as a buffer of age decline

We start to examine the effect of childhood index on cognition based on the entire sample who answered questions and performed cognition test in two waves by using the ordinary least squares (OLS) estimation. The empirical specification is shown in equation (1).

$$Y_{it} = \alpha + AGE_{it}^{'} \beta_1 + AGE_{it}^{2\,'} \beta_2 + CHILD_i^{'} \beta_3 + z_{it}^{'} \gamma_1 + w_i^{'} \gamma_2 + c_i + \varepsilon_{it} \quad (1)$$

Y_{it} is the outcome variable (word recall and mental intactness). The estimated coefficient of $CHILD_i$ is of the main interest to explore the impact of childhood index. Furthermore, the study includes the quadratic term of age and the marginal effect of age, computed as $\beta_1 + 2 * \beta_2 * AGE_{it}$ at every five years between age 45 and 80. The set of time-varying control variables is denoted by z_{it}, while time-invariant covariates are denoted by w_i. c_i is the individual-specific unobserved component. In OLS, c_i is assumed to be uncorrelated with all other explanatory variables (it falls in the error term). The omission of time-invariant variables, which are of interest in the regression model and are positively related with both Y_{it} and $CHILD_i$, may lead to an overestimate of the effect of the childhood index. For example, if we exclude relevant time-invariant variables such as education and hukou type, the estimated coefficient of childhood index (see Table 4.1 in Appendix) is much larger than the number in the complete regression in Table 4.2. Thus, we will have empirical bias for the coefficient of the childhood index when relevant unobserved time-invariant variables are omitted. It again confirms the importance of controlling variables such as education.

Table 4.2 shows the main regression results after adding a complete set of covariates, where Model 1 presents the result of word recall and Model 2 is the result of mental intactness. Childhood index has a significantly positive impact on both word recall and mental intactness at critical level 1% as expected. If we consider an extreme case when childhood index improves from 0 (the worst case) to 1(the best base), people can recall two more words and improve their mental intactness scores by 0.62. It also implies that considering the percentage variation with respect to the mean, the average word recall score will be increased by around 27% (=2/7.5) while mean score of mental intactness will be raised by 11% (=0.62/5.4). The magnitude of word recall is twice as large as that of mental intactness. Furthermore, the result seems to be quite considerable if we compare the positive effect of childhood index with the coefficients of education dummies. Increasing childhood index by 1 point is almost equivalent to improve the education level from illiterate to secondary education level in the case of the word recall.

As stated widely in the literature, cognitive functioning tends to decline with age. We find that the joint significance of age and age square is statistically significant at 1%

for the word recall but it is only marginally significant for the mental intactness. Unlike word recall, mental intactness is less sensitive to age.

TABLE 4.2 ABOUT HERE

In order to compare the impact of an additional year of age with the effect of improving childhood conditions, we test the significance of a linear constraint on the parameters of age, age square and childhood index, which is statistically significant at the critical level 1%. Then, marginal effect of age are computed at age 45, 50, 55, 60, 65, 70, 75, 80[34]. The marginal effect of an additional year of age on word recall has a statistically negative effect since age 50 and its magnitude ascends gradually from -0.024 at age 50 to -0.07 at age 80. This finding is in line with the theoretical model that cognitive ability will deteriorate with age. Noticeably, according to the regression results in Table 4.1, if childhood index is increased by 1, word recall score will be improved by 2 which is much higher than the negative effect of one additional year of age on word recall. The positive effect of switching from the worst to the best childhood conditions case overwhelms the negative effect of an additional year of age on word recall. However, the compensated effect tends to reduce gradually. For example, the positive effect of improving childhood condition from 0.6 (first quartile) to 0.7 (third quartile) is 0.2, which is eight times larger than the marginal effect at age 50 (around -0.024) and only three times as higher than the effect at age 80 (around -0.07). For mental intactness, the negative marginal effect of age is found to be statistically significant only at age 45, 50 and 55. We did not find any clear pattern as found from word recall. In contrast, mental intactness seems to decline slightly at the beginning of old age and then keeps stable.

TABLE 4.3 ABOUT HERE

Furthermore, significant results are found in other control variables such as gender, education, hukou status, marital status and regions. For example, females tend to perform better than male in terms of word recall while the result is reversed for the mental intactness. Lei et al. (2014) also find the same results using CHARLS in 2011. Once controlling for all the other socio-economic characteristics, Chinese women

[34]For the sample of word recall, the other covariates are set to rural hukou holder, female, the married, primary education, west region, belong to cohort 1950-1959, three children, household size is four. For the sample of mental intactness, the other covariates are set to rural hukou holder, male, the married, primary education, east region, belong to cohort 1950-1959, two children, household size is four. The value of each variable is determined according to the category with the highest proportion of the whole sample for categorical variables and the mean for continuous variables. Same values are used in calculating the marginal effect of age for all the regressions in this paper.

score somewhat better than Chinese men in terms of word recall while they perform much worse than Chinese men regarding the mental intactness measure. Furthermore, people who obtained a higher education level tend to have a higher cognitive score. Urban hukou holders and married people are more likely to have a better cognitive performance than their counterparts in terms of both measures of cognition.

To sum up, consistent with the theoretical models, the exposure to better childhood conditions lead to higher levels of cognitive skills later in life. The positive effect of improving childhood conditions on cognition exceeds the negative effect of age.

3.4.2 Childhood conditions differentials in age decline

This section analyzes the difference in the age-related cognitive decline between the two groups of old people who experienced favorable conditions or unfavorable conditions during childhood by using OLS and panel data analysis with fixed effects (FE). Our empirical analysis might be restricted because of sample selection. The sample considers those who reach at least 45 years old and those who died before age 45 cannot be included in the sample by construction. It is likely that the longevity of these individuals who survive is higher than the average of their birth-cohort mates due to unobserved factors such as genes (Nijman and Verbeek, 1992; Van den Berg et al., 2010). If genes or other unobserved factors influence cognitive functioning, we might have endogenous sample selection. Hence, FE estimation can be of great help to control for this issue.

The regression model (2) ran separately between favorable and unfavorable childhood condition groups for both OLS and FE.

$$\mathrm{Y_{it}} = \alpha + \mathrm{AGE_{it}^{'}}\,\beta_1 + \mathrm{AGE_{it}^{2\,'}}\;\beta_2 + \mathrm{z_{it}^{'}}\,\gamma_1 + \mathrm{w_i^{'}}\;\gamma_2 + \mathrm{c_i} + \varepsilon_{\mathrm{it}} \quad (2)$$

Y_{it} is the outcome variable (word recall and mental intactness). The second order polynomial of age and age square is added and the marginal effect of age is computed as $\beta_1 + 2 * \beta_2 * AGE_{it}$ at every 5 years between 45 and 80. z_{it} includes all time-varying controls while w_i includes all time-invariant covariates. c_i is the individual-specific unobserved term. In OLS, c_i is assumed to be uncorrelated with all other explanatory variables and hence falls in the error term. In FE, time-invariant explanatory variables like marital status and gender are dropped and c_i is assumed to be arbitrarily correlated with other explanatory variables

First, the OLS results are presented in Table 5.1 and 5.2. Table 5.1 shows the OLS regression results between favorable and unfavorable childhood condition groups, in terms of the word recall and mental intactness, respectively. Marginal effects of age are computed at every five years from 45 to 80. According to the first column of

Table 5.2, for the unfavorable childhood condition group, the marginal effect of age on word recall has a negative impact since age 55, statistically significant at 5% critical level. The magnitude of the negative impact rises from -0.035 at 55 to -0.10 at 80. For the favorable childhood conditions group, word recall is found to depreciate between 55 and 65 but its magnitude of the marginal effect is smaller than the unfavorable childhood conditions group. We did not find any similar results from mental intactness. The third and the last column test the difference in the marginal effect of age between two groups of people. Unfortunately, the difference is not statistically significant in either case. Thus, the slopes of the trajectories between favorable and unfavorable groups are not stark in terms of OLS regression results.

TABLE 5.1 AND TABLE 5.2 ABOUT HERE

More intuitively, we plotted the predicted values of both measures by considering a representative profile of individuals common to both groups[35]. Figure 3.1 shows a clearly declining pattern over the age for both favorable and unfavorable childhood conditions groups. The favorable childhood group obtains a higher level of word recall than the other group, especially between 55 and 65. Nevertheless, we do not observe a significant difference in the slopes between two groups of people as found in the regression results. Figure 3.2 depicts the result of mental intactness. In line with the regression results, the difference between the two groups of people is not statistically significant both in terms of level and slope.

FIGURE 3.1 AND FIGURE 3.2 ABOUT HERE

Interestingly, we also found some significant results from other covariates. Chinese women are more likely to obtain a higher word recall score than men, especially those came from the favorable childhood conditions group. But Chinese women tend to perform worse in terms of mental intactness than men, in particular those from the unfavorable childhood conditions group. Holding urban hukou, obtaining higher education level, being married will achieve a higher level of cognitive skills for both groups of people. Region dummies also have a statistically significant influence on cognition.

Second, we go on to test the second research question by performing panel data analysis with FE so as to consider unobserved individual effects based on the same

[35] We insert into the same values as used in computing marginal effect of age.

sample and same variables. Main regression results are presented in Table 6.1 and the marginal effect of age is shown in Table 6.2. After controlling for unobserved individual effects, the joint significance of age and age square on two measures of cognition is statistically significant at 1% for both favorable and unfavorable childhood conditions groups. According to Table 6.2, the marginal effect of age on the word recall is found to be negative for unfavorable childhood conditions group since age 65. The deteriorated effect of age will be increased by twice more in fifteen years from age 65 to 80. The magnitude is much smaller for favorable childhood conditions group though they are not statistically significant. Moreover, the difference in marginal effect between two groups is now statistically significant since 60 years old and the gap rises gradually. This finding implies that after controlling for unobserved individual effects, the unfavorable childhood conditions group is exposed to a faster rate of decline with ageing than those from favorable childhood conditions group. Mental intactness does not show such a pattern.

TABLE 6.1 AND TABLE 6.2 ABOUT HERE

Then, the graphs of the predicted values of each group are drawn by considering a representative profile of individuals common to both groups. Figure 4.1 reveals that there exists a great distinction of word recall between unfavorable and favorable childhood condition groups since age 55. Advantageous childhood condition group not only reaches a higher level of cognitive skills, but the age-related decline also tends to start a bit late. The slope of the graph is much flatter than the disadvantageous group since age 60. As presented by Figure 4.2, the favorable childhood conditions group reaches a higher level of mental intactness scores at the beginning (around age 45-55), but afterwards this advantage disappears.

According to both OLS and FE analysis, we find some evidence to confirm that if childhood conditions were more favorable, a higher level of late-life cognition will be achieved in all estimations in terms of word recall. The score of word recall from favorable childhood conditions group tends to drop more slowly than those from unfavorable childhood conditions group only from the FE analysis. Mental intactness is more stable and less sensitive to the age-related decline.

FIGURE 4.1 AND FIGURE 4.2 ABOUT HERE

3.5 Extensions and sensitivity analysis

To assess the robustness of our main findings, a battery of sensitivity checks is carried out. First, we use the alternative weighting schemes to construct childhood index. Second, we divide our sample into four quartile groups.

3.5.1 Alternative weighting scheme for childhood index

For the baseline model, equal weights are assigned to each dimension (1/4) and to each indicator under each dimension. In order to test whether our results are consistent regardless of the weighting schemes used for childhood index, we use the frequency-based weighting scheme proposed by Desai and Shah (1988) as well as equal weights to all the indicators to construct the childhood index. For the frequency-based weighting scheme, the weight of each indicator is equal to the corresponding proportion of the non-deprived individuals in the sample. For equal weights, each indicator is assigned to the same weight (1/20). Table 2.1 and Table 2.2 present the distribution of the childhood index for the sample of word recall and mental intactness. For instance, the median scores of childhood index with frequency-based weighting scheme is around 0.85 and the one with equal weights is equal to 0.7. Comparing with the baseline weighting scheme, the values of childhood index for different percentiles are mildly higher in the case of the frequency-based weighting scheme.

We analyzed both research questions using two alternative childhood indexes as in the baseline model. First, we examine the direct effect of the childhood index on two measures of cognition. Results are shown at Table 7.1 and Table 7.2 (in Appendix). In both samples, childhood index has a significantly positive impact on cognition as in the baseline model. For the frequency-based weighting scheme, the estimated coefficient of childhood index is slightly lower than the benchmark in the case of the word recall while a bit higher for the mental intactness. For the equal weights, the coefficients are very close to the baseline model. We find quite similar results about the marginal effect of an additional year of age in terms of both sign and magnitude. Those who grew up in an advantageous childhood condition will have a higher level of cognition and better childhood conditions offset the negative effect of an additional year of age. Mental intactness does not suffer much from a continuously deteriorated effect of age.

For assessing the differential effect of age on cognitive functioning between two groups of people, we divide the sample by median with the alternative childhood indexed. Table 8.1 and Table 8.2 (in Appendix) shows the coefficient estimation of FE and marginal effect of age on cognition. For both two weighting schemes, unfavorable childhood conditions group is exposed to a negative marginal effect of

age since age 65 as the baseline results. The difference in the marginal effect between two groups are statistically significant between age 50 to 70. The results from FE confirm our findings from the baseline model[36]. On the contrary, no significant difference in terms of both levels and slopes are found from mental intactness. Generally, similar conclusions are reached with the alternative weighting schemes. Our results are robust regardless of the weighting schemes we apply.

3.5.2 Childhood condition groups by quartiles

We distinguish our sample by the median in the baseline. Hence, two groups of people are close to each other to some extent. It is also interesting to see the results of more extreme cases considering those who are at the top and those at the bottom of the childhood conditions. Then, we split our sample into four groups according to the first quartile, median, and third quartile of childhood index. Table 9.1 (in Appendix) presents the coefficient estimates of FE for four quartile groups. The joint significance of age and age square is found to be statistically significant for the first, second and the fourth quartile groups in terms of word recall. The negative marginal effects of an additional year of age are found to be significant only for the first and the second quartile group. The magnitude of the marginal effect is much larger for the first quartile group than the second quartile and the unfavorable childhood conditions group in the baseline model. More importantly, we find that the difference in the marginal effect of age between the first and the fourth quartile groups is statistically significant between age 60 and 75. The differences vary between 0.151 to 0.251 which are slightly larger than the difference between unfavorable and favorable childhood conditions group of the same age period in the baseline model. As implied by the regression results, the cognitive functioning of the first quartile group seems to decline faster than the fourth quartile group.

We plotted the graph by taking into account a representative profile of individuals as the baseline model. According to Figure 5.1, it is clear that the difference between the first and the fourth groups exist both in terms of the level and the slope as found in the regression estimations[37]. Therefore, comparing those who are experiencing very poor childhood conditions with those with more advantageous childhood condition, the gap is slightly more distinct concerning the level of cognition and the rate of decline.

[36] Results of OLS are also the same as the baseline results.

[37] For the OLS results, the difference is statistically significant on in terms of the level between the first and the fourth quartile groups.

3.6 Conclusion

This paper investigates whether and how childhood conditions influence later life cognition and whether favorable childhood conditions can slow down the age-related cognitive decline based on the CHARLS data in 2011 and 2013. As the first step, we use OLS analysis to explore the direct impact of childhood index on two measures of cognition, which are word recall and mental intactness. Second, the sample is distinguished into two groups of people according to the median of childhood index. We look at the differentials in trajectories of age-related cognitive decline between favorable and unfavorable childhood condition groups.

First, our evidence confirms the theoretical model that cognition is declining with age. According to the theory, childhood inputs will help accumulate the total stocks of cognition over the whole life cycle. The empirical evidence of this study is in accordance with the previous conclusion that the higher the childhood index is, the higher the level of cognitive functioning will be at old ages in terms of both word recall and mental intactness. The effect of improving childhood condition on late-life cognition is considerable when comparing with the negative impact of age. Additionally, favorable childhood condition group reaches a higher level of word recall in all the cases. Individuals who grew up in better childhood conditions tend to have a lower rate of decline in old age only in terms of the FE analysis. Unlike the measure of word recall, mental intactness is less sensitive to age. This is probably due to different types of cognitive abilities (Horn and Cattell, 1967). Word recall is more related to the fluid cognitive abilities that is more likely to reduce over the time. However, considering the construction of mental intactness in this paper, it is largely influenced by the numerical questions which are more relevant to crystallized cognitive abilities. Crystallized cognitive ability is hard to lose and less sensitive to age-related decline.

Therefore, our results imply that monitoring and helping those children under worse childhood environment could help improve their cognition and slow down their cognitive decline at old ages. As China is facing an increasing ageing population, the costs and the inputs of the care for cognitively impaired elderly will undoubtedly increase in the future. For the young generation, helping those born at adverse conditions may improve the cognition at the national level and mitigate the speed of age-related decline for the whole society in the long term. Moreover, our study suggests the importance of considering early life conditions, in particular childhood conditions when assessing late life cognition.

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TABLES

Table 1.1 Correlation table of four dimensions of childhood index for the sample of word recall

	parental characteristics	childhood wealth	childhood health status and health care	childhood neighborhood
parental characteristic	1			
childhood wealth	0.116	1		
childhood health status and health care	0.099	0.110	1	
childhood neighborhood	0.085	0.048	0.096	1

Notes: Sample include 13,992 observations

Table 1.2 Correlation table of four dimensions of childhood index for the sample of mental intactness

	parental characteristics	childhood wealth	childhood health status and health care	childhood neighborhood
parental characteristic	1			
childhood wealth	0.116	1		
childhood health status and health care	0.087	0.101	1	
childhood neighborhood	0.087	0.048	0.084	1

Notes: Sample include 11,006 observations

Table 2.1 The distribution of childhood index for the sample of word recall

childhood index	**10%**	**25%**	**50%**	**75%**	**90%**	**mean**
Equal-dimension weights (baseline model)	0.544	0.610	0.675	0.738	0.769	0.667
Frequency-based weights	0.713	0.784	0.851	0.899	0.933	0.836
Equal weights	0.550	0.650	0.700	0.750	0.800	0.685

Notes: Sample include 13,992 observations

Table 2.2 The distribution of childhood index for the sample of mental intactness

childhood index	**10%**	**25%**	**50%**	**75%**	**90%**	**mean**
Equal-dimension weights (baseline model)	0.560	0.623	0.685	0.738	0.788	0.673
Frequency-based weights	0.718	0.783	0.850	0.90	0.937	0.837
Equal weights	0.600	0.650	0.700	0.750	0.800	0.691

Notes: Sample include 11,006 observations

Table 3.1 Descriptive statistics for the sample of word recall

	Overall sample (13,992 observation)		Unfavorable childhood group (6,808 observations)		Favorable childhood group (7,184 observations)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
word recall	7.51	3.40	7.05	3.204	7.95	3.32
childhood index	0.667	0.089	0.595	0.063	0.736	0.046
age	58.2	8.31	59.42	8.30	57.04	8.15
age2	3456.3	988.6	3599.9	1001.2	3320.2	956.8
hukou status						
rural	0.791	0.407	0.832	0.374	0.751	0.432
urban	0.209	0.407	0.168	0.374	0.249	0.432
gender						
male	0.489	0.500	0.503	0.500	0.475	0.499
female	0.511	0.500	0.497	0.500	0.525	0.499
marital status						
married	0.909	0.287	0.893	0.309	0.924	0.265
separated	0.003	0.057	0.005	0.072	0.002	0.039
divorced	0.007	0.085	0.007	0.083	0.008	0.087
widowed	0.074	0.262	0.087	0.282	0.062	0.241
Never married	0.006	0.080	0.008	0.089	0.005	0.070
# of children	2.51	1.29	2.71	1.37	2.33	1.18
household size	4.31	1.67	4.36	1.74	4.26	1.60
region						
west	0.322	0.467	0.357	0.479	0.289	0.453
east	0.309	0.462	0.296	0.457	0.321	0.467
central	0.291	0.454	0.283	0.451	0.298	0.458
north	0.078	0.269	0.064	0.244	0.092	0.289
cohorts						
<1939	0.055	0.227	0.071	0.257	0.039	0.193
1940-1949	0.250	0.433	0.281	0.449	0.220	0.414
1950-1959	0.404	0.491	0.414	0.493	0.394	0.489
1960+	0.292	0.455	0.234	0.423	0.347	0.476
education level						
illiterate	0.218	0.413	0.274	0.446	0.166	0.372
primary	0.413	0.492	0.446	0.497	0.382	0.486
secondary	0.348	0.476	0.265	0.442	0.426	0.494
tertiary	0.021	0.144	0.015	0.122	0.027	0.162

Table 3.2 Descriptive statistics for the sample of mental intactness

	Overall sample (11,006 observations)		Unfavorable childhood group (5,416 observations)		Favorable childhood group (5,590 observations)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	std. dev
mental intactness	5.35	1.835	5.18	1.88	5.51	1.772
childhood index	0.673	0.088	0.603	0.061	0.742	0.046
age	57.96	8.22	59.3	8.12	56.6	8.11
age2	3427.04	974.59	3584.8	978.9	3274.2	945.7
hukou status						
rural	0.755	0.430	0.798	0.401	0.713	0.452
urban	0.245	0.430	0.202	0.401	0.287	0.452
gender						
male	0.563	0.496	0.590	0.492	0.537	0.499
female	0.437	0.496	0.410	0.492	0.463	0.499
marital status						
married	0.918	0.274	0.907	0.290	0.929	0.257
separated	0.002	0.049	0.004	0.061	0.001	0.035
divorced	0.007	0.082	0.006	0.077	0.008	0.086
widowed	0.067	0.250	0.076	0.264	0.059	0.236
Never married	0.005	0.073	0.007	0.086	0.003	0.058
# of children	2.45	1.26	2.66	1.34	2.25	1.15
household size	4.30	1.64	4.35	1.68	4.25	1.60
region						
west	0.308	0.462	0.345	0.475	0.272	0.445
east	0.313	0.464	0.295	0.456	0.330	0.470
central	0.298	0.457	0.292	0.455	0.303	0.459
north	0.082	0.274	0.065	0.246	0.096	0.294
cohorts						
<1939	0.049	0.216	0.065	0.246	0.034	0.180
1940-1949	0.249	0.433	0.285	0.452	0.214	0.410
1950-1959	0.398	0.490	0.417	0.493	0.380	0.486
1960+	0.303	0.460	0.233	0.423	0.372	0.483
education level						
illiterate	0.116	0.321	0.154	0.361	0.080	0.272
primary	0.432	0.495	0.483	0.500	0.383	0.483
secondary	0.424	0.494	0.343	0.475	0.502	0.500
tertiary	0.028	0.164	0.021	0.144	0.034	0.182

Table 4.1 Coefficient estimates of OLS regressions of word recall and mental intactness with the omission of time-invariant variables

VARIABLES	**Word recall**	**Mental intactness**
age	0.040	-0.116**
	(0.079)	(0.050)
Age^2	-0.001	0.001**
	(0.001)	(0.0004)
Childhood index	4.45***	1.54***
	(0.365)	(0.226)
Further controls	yes	yes
Observations	13,992	11,006
R-squared	0.087	0.049
joint significance of age,age^2	0.001	0.024
p-value F-test marital status	0	0.001
p-value F-test cohorts	0	0.130
p-value F-test regions	0	0

Notes: All the regressions are controlled for age, age2, gender, marital status, household size, number of children, cohorts, regions. Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 4.2 Coefficient estimates of OLS regressions of word recall and mental intactness with the entire sample

VARIABLES	**Model 1** **word recall**	**Model 2** **mental intactness**
age	0.054	-0.093*
	(0.071)	(0.048)
age^2	-0.001	0.001*
	(0.001)	(0.0004)
cohort 1940-1949	0.188	0.261*
	(0.206)	(0.146)
cohort 1950-1959	0.338	0.331*
	(0.275)	(0.194)
cohort 1960+	0.629**	0.112
	(0.320)	(0.221)
childhood index	2.007***	0.617***
	(0.340)	(0.218)
urban	0.920***	0.197***
	(0.083)	(0.049)
primary education	1.114***	0.951***
	(0.080)	(0.069)
secondary education	2.275***	1.361***
	(0.094)	(0.073)
tertiary education	3.716***	1.656***
	(0.228)	(0.116)
female	0.312***	-0.312***
	(0.060)	(0.039)
separated	-0.297	-0.863*
	(0.442)	(0.452)
divorced	-0.243	-0.123
	(0.362)	(0.199)
widowed	-0.112	-0.181**
	(0.115)	(0.081)
never married	-0.962**	-0.470**
	(0.386)	(0.239)
no. of children	-0.016	-0.019
	(0.029)	(0.018)

(continues)

(Continued)

VARIABLES	**word recall**	**mental intactness**
household size	-0.023	0.012
	(0.019)	(0.012)
east	0.313***	0.463***
	(0.079)	(0.049)
central	-0.053	0.337***
	(0.078)	(0.050)
north	0.364***	0.177**
	(0.121)	(0.077)
Constant	3.724*	6.398***
	(2.045)	(1.358)
Observations	13,992	11,006
R-squared	0.175	0.101
joint significance of age,age^2	0	0.086
p-value F-test marital status	0.098	0.015
p-value F-test cohorts	0.124	0.013
p-value F-test regions	0	0
p-value F-test education levels	0	0

Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 4.3 Marginal effect of an additional year of age on expected word recall and mental intactness

age	**Model 1 word recall**	**Model 2 mental intactness**
45	-0.016	-0.027**
	(0.019)	(0.012)
50	-0.024*	-0.020**
	(0.014)	(0.009)
55	-0.032***	-0.013*
	(0.011)	(0.007)
60	-0.040***	-0.006
	(0.010)	(0.007)
65	-0.048***	0.003
	(0.013)	(0.009)
70	-0.055***	0.009
	(0.017)	(0.012)
75	-0.063***	0.016
	(0.023)	(0.016)
80	-0.071**	0.023
	(0.028)	(0.020)

13,992 observations for word recall and 11,006 observations for mental intactness.

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

Table 5.1 Coefficient estimates of OLS regressions of word recall and mental intactness by childhood condition groups

	Model 3		Model 4	
	word recall		mental intactness	
VARIABLES	Unfavorable	Favorable	Unfavorable	Favorable
age	0.104	0.010	-0.005	-0.154**
	(0.095)	(0.103)	(0.083)	(0.060)
age^2	-0.001	-0.0003	3.36e-05	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
cohort 1940-1949	0.126	0.300	0.106	0.476**
	(0.268)	(0.324)	(0.197)	(0.226)
cohort 1950-1959	0.149	0.593	0.249	0.492*
	(0.365)	(0.421)	(0.261)	(0.293)
cohort 1960+	0.546	0.824*	0.134	0.231
	(0.435)	(0.478)	(0.300)	(0.330)
urban	0.960***	0.895***	0.185**	0.200***
	(0.122)	(0.111)	(0.075)	(0.064)
female	0.146	0.463***	-0.380***	-0.245***
	(0.091)	(0.083)	(0.060)	(0.052)
primary education	0.965***	1.334***	1.004***	0.810***
	(0.106)	(0.122)	(0.088)	(0.109)
secondary education	2.018***	2.594***	1.471***	1.174***
	(0.132)	(0.134)	(0.097)	(0.111)
tertiary education	3.363***	4.125***	1.798***	1.462***
	(0.436)	(0.271)	(0.164)	(0.165)
separated	-0.367	-0.510	-0.135	-2.910***
	(0.522)	(0.780)	(0.467)	(0.202)
divorced	-0.325	-0.223	-0.074	-0.155
	(0.534)	(0.488)	(0.337)	(0.231)
widowed	-0.048	-0.198	-0.274**	-0.050
	(0.150)	(0.177)	(0.112)	(0.114)
never married	-0.905*	-1.169**	-0.162	-1.217***
	(0.549)	(0.501)	(0.304)	(0.335)
no. of children	0.020	-0.0678	-0.009	-0.035
	(0.037)	(0.045)	(0.024)	(0.027)

(continues)

(Continued)

	word recall		mental intactness	
VARIABLES	Unfavorable	Favorable	Unfavorable	Favorable
household size	-0.028	-0.014	0.009	0.013
	(0.025)	(0.027)	(0.017)	(0.017)
east	0.392***	0.250**	0.559***	0.354***
	(0.106)	(0.112)	(0.069)	(0.067)
central	-0.047	-0.046	0.340***	0.328***
	(0.105)	(0.112)	(0.071)	(0.068)
north	0.501***	0.274*	0.347***	0.038
	(0.182)	(0.158)	(0.116)	(0.101)
Constant	3.869	5.861**	4.034*	8.719***
	(2.773)	(2.896)	(2.428)	(1.610)
Observations	6,808	7,184	5,416	5,590
R-squared	0.135	0.182	0.124	0.070
joint significance of age,age^2	0.003	0.118	0.989	0.014
p-value F-test marital status	0.466	0.128	0.180	0
p-value F-test cohorts	0.181	0.286	0.388	0.009
p-value F-test regions	0	0.017	0	0
p-value F-test education	0	0	0	0

Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 5.2 Marginal effect of an additional year of age on expected word recall and mental intactness by childhood condition groups

	Model 3 word recall			Model 4 mental intactness		
age	Unfavorable	Favorable	F-N	Unfavorable	Favorable	F-N
45	-0.009	-0.020	-0.011	-0.002	-0.042***	-0.040
	(0.026)	(0.027)	(0.037)	(0.023)	(0.014)	(0.027)
50	-0.022	-0.024	-0.002	-0.002	-0.030***	-0.028
	(0.020)	(0.030)	(0.028)	(0.017)	(0.011)	(0.020)
55	-0.035**	-0.027*	0.007	-0.0018	-0.017*	-0.016
	(0.016)	(0.015)	(0.021)	(0.012)	(0.009)	(0.015)
60	-0.047***	-0.031**	0.017	-0.001	-0.005	-0.003
	(0.015)	(0.015)	(0.021)	(0.010)	(0.010)	(0.014)
65	-0.060***	-0.034*	0.026	-0.001	0.008	0.009
	(0.018)	(0.019)	(0.026)	(0.012)	(0.013)	(0.018)
70	-0.073***	-0.037	0.025	-0.001	0.020	0.0209
	(0.023)	(0.026)	(0.035)	(0.017)	(0.018)	(0.024)
75	-0.085***	-0.041	0.044	-0.0004	0.033	0.033
	(0.030)	(0.034)	(0.045)	(0.023)	(0.023)	(0.032)
80	-0.098***	-0.044	0.056	-0.0001	0.045	0.045
	(0.037)	(0.042)	(0.056)	(0.0292)	(0.027)	(0.040)

13,992 observations for word recall and 11,006 observations for mental intactness.

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

Table 6.1 Coefficient estimates of FE linear regressions of word recall and mental intactness by childhood groups

	Model 5 word recall		Model 6 Mental intactness	
VARIABLES	Unfavorable	Favorable	Unfavorable	Favorable
age	0.984***	0.623***	0.184	-0.155
	(0.227)	(0.227)	(0.157)	(0.147)
age2	-0.009***	-0.005**	-0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)
separated	-0.769	-0.327	-0.521	-2.453***
	(0.971)	(1.044)	(0.705)	(0.591)
divorced	-0.075	-1.635	0.075	-0.683
	(1.301)	(1.070)	(0.669)	(0.668)
widowed	-0.240	-0.065	-0.667**	0.424
	(0.389)	(0.384)	(0.316)	(0.356)
never married	-1.463	0.140	0.587	0.764
	(1.501)	(0.832)	(0.922)	(0.771)
household size	0.096	-0.086	-0.100*	-0.013
	(0.070)	(0.080)	(0.056)	(0.060)
Constant	-21.09***	-12.22*	-1.131	10.70**
	(6.829)	(6.496)	(4.681)	(4.171)
Observations	6,808	7,184	5,416	5,590
R-squared	0.008	0.005	0.005	0.004
joint significance of age,age2	0	0.0004	0.073	0.274
p-value F-test marital status	0.761	0.652	0.209	0.0004

Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 6.2 Marginal effect of an additional year of age on expected word recall and mental intactness by childhood condition groups

	Model 5 word recall			Model 6 mental intactness		
age	Unfavorable	Favorable	F-N	Unfavorable	Favorable	F-N
45	0.216***	0.217***	0.001	0.081*	-0.055	-0.136**
	(0.065)	(0.058)	(0.086)	(0.044)	(0.037)	(0.056)
50	0.130***	0.171***	0.041	0.069**	-0.044	-0.113***
	(0.050)	(0.043)	(0.065)	(0.033)	(0.028)	(0.043)
55	0.045	0.126***	0.081	0.058**	-0.033	-0.091***
	(0.038)	(0.034)	(0.050)	(0.025)	(0.023)	(0.033)
60	-0.040	0.081**	0.121**	0.046**	-0.022	-0.068**
	(0.033)	(0.035)	(0.047)	(0.023)	(0.025)	(0.033)
65	-0.126***	0.036	0.161***	0.035	-0.011	-0.045
	(0.039)	(0.045)	(0.059)	(0.027)	(0.032)	(0.041)
70	-0.211***	-0.010	0.202**	0.023	0.0003	-0.023
	(0.051)	(0.061)	(0.078)	(0.036)	(0.042)	(0.055)
75	-0.297***	-0.055	0.241**	0.012	0.011	-0.0001
	(0.066)	(0.078)	(0.101)	(0.047)	(0.054)	(0.071)
80	-0.382***	-0.100	0.282**	-3.00e-06	0.023	0.023
	(0.083)	(0.096)	(0.125)	(0.058)	(0.066)	(0.023)

13,992 observations for word recall and 11,006 observations for mental intactness.

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

Table 7.1 Coefficient estimates of OLS regressions of word recall and mental intactness with alternative weighting schemes for childhood index

	word recall		mental intactness	
VARIABLES	Frequency-based weights	Equal weights	Frequency-based weights	Equal weights
childhood index	1.463***	2.135***	0.709***	0.676***
	(0.325)	(0.331)	(0.216)	(0.213)
Further controls	yes	yes	yes	yes
observations	13,992	13,992	11,006	11,006
joint significance of age,age2	0	0	0.076	0.09

Notes: All the regressions are controlled for age, age2, gender, hukou type, marital status, education level, household size, number of children, cohorts, regions. Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 7.2 Marginal effect of an additional year of age on expected word recall and mental intactness with alternative weighting schemes for childhood index

	word recall		mental intactness	
age	Frequency-based weights	Equal weights	Frequency-based weights	Equal weights
45	-0.019	-0.015	-0.028**	-0.027**
	(0.019)	(0.019)	(0.012)	(0.012)
50	-0.026*	-0.023	-0.021**	-0.020**
	(0.014)	(0.014)	(0.009)	(0.009)
55	-0.033***	-0.031***	-0.013*	-0.013*
	(0.011)	(0.011)	(0.007)	(0.007)
60	-0.041***	-0.039***	-0.006	-0.005
	(0.010)	(0.010)	(0.007)	(0.007)
65	-0.048***	-0.048***	0.002	0.002
	(0.013)	(0.013)	(0.009)	(0.009)
70	-0.055***	-0.056***	0.009	0.009
	(0.017)	(0.017)	(0.012)	(0.012)
75	-0.063***	-0.064***	0.017	0.016
	(0.023)	(0.023)	(0.016)	(0.016)
80	-0.070**	-0.072**	0.024	0.023
	(0.028)	(0.028)	(0.020)	(0.020)

Notes: 13,992 observations for word recall and 11,006 observations for mental intactness.

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

Table 8.1 Coefficient estimates of FE regressions of word recall and mental intactness by childhood condition groups with alternative weightings schemes for childhood index

Word recall	Frequency-based weights		Equal weights	
	Unfavorable	Favorable	Unfavorable	Favorable
age	0.705***	0.877***	0.769***	0.753***
	(0.224)	(0.228)	(0.197)	(0.281)
age2	-0.006***	-0.007***	-0.007***	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
further controls	yes	yes	yes	yes
Observations	6,932	7,060	9,332	4,660
joint significance of age,age2	0.001	0	0	0

Mental intactness	Frequency-based weights		Equal weights	
	Unfavorable	Favorable	Unfavorable	Favorable
age	0.143	-0.109	0.008	-0.001
	(0.153)	(0.150)	(0.137)	(0.177)
age2	-0.001	0.001	0.0001	-0.0001
	(0.001)	(0.001)	(0.001)	(0.002)
further controls	yes	yes	yes	yes
Observations	5,508	5,498	7,066	3,940
joint significance of age,age2	0.071	0.305	0.002	0.004

Notes: All the regressions are controlled for age, age2, marital status, household size. Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 8.2 Marginal effect of an additional year of age on expected word recall and mental intactness by childhood condition groups with alternative weighting schemes

	word recall						mental intactness					
	Frequency-based weights			Equal weights			Frequency-based weights			Equal weights		
age	Unfavorable	Favorable	F-N	Unfavorable	Favorable	F-N	Unfavorable	Favorable	F-N	Unfavorable	Favorable	F-N
45	0.138**	0.281***	0.143*	0.172***	0.274***	0.102	0.072*	-0.048	-0.120**	0.018	-0.012	-0.030
	(0.064)	(0.059)	(0.087)	(0.056)	(0.068)	(0.087)	(0.043)	(0.038)	(0.057)	(0.038)	(0.042)	(0.056)
50	0.075	0.215***	0.140**	0.106**	0.220***	0.114*	0.064*	-0.042	-0.105**	0.019	-0.013	-0.032
	(0.049)	(0.044)	(0.066)	(0.043)	(0.050)	(0.065)	(0.033)	(0.028)	(0.043)	(0.029)	(0.031)	(0.042)
55	0.012	0.148***	0.137***	0.040	0.167***	0.127**	0.056**	-0.035	-0.091***	0.020	-0.014	-0.034
	(0.038)	(0.035)	(0.051)	(0.033)	(0.041)	(0.052)	(0.025)	(0.023)	(0.034)	(0.022)	(0.027)	(0.034)
60	-0.051	0.082**	0.133***	-0.027	0.114**	0.140***	0.048**	-0.028	-0.076**	0.021	-0.015	-0.036
	(0.033)	(0.035)	(0.048)	(0.029)	(0.046)	(0.053)	(0.022)	(0.025)	(0.033)	(0.020)	(0.031)	(0.036)
65	-0.114***	0.016	0.130**	-0.093***	0.061	0.154**	0.040	-0.022	-0.062	0.022	-0.017	-0.038
	(0.039)	(0.045)	(0.058)	(0.034)	(0.061)	(0.069)	(0.026)	(0.033)	(0.041)	(0.024)	(0.041)	0.047)
70	-0.177***	-0.050	0.127*	-0.159***	0.007	0.167*	0.032	-0.015	-0.047	0.024	-0.018	-0.040
	(0.051)	(0.060)	(0.077)	(0.044)	(0.081)	(0.091)	(0.035)	(0.043)	(0.055)	(0.032)	(0.054)	(0.062)
75	-0.240***	-0.116	0.124	-0.226***	-0.046	0.180	0.024	-0.008	-0.032	0.024	-0.019	-0.043
	(0.066)	(0.078)	(0.100)	(0.027)	(0.031)	(0.041)	(0.046)	(0.055)	0.070)	(0.020)	(0.020)	(0.028)
80	-0.303***	-0.183*	0.121	-0.103***	-0.050	0.053	0.016	-0.002	-0.018	-0.006	0.041	0.047
	(0.082)	(0.096)	(0.125)	(0.034)	(0.039)	(0.051)	(0.057)	(0.067)	(0.87)	(0.025)	(0.025)	(0.035)

Notes: 13,992 observations for word recall and 11,006 observations for mental intactness.

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

Table 9.1 Coefficient estimates of FE regressions of word recall and mental intactness by four quartile groups

word recall	**Q1**	**Q2**	**Q3**	**Q4**
age	1.042***	0.910***	0.416	0.793**
	(0.330)	(0.312)	(0.319)	(0.316)
age2	-0.009***	-0.008***	-0.003	-0.006**
	(0.003)	(0.003)	(0.003)	(0.003)
further controls	yes	yes	yes	yes
Observations	3,496	3,312	3,590	3,594
joint significance of age,age2	0.001	0.011	0.122	0.002

mental intactness	**Q1**	**Q2**	**Q3**	**Q4**
age	0.300	0.129	-0.351	-0.023
	(0.231)	(0.218)	(0.217)	(0.199)
age2	-0.002	-0.001	0.003	2.76e-05
	(0.002)	(0.002)	(0.002)	(0.002)
further controls	yes	yes	yes	yes
Observations	2,608	2,808	2,554	3,036
joint significance of age,age2	0.003	0.805	0.161	0

Notes: All the regressions are controlled for age, age2, marital status, household size. Standard errors are clustered to account for intrahousehold correlation in the error term.

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

Table 9.2 Marginal effect of an additional year of age on expected word recall and mental intactness by four quartile groups

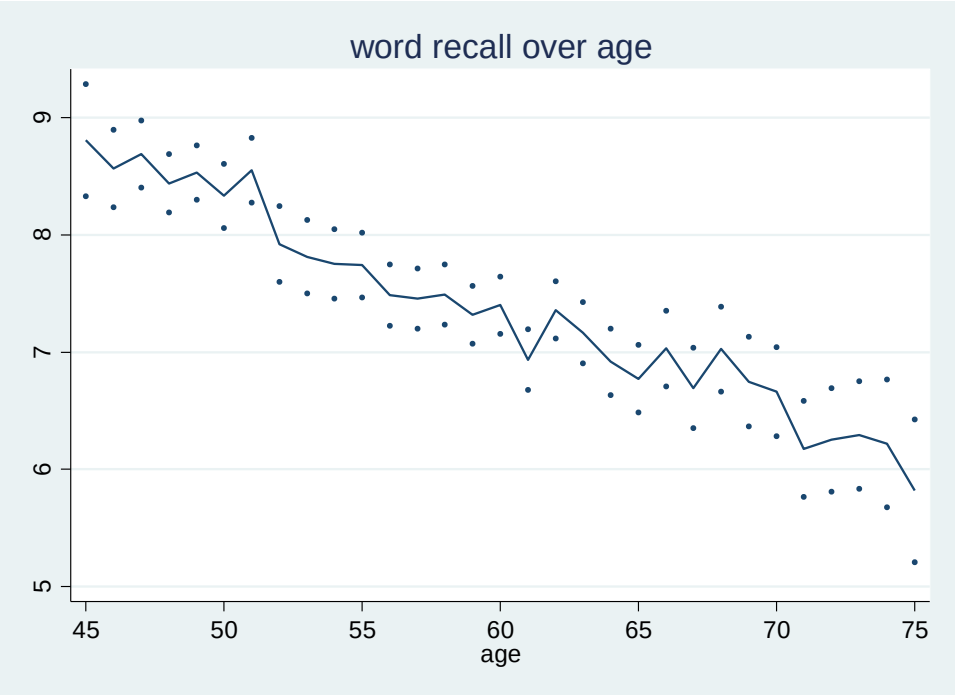
	word recall					mental intactness				
age	Q1	Q2	Q3	Q4	Q4-Q1	Q1	Q2	Q3	Q4	Q4-Q1
45	0.212**	0.219**	0.156*	0.263***	0.051	0.157**	0.025	-0.109*	-0.020	-0.177**
	(0.095)	(0.090)	(0.085)	(0.077)	(0.122)	(0.067)	(0.058)	(0.057)	(0.047)	(0.081)
50	0.120*	0.142**	0.127**	0.204***	0.084	0.141***	0.013	-0.082*	-0.020	-0.161***
	(0.073)	(0.069)	(0.064)	(0.058)	(0.092)	(0.052)	(0.044)	(0.043)	(0.035)	(0.061)
55	0.027	0.066	0.098**	0.145***	0.117	0.125***	0.001	-0.055	-0.020	-0.144***
	(0.055)	(0.053)	(0.049)	(0.047)	(0.072)	(0.039)	(0.034)	(0.034)	(0.030)	(0.048)
60	-0.065	-0.011	0.069	0.086*	0.151**	0.109***	-0.010	-0.029	-0.019	-0.128***
	(0.047)	(0.047)	(0.046)	(0.051)	(0.069)	(0.032)	(0.032)	(0.034)	(0.035)	(0.047)
65	-0.157***	-0.088	0.040	0.027	0.184**	0.0927**	-0.022	-0.002	-0.019	-0.112*
	(0.054)	(0.054)	(0.058)	(0.068)	(0.086)	(0.036)	(0.040)	(0.043)	(0.047)	(0.059)
70	-0.249***	-0.165**	0.011	-0.032	0.217*	0.077	-0.034	0.025	-0.019	-0.0956
	(0.071)	(0.070)	(0.078)	(0.090)	(0.114)	(0.048)	(0.054)	(0.056)	(0.061)	(0.078)
75	-0.342***	-0.242***	-0.018	-0.091	0.251*	0.061	-0.045	0.052	-0.019	-0.0793
	(0.093)	(0.091)	(0.101)	(0.115)	(0.147)	(0.063)	(0.069)	(0.072)	(0.078)	(0.10)
80	-0.434***	-0.318***	-0.046	-0.150	0.284	0.045	-0.057	0.079	-0.018	-0.0631
	(0.117)	(0.114)	(0.126)	(0.141)	(0.182)	(0.0795)	(0.086)	(0.089)	(0.094)	0.123)

Notes: 13,992 observations for word recall and 11,006 observations for mental intactness.

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

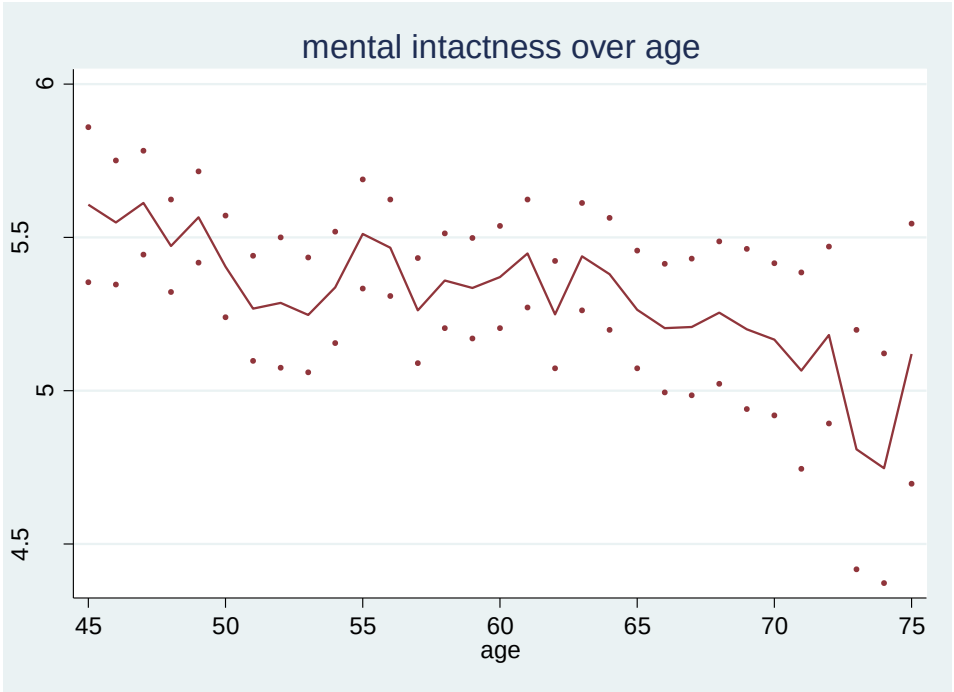
FIGURES

Figure1.1 Average score of word recall between age 45 to 75



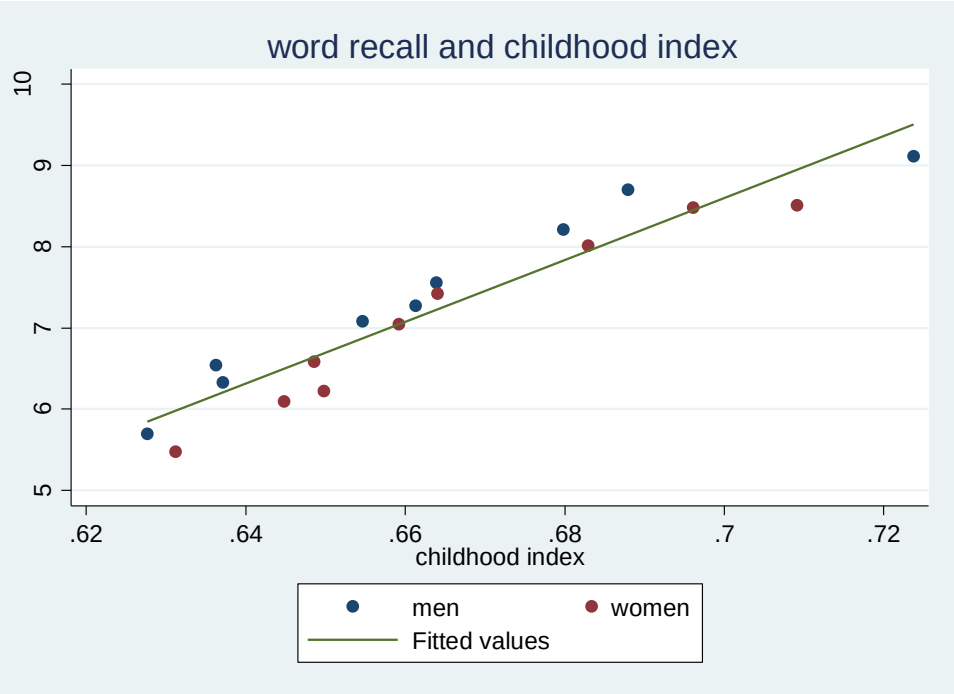
Notes: sample consists of 13,992 observations. Dots are the 95% confidence interval. The line represents the mean score of word recall of each age.

Figure 1.2 Average score of mental intactness between age 45 to 75



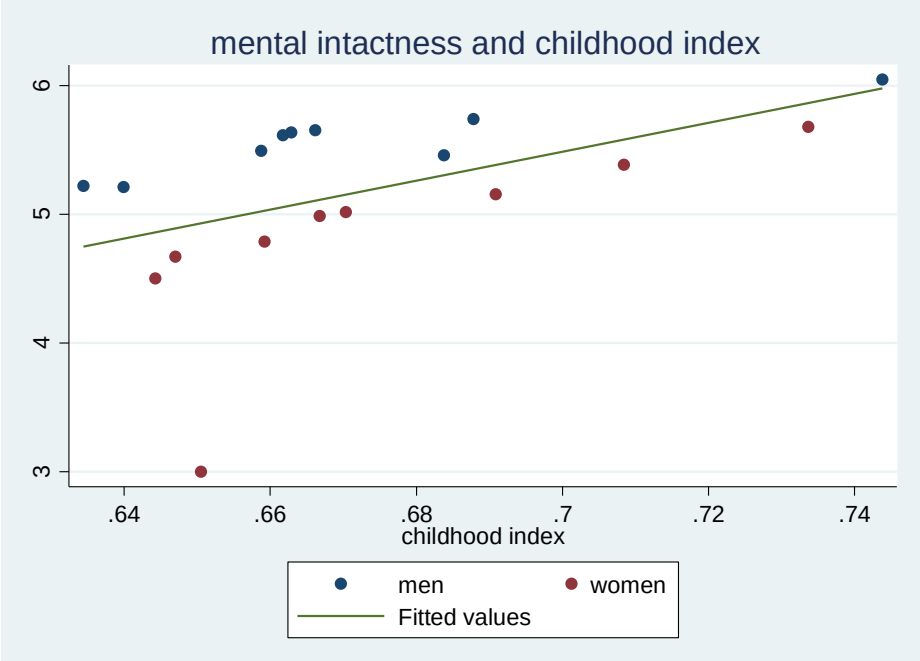
Notes: sample consists of 11,006 observations. Dots are the 95% confidence interval. The line represents the mean score of mental intactness of each age.

Figure 2.1 Scatter plot between word recall and childhood index



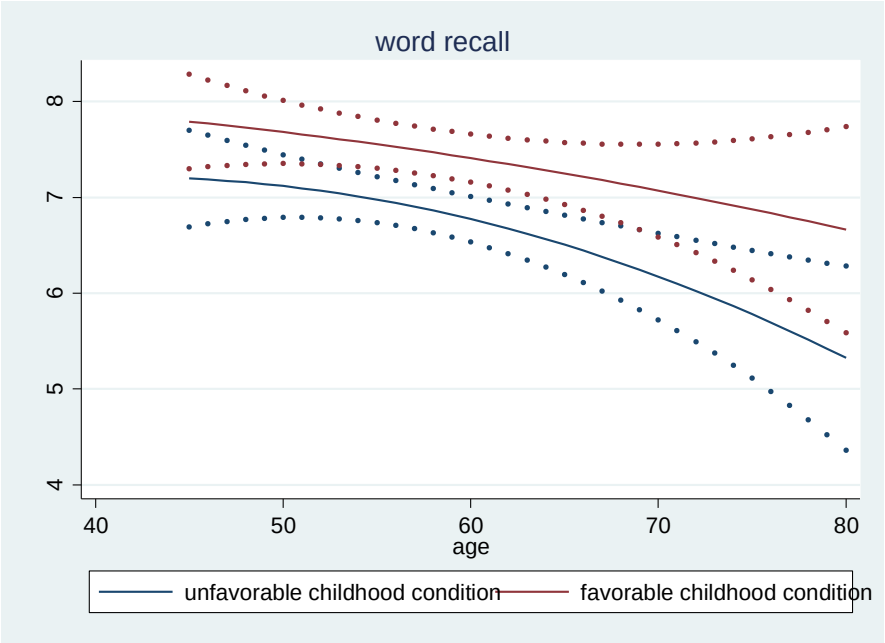
Notes: sample consists of 13,992 observations. Dots are the average value of word recall scores and childhood index by nine age classes between male and female. The green line represents the linear prediction of word recall on childhood index.

Figure 2.2 Scatter plot between mental intactness and childhood index



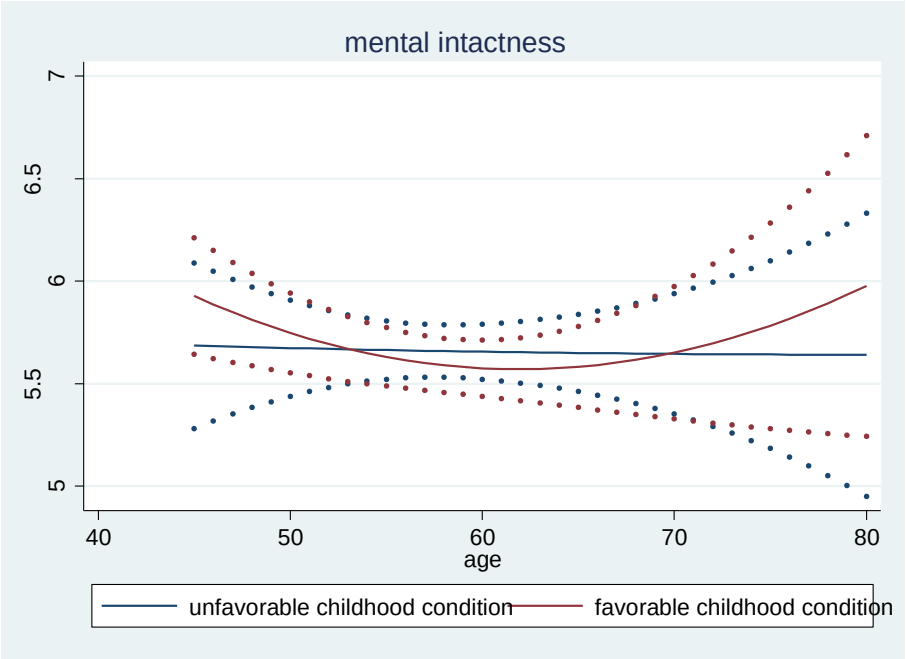
Notes: sample consists of 11,006 observations. Dots are the average value of word recall scores and childhood index by nine age classes between male and female. The green line represents the linear prediction of mental intactness on childhood index.

Figure 3.1 Predicted value of word recall from OLS



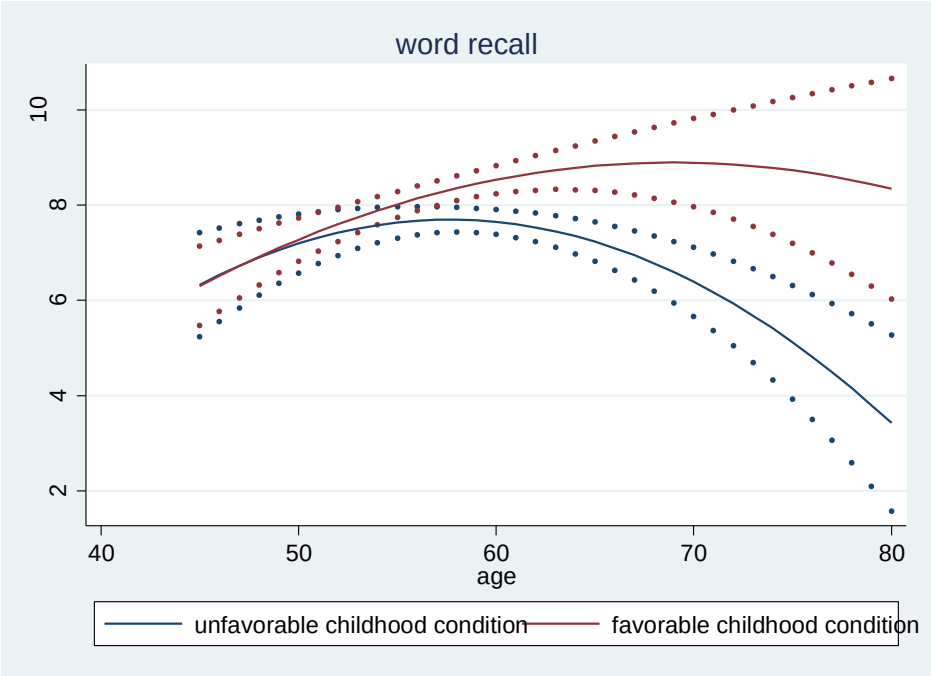
Notes: The solid line is the predicted value of word recall for a hypothetical person (rural hukou holder, female, the married, primary education, west region, belong to cohort 1950-1959, three children, household size is four). The values of each variable which insert into OLS regression are according to the category with the highest percentage of the whole sample for the categorical variables (i.e. rural hukou holders consists of 79%) and mean for continuous variables (i.e. mean of household size is 4) into OLS regression models. The dashed line is the 95% confidence interval. 13,992 observations are included.

Figure 3.2 Predicted value of mental intactness from OLS



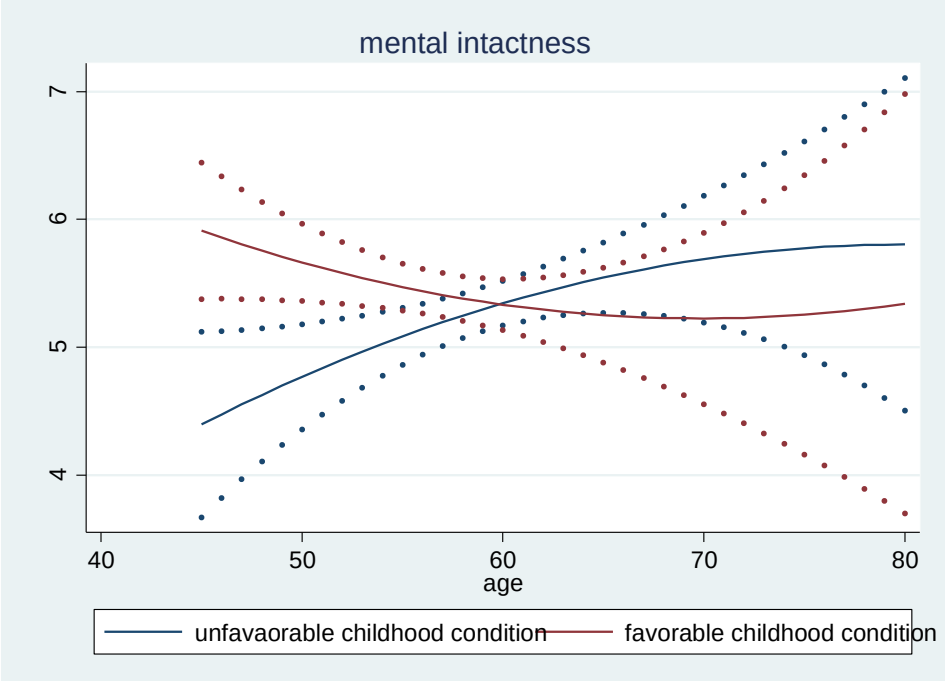
Notes: The solid line is the predicted values of mental intactness for a hypothetical person (rural hukou holder, male, the married, primary education, east region, belong to cohort 1950-1959, two children, household size is four). The values of each variable which insert into OLS regression are according to the category with the highest percentage of the whole sample for the categorical variables (i.e. rural hukou holders consists of 76%) and mean for continuous variables (i.e. mean of household size is 4) into OLS regression models. The dashed line is the 95% confidence interval. 11,006 observations are included.

Figure 4.1 Predicted value of word recall from fixed effect



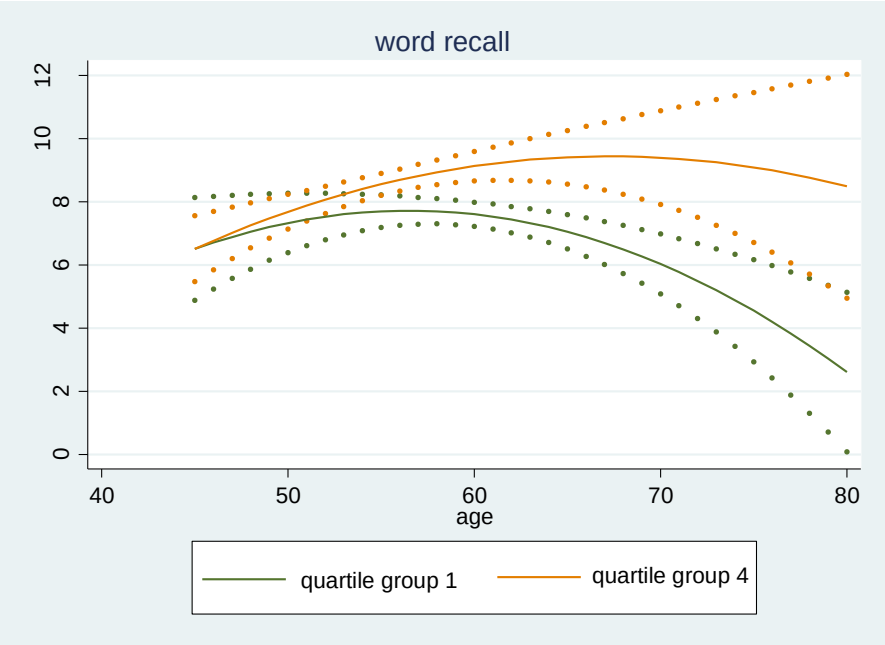
Notes: The solid line is the predicted values of word recall after inserting certain values (the married, household size is five) into FE regression models. The dashed line is the 95% confidence interval. 13,992 observations are included.

Figure 4.2 Predicted value of mental intactness from fixed effect



Notes: The solid line is the predicted values of word recall after inserting certain values (the married, household size is four) into FE regression models. The dashed line is the 95% confidence interval. 11,006 observations are included.

Figure 5.1 Predicted value of word recall from FE (first quartile vs. fourth quartile)



Notes: The solid line is the predicted values of word recall after inserting certain values (the married, household size is five) into FE regression models. The dashed line is the 95% confidence interval. 13,992 observations are included.

Acknowledgements

I would like to express my sincere gratitude to many people, who so generously contributed to the work presented in this thesis. Because of them, the experience of my PhD is so amazing and joyful.

First and foremost, I would like to thank my supervisors Prof. Agar Brugiavini and Prof. Danilo Cavapozzi, from whom I have learned how to become a good researcher in Economics. I appreciate all of their contributions of time, ideas, insightful discussions and funding to make my PhD experience productive and stimulating. Especially during the tough times of the PhD, their enthusiasm and rigorous attitude towards research were contagious and motivational for me. I thank both of them wholeheartedly, not only for their tremendous academic support, but they also give me an excellent example as a successful Economist and professor.

I am also hugely appreciative of Prof. Rob Alessie and Prof. Viola Angelini who were my supervisors in the master program at the University of Groningen and gave me helpful feedbacks on this thesis during the conferences and workshops. I am particularly indebted to Rob who has led me to the this research field. Without his support and kindly suggestion, probably I would not have pursued my PhD.

Many thanks to Prof. Luca Corazzini, Prof. Cheti Nicoletti and Prof. Vincenzo Atella, who read the draft and contributed to the improvement of the thesis by providing valuable comments and suggestions.

I would also thank Prof. Arie Kapteyn, at the Center for Economics and Social Research of the University of Southern California, where I spent my visiting period in Spring 2017. Discussions with Arie inspired me a lot. I have very fond memories of my time there.

I am thankful to our PhD coordinator Giacomo Pasini, the professors, colleagues, and secretary at the PhD program in Economics at Ca'Foscari University of Venice.

Special mentions go to Shuqing Hong, Aobo Jiang, Pengpeng Cai, Danmeng Feng, Yangning Nie, Prof. Bruna Zolin, Elena Bassoli, Jingxin Guo , Junshi Li, Boqi Zhang and Prof. Jin Fang and to all my Chinese and Italian friends who have supported and encouraged me during my entire PhD life.

Finally, but by no means least, I would like to thank my family (especially my grandfather in heaven) for their love and encouragement. My mum and dad who not only raised me with a lot of love but also taught me how to be a great person. Thanks again for all their supports in all my pursuits. They are the most important people in my world and I dedicate this thesis to them.

Estratto per riassunto della tesi di dottorato

Studente: Yao Pan matricola: 956203
Dottorato: Economics
Ciclo: XXX

Titolo della tesi : *Wellbeing and Ageing in China*

Abstract:
Population ageing is a major problem which not only happens in the developed countries but also spreads to the developing countries. China has been suffering from fast ageing since the past several decades because of reducing mortality rate and increasing life expectancy. The aim of this thesis is to analyze and understand different well-being determinants of the elderly from various aspects. In particular, the thesis applies the relatively novel method to measure individuals' wellbeing and looks at this issue from different angles. The first chapter investigates the well-being of Chinese individuals by summarizing the key social economic policies that tend to influence their wellbeing over their whole life. It points out the importance of the rural-urban difference imposed by hukou system. The second chapter analyzes the long-term effect of education on the current well-being based on a representative sample of the Chinese population aged 45 or over. It investigates how the education gradient combines with the marked differences in the social policies implemented in rural and urban China. The third chapter focuses on the later life cognitive functioning which is a vital determinant of the quality of life and well-being of the elderly. This chapter looks at whether and how childhood conditions influence later life cognition. The thesis contributes to the literature on well-being of the elderly by highlighting the importance of social economic policies and early life conditions, which are expected to affect individuals' well-being in the long run.

Abstract (italiano):
L'invecchiamento della popolazione è un problema cruciale non presente solo nei paesi sviluppati, ma anche in quelli in via di sviluppo. La Cina soffre di invecchiamento della popolazione da decadi passate a causa della riduzione del tasso di mortalità e dell'aumento dell'aspettativa di vita. L'obiettivo di questa tesi è analizzare e comprendere le diverse componenti del benessere degli anziani, da diversi punti di vista. In particolare, in questa tesi si applicano nuovi metodi di stima del benessere individuale e si concentra su questo tema da diverse prospettive. Il primo capitolo si focalizza sul benessere dei cinesi riassumendo le politiche economiche e sociali che tendono a influenzarli durante il corso della vita. Si evidenzia l'importanza delle differenze tra zone urbane e rurali imposte dal sistema Hukou. Il secondo capitolo analizza gli effetti di lungo periodo dell'educazione sul benessere presente sulla base di un campione di popolazione cinese dai 45 anni in poi. Si studia come il gradiente scolastico si unisca alle marcate differenze tra politiche sociali rurali e urbane. Il terzo capitolo infine, si basa sulle abilità cognitive in età avanzata, le quali sono determinanti della qualità di vita e del benessere degli anziani. Questo capitolo

investiga se e come le condizioni di vita dell'infanzia abbiano un impatto sulle capacità cognitive da anziani. Questa tesi contribuisce alla letteratura sul benessere degli anziani mettendo in luce l'importanza delle politiche economiche e sociali e le condizioni di vita primarie, le quali si ritiene influenzino il benessere dell'individuo nel lungo periodo.

Firma dello studente

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