Essays on education and pension policies in rural China

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III. List of Abbreviations

2PL	Two Parameter Logistic
2SLS	Two Stage Least Squares
3PL	Three Parameter Logistic
DID	Difference in Differences
GDP	Gross Domestic Product
GVIO	Gross Value of Industrial Output
IDA	Iron Deficiency Anemia
IRT	Item Response Theory
IV	Instrumental Variable
MOE	Ministry of Education
MOHRSS	Ministry of Human Resources and Social Security
NBSC	National Bureau of Statistics of China
NPCSC	Standing Committee of the National People's Congress
NRSPP	New Rural Social Pension Program
OLS	Ordinary Least Squares
RCT	Randomized Controlled Trial
TIMSS	Trends in International Mathematics and Science Study
WHO	World Health Organization

Chapter 1. Introduction

1.1 China's development and challenges

The economy of China has experienced huge changes after the reforms in 1978, the size of economy in 2011 was more than ten times that in 1978 (NBSC, 2012). And during the process of modernization, China has been experiencing the rapid transformation—from rural to urban and from agriculture to industry and services section (Taylor *et al*., 2003). The urban population share in China rose significantly from 18% in 1978 to 31% in 2011, and urban population rose by 222 million (NBSC, 2012). It is clear that as China's economy is growing, it is beginning to move from rural to urban which move along the transformation path. In a word, China has made a big progress along the economic development path over the past three decades. Migration, which is tightly linked to labor productivity growth, is a significant contributor to rapid economic growth rates (De Haan, 2000; Taylor and Martin, 2001). And China's industrialization has benefited from the low wages of the massive shift of rural to urban labor (Park *et al.*, 2007).

However, during the process of urbanization, development of China faced challenging at least two aspects. First, the rural labor needs to get adequate education to support the industries to move up the productivity ladder, but there are large educational gap between rural and urban (Qian and Smyth, 2008). Many studies found that children whose parents have migrated were worse in terms of school enrollment and school performance (Liang and Chen, 2007; Lee, 2011; Meyerhoefer and Chen, 2011; Wen and Lin, 2012). And there are also many researches indicated that inadequate nutrition intake may be an important cause of low student health and growth and school performance (Luo *et al*., 2009, Luo *et al*., 2012). Besides the liquidity constraints, parents' lack of sufficient nutrition knowledge may also be a reason of malnutrition problem of rural children.

Second, the rise of off-farm employment and rural-to-urban migration often leave the elderly to live on their own without the familial support (Benjamin *et al*., 2000; Pang *et al.*, 2004; Zhang and Goza, 2006; Giles *et al.*, 2010). China's population is currently aging more rapidly, by 2011, 9.1% China's population was

over the age of 65 (NBSC, 2012). By 2050 it is expected that more than a quarter of the world's people who are over 65 will live in China (Salditt *et al.*, 2008). Therefore, rural people are (and will be) increasingly reliant on some form of pension to maintain their standard of living in their old age. However, old age security benefits provided to rural and urban residents are imbalanced, while many urban residents more or less enjoy pension security, rural residents do not.

Therefore, it is of primary importance to address a set of basic development questions if the rural economy is to materialize. First, will the rural students who will be the future rural off farm labor receive adequate education and nutrition? Second, will the government better expand and improve the pension schemes of the rural old age security? More details of these two aspects are discussed in the next two subsections.

1.2 Challenge of rural education

There is controversy regarding whether China will successfully transform into a developed country given there are challenges of rural education. It is well known that one of the important factors to be competitive globally is to have a well-educated labor force able to deal with newer and more sophisticated technologies (Bernanke, 2007; Holz, 2008). The question that China needs to address is whether it can become competitive in a way that more technologically advanced factories can be established to replace the existing low-wage firms (Liu *et al*., 2009). The challenge is that the future industrialization will increasingly depend on the educated and skilled labor force (Zhang *et al.*, 2002). However, by the end of 2011, among 24.5 million high school students, only 1 million students are from rural areas (NBSC, 2012). Only 25-30% of junior high school students in poor rural areas go to senior high school (Wang *et al.*, 2011) and the ratio of students from poor rural areas going to college is even lower: about 5% (Liu *et al*., 2011). There are many reasons explaining this, such as a large number of left behind children may be bad at their school performance due to lack of parental care; inadequate nutritional intake for the rural students may negatively affect students' physical and mental development as well as their behavior and school performance; both of these reinforced the gap in education.

1.2.1 Migrants' effect on children's school performance

China's past development has been built on a shift of population in which labor moves from rural to urban areas (De Haan, 2000; Taylor and Martin, 2001). According to the National Bureau of Statistics of China (NBSC, 2012), there were more than 200 million migrants in 2011, double the figure from the past decade. The low cost of labor has been one of the major reasons for the prosperity of manufacturing industries of China (World Bank, 2009). However, the increasing off farm employment will have negative effect on their children's school performance. Under constraints from institutional arrangements such as the Household Registration (hukou) System, the migrants have to leave their children to rural areas which enlarge the educational gap between rural and urban population due to the inferior school facilities, lower qualifications of teachers in rural areas and less caring of parents.

Many studies show that the parental migration can be expected to lead to inconsistencies in children's school performance in various directions. It could results in lack of adult labor in the home, and the left behind children have to perform more household works, which may lead the children complete less total schooling years than children in non-migrant family (McKenzie and Rapoport, 2007) or restrict their access to school (McKenzie and Rapoport, 2011; Mansuri, 2006). Furthermore, the absence of a parent may negatively affect the left behind children's psychological wellbeing, and thus lead to academic, behavioral, and emotional problems (Lahaie *et al.*, 2009). China is no exception. Liang and Chen (2007) indicate that temporary parental migration into cities or suburban areas in the Guangdong province can significantly decrease children's school enrollment rate due to the absence of parental guardian. Other studies include Meyerhoefer and Chen (2011), Wen and Lin (2012) and Lee (2011) find that children whose parents have migrated were worse off in terms of school enrollment and years of schooling, compared to children whose parents have not migrated.

However, the results from many other studies in different countries show there are a mixture of individualistic and familial motives explains the impact of migrants on children's schooling (Kuhn, 2006; Amuedo-Dorantes and Pozo, 2010; Calero *et al.*, 2009; Edwards and Ureta, 2003; Yang, 2008; Alcaraz *et al.*, 2012; Antman, 2012; Lu and Treiman, 2011). According to such researches, migrants can increase their own level of economic livelihood, and these families can thus invest more in aspects of

their children's education. In case of China, some studies also indicate that migrants remit a large share of their income and the amount of these remittances is responsive to the needs of other family members (Taylor *et al*., 2003; Du *et al*., 2005). Thus, migrants can invest more in aspects of their children's education such as tutoring, computer assisted learning and other academic resources that effectively improve the children's intellectual performance (Lai *et al.*, 2009; Li *et al.*, 2010). Therefore, whether the effect of parental migration on children's school performance is positive or negative should be examined.

1.2.2 Nutrition education and students' health

There are strong indications that students' learning success during their elementary years is affected by health problems: if students are sick or malnourished, they may not be able to learn (Luo *et al*., 2012). As an important human capital in the process of economic development, health plays an extremely important role, such as increasing the labor supply and improving labor productivity, increasing household income, promoting economic growth, reducing poverty, etc (Schultz and Tansel, 1993; Thomas and Strauss, 1997). A scientific and balanced nutrition is the basis of health, especially the nutritional status during children's period is closely related to the health and the development of a lifetime and plays a vital role in the comprehensive development of the people (Case *et al.*, 2001; Thomas and Frankenberg, 2002; Ruger *et al.*, 2011). Anemia has been identified to be one of the most important health issues negatively affecting students' physical and mental development as well as their behavior and school performance. Studies on a range of countries have established that children with iron deficiency anemia (IDA) had worse physical health, lower school attendance and worse academic performance compared to children with normal iron status, (Halterman *et al.*, 2001; Stoltzfus, 2001; Stoltzfus *et al.*, 2001; Miguel and Kremer, 2004; Bobonis *et al.*, 2006).

A potential problem with regard to students' health is a lack of expertise on health and nutrition of people who are responsible for the students' meals, such as parents and school canteen staffs. They may be lacking nutritional knowledge necessary to induce appropriate and cost effective action, particularly nutritious meals, to fight malnutrition and children anemia (Luo *et al.*, 2009; Yang *et al.*,

2009).Whether is the parental nutrition education program effective on alleviating children's anemia in poor areas of rural China, a better understanding of this issue will help the advancing of a nutrition program and eventually improve the development of human capital.

1.3 Challenge of rural pension

Due to a worldwide decline in fertility and a corresponding increase in life expectancy, more and more countries have begun to enter what is being called an era of "aging society" (United Nations Population Fund, 2006). China is no exception. By 2050 it is expected that more than a quarter of the world's people who are over 65 will live in China (Salditt *et al.*, 2008). As this demographic shift has accelerated in recent decades, China's government has struggled to effectively deal with the needs of its rapidly aging population. However, the problems that arise from an underdeveloped pension system are especially acute in rural China. The rise of off farm employment and rural to urban migration as well as increased social mobility are changing the nature of the extended family in rural China, often leaving the elderly to live on their own without the familial support enjoyed by previous generations (Benjamin *et al.*, 2000; Pang *et al.*, 2004; Zhang and Goza, 2006; Giles *et al.*, 2010). Rural people are increasingly reliant on some form of pension to maintain their standard of living in their old age.

China's government is well aware of the looming social security crisis facing its rural population and has taken steps to help mitigate it (Herd *et al.*, 2010). In 2009 China's government issued guidance regarding the development of the New Rural Social Pension Program (NRSPP). Since the NRSPP began at 2009 many decisive reforms have followed and further solidified the rural pension program's framework. By the end of 2011, the number of NRSPP participants reached 326 million and the number of NRSPP beneficiaries reached 89 million. That same year the pension payment across the whole country totaled 58 billion RMB (NBSC, 2012). Despite these gains, however, participation in the NRSPP was far from universal, and there was a clear need to better understand the factors (both behavioral and policy related) influencing individual participation in the program. Besides the participation, whether the program will affect the work of rural elderly and what is the welfare consequence

of it also need to be studied.

1.4 Methodology

In my studies, I attempt to identify attribution between inputs and outcomes by employing experimental research methods. The methodology helps to evaluate which factor or program or policy works by focusing on identifying causality. Impact evaluation is a kind of attribution analysis, the fundament of economics research is to detect whether an intervention can play a role that is able to determine the causal relationship. However, when building an econometric model to explore the causality, if one or more regressors correlated with the error term, it is said to be endogenous. Endogeneity will lead to a biased estimation of the parameters which arise as a result of measurement error, auto regression with auto correlated errors, simultaneity and omitted variables (Stock and Watson, 2007). The instrumental variable estimation can be used to tackle the problem of endogeneity.

Furthermore, I used a data set from a randomized controlled trial (RCT) to take the impact evaluation. RCT is the forefront methods on impact assessments of scientific research. As the basic methods of impact evaluation, RCT can aim at the fundamental problem, by selecting sample and intervention group randomly, it can randomly assign to the intervention and control group. Through the intervention program implementation, ultimately it can be observed the effect of different intervention. It can effectively solve the problem of selection bias and reduce the systematic differences between the intervention group and the control group.

1.5 Dissertation outline

The dissertation is organized as follows. Chapters 2 to 4 contain in each chapter an essay on education or pension in rural China. Chapter 5 presents a summary of all the studies and concludes.

Chapter 2 of this dissertation studies the impact of parental migration on children's school performance in rural China. A substantial proportion of China's rapid economic growth has been attributed to its large amount of rural to urban migrants, but more than 80% of these migrants' children are left behind in rural areas,

mainly due to China's Household Registration system. The study wants to identify the impact of parents' migration on children's school performance to see whether the current economic growth in China partially sacrifice the future of next generation. The study demonstrates that having parental migrants can marginally reduce a child's math score, which implies that the current economic growth in China partially jeopardizes the future of the next rural generation. This essay has been presented on the 28th ICAE, Iguaçu, Brazil, and are under revision and resubmission in China Economic Review (as the first author and the correspondence author).

Chapter 3 investigates the impact of nutrition education on the anemia status of students in rural elementary schools in northwest China. One important factor that may be affecting the educational performance of students from rural areas is anemia. I use a randomized control trial of nutrition education program among over 1,900 fourth and fifth grade students in 42 randomly selected rural primary schools in Qinghai and Ningxia Province in northwest China. Results show that parental nutrition knowledge training could improve parents' knowledge and had a positive effect on students' anemia status which implies that Chinese government should include more intensive nutrition education and improve health and nutrition for students. This essay has been presented on the 5th International Symposium on Human Capital and the Labor Market, Beijing, China, and parts of it have been published on IAMO Annual 2012 (as the first author).

Chapter 4 presents a study that seeks to gain a better understanding on how China's New Rural Social Pension Program (NRSPP) in 2009 has affected the rural population. The analyses are based on a nationally representative household survey dataset collected in 5 provinces, 25 counties, 101 villages and 2020 households in rural China. Results show that the NRSPP has expanded rapidly since 2009. However, there are significant variations between provinces. The correlation analysis demonstrates that NRSPP policies, age, and individual confidence in the pension program appear to be systematically correlated with participation of rural individuals in the NRSPP program. In addition, the NRSPP improved the welfare of rural elderly by way of decreasing the working rate of the sick elderly. This essay has been presented on Chinese Economist Society annual conference 2013, Chengdu, China, and it has been submitted to the China Economic Review (as the first author).

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Chapter 2. The Impact of Parental Migration on Children's School Performance in Rural China

2.1 Introduction

A substantial proportion of China's rapid economic growth is attributed to the exodus of a massive number of hard working rural to urban people. According to the National Bureau of Statistics of China (NBSC, 2012), there were more than 200 million migrants in 2011, double the figure from the past decade. Migration, which is so tightly linked to labor productivity growth, is a significant contributor to rapid economic growth rates and long run national welfare (De Haan, 2000; Taylor and Martin, 2001; Wang *et al.*, 2007; Glauben *et al.*, 2008; Wang *et al.*, 2011; Tian and Yu, 2012).

Under constraints from institutional arrangements such as the Household Registration (*hukou*) System, in China rural migrant families living in cities benefit little from the available human resource service programs that fund education and health. One example of these families' problems is that their children cannot be enrolled in urban public schools, or they have to pay more than the children who had urban *hukou*, and they usually cannot afford it (Lai *et al.*, 2009). Latest research indicates that the migrant students who are unable to enroll in public schools perform significantly worse than their more fortunate counterparts (Chen and Feng, 2013). Even though in some cities there are a number of private and for profit schools that the children of rural to urban migrants can attend, the high tuition of these schools found there is let down by poor facilities and under qualified, demotivated teachers. Furthermore, most of these schools, which are not certified by the government, run the risk of being shut down. Thus, in most cases these families' school aged children are left behind in villages when the parents move to the city for work (Wu *et al.*,

2004). According to the census conducted in 2005, 58 million children, accounting for 21.7% of 0-17 age cohort children, were left in villages by their migratory parents (NBSC, 2005). The Sixth National Population Census indicated that the number increased again by 3 million to 61 million in 2010, which represents 37.7% of rural children (NBSC, 2011). At the compulsory education stage (elementary and junior high school), the number of children left behind is 22.7 million (MOE, 2011).

The consequences of rural to urban migration are not fresh in the literature and have been amplified given the increased trend. There are many studies on the impact of parental migration on left behind children in the context of international migration. However, the findings are mixed.

Some studies find positive effect of parents' migration. Migration not only imparts significant benefits to individuals through higher returns for working capability, but also has strong and transformative impacts on the rural families and the communities from which the migrants come (Ellis, 2003). The results from many empirical studies in different countries show that a mixture of individualistic and familial motives explains the impact of remittances on children's schooling (Kuhn, 2006, in Bangladesh; Amuedo-Dorantes and Pozo, 2010, in Dominican Republic; Calero *et al.*, 2009 in Ecuador; Edwards and Ureta, 2003, in El Salvador; Yang, 2008, in Philippine; Alcaraz *et al.*, 2012, in Mexico; Antman, 2012, in Mexico; Lu and Treiman, 2011, in South Africa;) According to such research, migrants can increase their own level of economic livelihood, and these families can invest more in aspects of their children's education. For example, Antman (2012) makes an estimation of the causal effect of parental migration on children's educational attainment by looking within the family to exploit variation in siblings' ages at the time of parental migration. She finds a statistically significant positive effect of parental US migration on educational attainment for girls, and finds that father absence does not play a major role in determining children's educational outcomes. Instead, the results suggest that the marginal dollars from US migrant remittances appear to enable families to further educate their daughters.

However, some studies find negative effect. Parental migration, which is usually undertaken without the consent of their children, can be expected to lead to inconsistencies in children's school performance in various directions. Parental migration could results in lack of adult labor in the home, and the left behind children have to perform household works, which may lead the children complete less total schooling years than children in non-migrant families (McKenzie and Rapoport, 2007, in Mexico) or restrict their access to school households (McKenzie and Rapoport (2011) in Mexico; Mansuri (2006) in Pakistan;). McKenzie and Rapoport examine the impact of migration on educational attainment in rural Mexico. By employing historical state migration rates as instruments, they find evidence of a significant negative effect of migration on school attendance and attainment. Furthermore, the absence of a parent results in loss of parental attention and supervision over the children, and leads to poorer school performance. Especially, the absence of a parent may negatively affect the left-behind children's psychological wellbeing, and thus lead to academic, behavioral, and emotional problems (Lahaie *et al*., 2009 in Mexico). The conclusion is consistent with the study by Spera (2005) suggesting that parental involvement and monitoring are robust predictors of children's academic achievement.

In case of China, the empirical result on the effect of parental migration on the educational outcome of left behind children is also mixed. Liang and Chen (2007) indicate that temporary parental migration into cities or suburban areas in Guangdong province significantly decrease children's school enrollment rate due to the absence of parental fiduciary. Many migrants leave their children with grandparents in the village. However, studies reach a consensus that the children are usually looked after by poorly educated grandparents, who are unable to substitute the roles of the parents (Biao, 2007). Grandparents may either spoil the children or fail to provide enough emotional care (Wang *et al*., 2006; Zhang *et al*., 2007). Further, living with grandparents is often negatively correlated with some health outcomes (Gao *et al*., 2010). Other studies include Lee (2011), Meyerhoefer and Chen (2011) and Wen and

Lin (2012) find that children whose parents have migrated were worse off in terms of school enrollment and years of schooling, compared to children whose parents have not migrated.

On contrary, migrants remit a large share of their income and the amount of these remittances is responsive to the needs of other family members (Taylor *et al*., 2003; Du *et al*., 2005). Thus, migrants can invest more in aspects of their children's education such as tutoring, computer assisted learning and other academic resources that effectively improve the children's intellectual performance (Lai *et al.*, 2009; Li *et al.*, 2010). Chen *et al*. (2009) study left behind children in Shaanxi Province in China, and they fail to find evidence that parental migration affect school performance (average Chinese and math test scores) negatively. They actually find that having a migrant father improves the left behind children's school performance. However, these results, as pointed out by the authors of the paper itself, might not be robust.

The main hurdle to conducting ideal research substantially rests on the problem of endogeneity, except for the omitted variables that are correlated both with migration and children's outcomes may cause problem, endogeneity also be resulting from the possible reverse causalities between children's school performance and parental migration. In counteraction to the possible negative impact of parental migration on children's school performance, it could be that parents could alter their decision to migrate in order to improve their children's school performance.

In summary, this study examines whether the effect of parental migration on children's school performance is positive or negative, identifies whether the migration decision is exogenous, and determines whether there are differences in the impact of a mother versus a father on school performance. By using a bivariate probit model, this study proposes instrumental variable estimations to help answer these questions. The study is based on a unique survey data obtained from a sample of 7,648 4^{th} and 5^{th} grade pupils in the rural areas of the Ningxia Autonomous Region and Qinghai province in northwest China.

The rest of the paper is organized as follows: We first introduce the survey methods and present data descriptions. We then provide the econometric models and identification strategy, which is followed by the estimation results and discussions. Finally, we conclude by summarizing the findings and offering policy implications.

2.2 Survey region and data

The utilized survey was conducted in October 2009 and the sample included 7,648 4^{th} and 5^{th} grade pupils from 74 rural primary schools in 10 counties in the Ningxia Autonomous Region and Qinghai Province. Figure 2.1 maps the location of each school. The two regions are located in northwestern China and have distinct geographic features. Ningxia consists of many arid, dry deserts, while Qinghai has a massive mountain range that surrounds the Tibetan Plateau. According to official statistics (NBSC, 2010a), per capita incomes of rural households in Ningxia and Qinghai are 21.4% and 35.1% lower than the national average level, respectively, mainly resulting from their disadvantaged geographic locations. In addition, a fair amount of the population in both provinces belongs to ethnic minorities. For instance, 46.3% of the population in Qinghai province is Tibetan and Hui, and 36% in the Ningxia autonomous region are Hui ethnicity (NBSC, 2010a).

Using an income stratified sampling method, we randomly select 31 towns from each province according to the local per capita gross value of industrial output (GVIO) (Rozelle, 1996). In each township only the schools which had 4^{th} and 5^{th} grade classes and enrolled more than 400 students were selected for this project. In total, 74 schools (38 in Qinghai and 36 in Ningxia) were involved in our project, and 7,648 students in the 4^{th} and 5^{th} grade were selected. Our sample indicates that 4,115 students have at least one migratory parent, accounting for 53.80% of the sample. Furthermore, among this group, 1,089 students have two migratory parents, implying that parental migration is highly prevalent in both provinces.

We conducted three different surveys, including a survey on schools, a survey on

teachers, and a survey on students and their families. Each survey team consisted of six members, with one member conducting the surveys on school information, which included the principal's information and school facilities. Two members personally interviewed all of the 4th and 5th grade teachers, including their educational background and teaching experience. The remaining three members carried out a survey that included a standard math test and collected students' characteristics. Furthermore, students also took questionnaires home to their adult family members to collect information on their parents, such as migratory status, educational levels, age, etc. For those students whose parents were migrants, the survey form was filled in by relatives who take care of the students.

In addition to collecting the students' personal characteristics, we also recorded their standard math test scores. The math test was based on questions drawn from a pool of questions that were originally created for the Trends in International Mathematics and Science Study (TIMSS). There are many ways to measure school performance, but most studies prefer to use test scores for math and language (Alderman *et al.*, 2001; Chen *et al.*, 2009). In Chinese elementary schools, Chinese language and math are the main courses, but we only use standard math test scores as a measure of school performance in this study because Chinese language tests might not be comparable across ethnic minority areas. Some ethnic minorities such as Tibetan students studied Chinese language from the 3th grade. After obtaining the math test scores, we calculated the percentile of each student score within his/her grade for comparisons. The percentile rank is widely used for measuring school performance in the current literatures (Kuhn and Weinberger, 2005; Gould *et al*., 2004; Lipscomb, 2007). This rank can identify whether the test taker performs better or worse than their counterparts, but not whether the test taker knows either more or less material than is necessary for a given purpose. Such an operation could make the school performances for different grades and classes comparable.

Table 2.1 presents the definition and descriptive statistics from the variables, tabulating the sample with and without migratory parents separately. The variables not

only include students' characteristics such as gender, grade, and their family and parental information, but also include the background of their math teachers and school information, which will be discussed in the next section. The results from the t tests imply that differences for most variables, except for grade, distance from home to school, the number of siblings and father's education in families both with and without migrants are statistically significant.

2.3 Statistical methods

2.3.1 Basic econometric model

There are many difficulties that impede identifying the effect of parental migration on children's school performance (Chen *et al.*, 2009; Antman, 2012). The sample selection plays an obstructive role. In a study on the urban Guangdong province of China, Liang and Chen (2007) found that temporary parental migration can significantly decrease a child's school enrollment rate. It is possible that sample selectivity bias may occur in this study, as some students who are performing poorly may drop out earlier. Liang and Chen's (2007) samples were collected from urban areas, and the students contained in the sample cover all grades ranging from 1st grade in elementary schools to senior students in middle schools. China has had a policy of nine years of compulsory education since 1986 with few drop outs occurring in elementary school (NPCSC, 2006). Drop outs from elementary schools (younger than 13 years old) are too young to work in the labor market. The graduation rate of the elementary school in Qinghai and Ningxia were 99.9% and 97.7% in 2009, while the average graduation rates in our sample counties were 98.6% and 95.5%, respectively, which are slightly lower than the provincial level (NBSC, 2010b, 2010c). We can presume that sample selectivity is not a substantial problem in this particular study.

We can specify the econometric model as follows:

$$y_i = \alpha_i + \beta M_i + \gamma X_i + u_i \qquad (1)$$

where y denotes the percentage rank of the standard math test score and M is a dummy variable that denotes whether there is a migratory parent for this student. Specifically, if either father or mother is a migrant, then M is 1 (including if both are migrants), otherwise M is 0.The coefficient β is the coefficient for migration in which we are interested, and measures the marginal impact of parental migration on children's school performance. The vector X is a vector of exogenous controlling variables comprising grade, gender, ethnicity, the number of siblings, the distance from home to school, both parents' educational levels and parents' age, etc, and γ is the related coefficient vector. The coefficient α is the intercept; and u is a random error following a normal distribution. Here, *i* represent each of the observations.

Furthermore, we also control for the unobservable heterogeneities from the dimensions of classes, schools and counties. Between classes, we add the educational background and the teaching year of the math teacher, which are the proxy variables for the quality of a teacher. At the school level, two dummy variables are included to represent a school's facilities (whether the school has a library or a computer room), which are believed to be related to the students' performance (Lai *et al*., 2009). Finally, county dummies are added to capture the invariant factors that differ between counties. Thus, equation (1) is extended to the following form:

$$y_{ijk} = \alpha_0 + \beta M_{ijk} + \gamma X_{ijk} + \delta T_{jk} + \eta S_k + \lambda C + u_{ijk} \qquad (2)$$

where i denotes student, j denotes class, and k denotes school. Compared to equation (1), we include T as the educational year and the teaching year of the math teacher, S as the dummy of whether a school has library or computer room. The county effect is captured by λ, and once again u is a random error following a normal distribution.

2.3.2 Extended model

Zhu (2002) find that the urban to rural income gap is larger for women than for men, which suggests that women receive larger monetary return from migration than men do. In this case, the proportion of female migrant workers keeps increasing. According to “2011 China Development Report”, by the end of 2010, the proportion of migrant women was 34.9%. And the third survey of Chinese women's social status in 2010 reported that the proportion is 14.7% higher than a decade ago. We should notice that recent evidence shows that not only are more women migrating, but they are going after marriage (Connelly *et al.*, 2011) which means more migrant women left their children behind. It is possible that the absence of the mother may require the child to undertake more extra household chores which had negative effect on child’s school performance. For example, from a survey conducted on 2006 in Sri Lanka, researchers found that children of migrant mothers have poorer attendance and performance than those children of non-working mothers (Save the Children, 2006). Thus, one can speculate that the roles of mother and father might be different in such a relation.

Therefore, we test the hypothesis of whether and to what extent differences exist in the school performance of children in families where the father migrates and where the mother migrates. In our survey, the proportion of the students who only have father migration accounts for 49.62%; only mother migration is 18.42%, and both mother and father migration is 14.24%. We included two dummy variables to represent the migratory status of father and mother in a family.

Equation (2) thus can be further extended into:

$$y_{ijk} = \alpha_0 + \beta_1 Fa_{ijk} + \beta_2 Mo_{ijk} + \gamma X_{ijk} + \delta T_{jk} + \eta S_k + \lambda C + u_{ijk} \qquad (3)$$

where migratory status of parents are separately denoted by two dummies, Fa and Mo, which denote father and mother migration, respectively. Specifically, if both parents are migrants, both dummies equal 1; if only the father is a migrant, Fa equals 1 and Mo equals 0, and vice versa; if neither of the parents are migrants, both

values equal 0. Coefficients β_1 and β_2 are the coefficients for parental migration, and measure the marginal impacts of migration status on children's school performance for the father's and mother's migration status, respectively.

2.3.3 Endogeneity and identity strategy

If reverse causality exists between parents' migration decision and the students' school performance in Equation (2) and Equation (3), leading to a problem of endogeneity, the OLS estimations are not consistent. An instrumental variable estimation should be used to address the problem. To identify the impact of parental migration on children's school performance, we propose using the cluster effect of parents' migration across school as the instrument for migration (Benjamin, 1992; Ji *et al*., 2012).

The cluster effect instruments used for the parental migration decision are the average probability of the neighboring parents of this student. Here, "neighboring" is defined as parents of all other children studying in the same school. This term is valid as IV to proxy for the local migration situation, and is satisfying for the following restrictions. In one aspect, the current studies show that the network established by neighbors plays a significant role in facilitating migration employment (Zhao, 2000; Zhao, 2003). In another aspect, the migration status of neighborhood children's parents is presumed to not directly affect the child's school performance. Instrumental validity significantly hinges on the robustness of the results.

However, there are two endogeneity variables in Equation (3) that require at least two instrumental variables for identification. The study by Huffman and Lange (1989) suggested that the off farm employment decision of the husband and wife are simultaneous decisions, and thus the probabilities of migration for the mother and father can be estimated by a bivariate probit model whether the residuals of the two decisions are allowed to be correlated. We propose two steps to estimate Equation (3), Step 1 will construct instruments for the mother and father's migration decision from

the predicted results of bivariate probit model. Step 2 will estimate Equation (3) with these instruments.

The bivariate probit estimation is estimating two equations simultaneously:

$$P_{Fa} = \Pr(\alpha_{Fa} + \gamma_{Fa} X + \pi_{Fa} Z^{Fa}) \qquad (4.a)$$

$$P_{Mo} = \Pr(\alpha_{Mo} + \gamma_{Mo} X + \pi_{Mo} Z^{Mo}) \qquad (4.b)$$

where P_r is the probability of migration decision for mother or father. In the second step, the predicted migration probabilities for mother and father from Equation (4.a) and (4.b) are used as instruments to estimate Equation (3). Given that carrying out the two step procedure explicitly may make to harmful mistakes, for example, the standard errors reported from the first stage regression will be incorrect (Wooldridge, 2010), we use a software package (STATA13) with a 2SLS command rather than explicitly carry out the two step procedure.

2.4 Empirical results

2.4.1 Model Comparison

Before discussing the main results, we provide an overview of selected diagnostic tests as reported in table 2.2. First, we test the null hypotheses that the unobserved factors across counties do not significantly different in estimating the impact of migration on children's school performance. The F test statistic is F (9, 7,624) =116.3, and is statistically significant at the 1% level, which indicates that the county dummies should be included in the estimation.

The Hausman test of endogeneity for the IV model rejects the null hypothesis of exogeneity of migration status at the P value less than 0.01. This implies that previous studies that did not consider the endogeneity of parental migration status do not completely evaluate student performance, suggesting that the IV model is the ideal

model for further discussion.

Furthermore, even though this instrumental variable is exogenously correlated with a household's decision to migrate, validity should be tested quantitatively to verify whether the instrument is weak (Staiger and Stock, 1997). If the instrument is weak, the normal distribution provides a poor approximation to the sampling distribution of the IV estimator, even with the large sample size. The F test value of the first stage regression of equation (2) is 15.86, which is larger than the usual critical value of 10.

For equation (3), table 2.6 reports the estimation results for the first stage for the instrumental estimation of equation (3). The correlation coefficient, reported in table 2.6, is 0.46 and is significantly different from zero. Thus, bivariate probit estimations of the migrant decision equations would be appropriate. The estimations of equation (3) are reported in table 2.3.

2.4.2 Results Discussion

The estimation results indicate that all the coefficients are consistent with our assumptions. The most important parameter is the coefficient for the variable of migration, -0.156, suggesting that when keeping other variables constant, parental migration does have a significant negative impact on a child's school performance. The magnitude of this coefficient provides evidence that the presence of parental migration leads to a marginal decline of 15.60% in math test rankings within the sample. Even without explicitly evaluating the personal economic gain of parental migration, our results show that migration has a negative impact on next generation's accumulation of human capital. From either an economic perspective or a human rights perspective, the Chinese government should take active measure to remove the institutional barriers between urban and rural areas. For example, the government could allow rural migrants' children to obtain the same level of education as their urban counterparts (i.e. where their parents work), and could facilitate closer

supervision of children in migrant families.

Our results also indicate that the gender bias in school performance persists, as the coefficient for gender (male) is 0.0248 and statistically significant. This implies that boys perform better in math tests, which perhaps results from discrimination towards girls, particularly in undeveloped rural areas (Klasen and Wink, 2003). The insignificance of the grade coefficient in particular indicates that there is no significant difference existing between 4^{th} and 5^{th} grade in school performance in our survey. The insignificance of the siblings' coefficient indicates no systematical differences of student performance between the students who had more or less siblings.

The coefficients for the educational level of father and mother are 0.0035 and 0.0006, respectively, and the former is statistically significant. This implies that having well educated parents can improve a child's school performance, and similar results have been found in the studies of Kochar (2004), Spera (2005) and Chen *et al.* (2009). One particularly interesting finding in this study is that when a father has one additional year of education, a significant increase of 0.35% in their child's math rank can be observed. As indicated by Spera (2005), increased parental practices and monitoring can have a significantly positive impact on children's school achievement.

The four dummy variables for controlling heterogeneities between different classes and between different schools are all positive and statistically significant, except for the variable of having a computer room. Specifically, when the math teacher has one additional year of education, the students' math rank increases by 1.14%, and an additional year of teaching experience increases the math rank by 0.25%. Students in a school with a library will be 5.62% higher in math rankings than those without a library.

We find that the coefficient for ethnicity is negative and statistically significant in the OLS estimation. However, its magnitude becomes smaller and it is not statistically significant after adding the county dummies. This implies that the reasons why

minorities do not perform well in math tests compared to the ethnic majority of Han pupils are not caused by inherent reasons such as race, but rather by geographical and social disadvantages. For example, in our sample, some counties had less minority students, such as Tongxin County, where just 12% of the schools are targeted to minorities. There, the math teachers have an average of 23.79 years of teaching experience, and 82% of schools have a library. However, 61% of schools target minorities in Minhe County, where only one third of the schools have a library, and the average level of teaching experience is only 11.27 years. In minority areas, we documented relatively poor education facilities and under qualified teachers because of the geographic and economic disadvantages. As a policy implication, it would be wise for the Chinese government to invest more heavily in the training and motivation of teachers in such areas.

Finally, table 2.3 reports the different estimation results for school performance separately for children with a migrant father and children with a migrant mother. The results show that the rank of math test are significantly lower, by 8.37% for children with a migrant father, and by 23.30% for children with a migrant mother, compared with children with no migrant parents. Other coefficients are basically consistent with the IV result in table 2.2.

2.4.3 Robustness check

Thus far the results have shown that parental migration had a significantly negative impact on children's school performance. We now consider the alternative subgroups to check the robustness of the results. The justification of the robustness obtained from the estimation for alternative subgroups is presented in table 2.4.

We first estimate by using students whose math test score are ranked lower than 50%. The results in column (1) suggest that the coefficients are consistent with the estimation using the whole sample, except for the coefficients of teacher and school characteristics, which show that for those students who do not perform well in math

tests, the effect of teacher quality and school facility are smaller and even statistically insignificant.

In addition, we further estimate by only using the minority students in column (2). The result is also similar to the full sample. However, the magnitude for the coefficients of the teacher and school characteristics becomes larger, and all of them are statistically significant at the 1% level. This implies that for minority students, teacher ability and the quality of their school facilities contribute significantly to their performance.

We also examine whether systemic differences exist between 4^{th} and 5^{th} grade, and between boys and girls. Column (3) reports the result of 5^{th} grade, and column (4) shows the results of boys. The results show that the signs and magnitudes of all the coefficients are consistent with the results from the full sample.

Furthermore, Brown and Park (2002) find that school performance is strongly correlated with household income. However, in this study we are not able to record income, because most households were not willing to reveal their true incomes. Following the principal components analysis proposed by Filmer and Pritchett (2001), we used the possession of certain rural durable assets as a proxy of household wealth. First, we asked about the household's ownership status of 21 assets including bicycles, refrigerators, televisions, cameras, and so on. If a household owned a specific asset, it was recorded as 1, otherwise as 0. Table 2.5 presents a descriptive statistic of the durable assets. Second, using the principal components analysis, we calculate the scoring factors for 21 assets. We used the first component as the proxy of asset following Filmer and Pritchett (2001). As shown in column (5), the results remain robust. The robustness checks convince us that the results remain robust with respect to different subgroups.

2.5 Conclusion

China's rapid economic growth is substantially driven by the large number of migrants from rural to urban areas searching for work. As a result, more than 80% of the migrants' children are left behind in rural areas due to China's household registration system. The relationship between parental migration and children's school performance has received a fair amount of attention over the years because it has important policy implications for China's long term economic growth. However, many unsolved problems remain in the current literatures. We address this issue by identifying the impact of parental migration on children's school performance, and whether the parental migration decision is exogenous to it.

Using a survey dataset collected in Qinghai Province and the Ningxia autonomous region in China, which involved more than 7,600 4^{th} and 5^{th} grade students from 74 rural elementary schools, we employed instrumental variable estimations, and identified that parental rural to urban migration has a significantly negative impact on children's school performance, even though the migration decision is endogenous. This is made clear through the finding that a migratory parent can reduce a child's math score by 15.60% in the percentile rankings. Specifically, by using a bivarite probit model, we separately obtain the effects of father's and mother's migration, which are -8.37% and -23.30%, respectively. This implies that even though migration has short term financial benefits to a family, it has a significantly negative impact on children's accumulation of human capital in the long run. Further, the current economic growth in China partially sacrifices the future of the next generation of Chinese workers as a result. Such a disadvantage for rural to urban migrants and their children might be created by rural to urban institutional barriers. To make economic growth sustainable and improve human rights, the Chinese government should take active measures to dismantle these barriers, for instance by abolishing the current household registration system, and by creating a better learning environment for the children of migrants.

Other findings include that female students and students in ethnic minority areas do not perform well in math exams, with discrimination against girls, poor educational facilities and unqualified teachers in minority areas perhaps being the main reasons. The Chinese government should implement more constructive policies to eliminate gender discrimination and increase investment in schools situated in minority areas to promote the education of female students and ethnic minorities.

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Table 2.1 Definitions and descriptive statistics of variables

Variables	Description	migration=1		migration=0		P value of the t test
		Mean	Std.Dev.	Mean	Std.Dev.	
math score	Dependant variable; standard math tests, 29 questions for 4^{th} grade and 20 questions for 5^{th} grade. Using percentile rank.	0.50	0.28	0.51	0.29	0.0218**
grade	Dummy; 0=4^{th} grade; 1=5^{th} grade	0.51	0.50	0.52	0.50	0.2848
gender	Dummy; 0=female;1=male	0.50	0.50	0.53	0.50	0.0003***
ethnic	Dummy; 0=ethnic groups, such as Hui, Tibetan, etc; 1=Han	0.64	0.48	0.65	0.48	0.6953
siblings	The number of siblings	2.40	1.26	2.49	1.32	0.0010***
distance	The distance from home to school (km)	6.26	12.16	6.27	11.20	0.9830
asset	Using principal components analysis to get the proxy of household durable assets	-0.03	1.82	0.04	1.98	0.1315
edu_father	The educational years of father	6.43	3.73	6.55	3.84	0.1582
edu_mother	The educational years of mother	3.59	3.89	3.86	4.01	0.0031**
age_father	The age of father	37.98	4.85	38.61	5.47	0.0001***
age_mother	The age of mother	35.49	4.33	36.00	4.76	0.0001***
diploma	The educational years of math teacher	15.00	0.89	14.94	0.90	0.0055***
teaching year	Math teacher's experience measured by teaching years	13.01	9.72	13.03	9.80	0.9604
library	Dummy; 1=have library in school;0=not have	0.41	0.49	0.37	0.48	0.0009***
computer room	Dummy; 1=have computer room in school;0=not have	0.54	0.50	0.55	0.50	0.5408
migration	Dummy; 0=both parents at home;1=either father or mother migrant, or both migrant					

Source: Authors' own survey

Table 2.2 Estimation results of migrants' effect on students' math score

Independent variables	Dependent variable: percent of math score		
	(1) OLS	(2) Adjusted OLS	(3) IV
migration	-0.0125*	-0.0077	-0.156***
	(1.96)	(1.28)	(3.21)
Student characteristics			
grade (1=grade 5th; 0=grade 4th)	-0.0067	-0.0060	-0.0081
	(1.05)	(1.00)	(1.30)
gender (1=male; 0=female)	0.0299***	0.0294***	0.0248***
	(4.67)	(4.90)	(3.87)
ethnic (1=non-han; 0=han)	-0.111***	-0.0076	-0.0113
	(15.53)	(0.94)	(1.34)
Family characteristics			
siblings (no.)	0.0068***	-0.0016	-0.0013
	(2.61)	(0.60)	(0.50)
distance (km)	-0.0005*	-0.0005*	-0.0004
	(1.74)	(1.79)	(1.64)
education of father (year)	0.0041***	0.0037***	0.0035***
	(4.51)	(4.36)	(3.92)
education of mother (year)	0.0032***	0.0013	0.0006
	(3.60)	(1.56)	(0.63)
age of father (year)	-0.002**	-0.0014	-0.0022**
	(2.15)	(1.58)	(2.33)
age of mother (year)	0.0022**	-0.0004	-0.0006
	(2.00)	(0.38)	(0.57)
Class and school characteristics			
diploma (year)		0.0108**	0.0114***
		(2.57)	(2.63)
teaching year (year)		0.0026***	0.0025***
		(6.07)	(5.62)
library (1=yes; 0=no)		0.0535***	0.0562***
		(7.25)	(7.29)
computer room (1=yes; 0=no)		0.0139**	0.0102
		(1.98)	(1.37)
county dummies	N	Y	Y
constant	0.521***	0.106	0.2172**
	(17.82)	(1.43)	(2.50)
Adjusted R-square	0.0522	0.1686	0.1023
Observations	7,648	7,648	7,648

Model diagnostics: Results of hypothesis tests

1. Joint hypotheses test

H_0:the unobserved factors across counties are not correlated with the explanatory variables

F(9,7624)=116.3

P-value <0.001

2. Endogeneity test of endogenous regressors

H_0: migration can actually be treated as exogenous

Chi-sq(2)=10.251

P-value <0.01

3. Weak instrumental variable test

H_0: the coefficients on the instruments equal zero in the first stage of two stage least squares

F(23,7624)=15.86

P-value <0.001

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 2.3 Estimation results of the difference between father and mother migrants

Independent variables	Dependent variable: percent of math score
father migrant	-0.0837**
	(2.04)
mother migrant	-0.233***
	(4.01)
Student characteristics	
grade (1=grade 5th; 0=grade 4th)	-0.0041
	(0.66)
gender (1=male; 0=female)	0.0312***
	(4.86)
ethnic (1=non-han; 0=han)	0.0009
	(0.10)
Family characteristics	
siblings (no.)	-0.0012
	(0.43)
distance (km)	-0.0003
	(1.01)
education of father (year)	0.0031***
	(3.44)
education of mother (year)	0.0027***
	(2.81)
age of father (year)	-0.001
	(1.03)
age of mother (year)	-0.0007
	(0.67)
Class and school characteristics	
diploma (year)	0.0105**
	(2.41)
teaching year (year)	0.0025***
	(5.51)
library (1=yes; 0=no)	0.0542***
	(7.00)
computer room (1=yes; 0=no)	0.0162**
	(2.18)
county dummies	Y
constant	0.105
	(1.27)
Endogeneity test	15.122***
Cragg-Donald Wald F statistic	77.44***
Observations	7,648

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 2.4 Robustness estimation results

Independent variables	Dependent variable: percent of math score				
	(1) percent<50%	(2) minority	(3) grade 5th	(4) boys	(5) with household asset
father migrant	-0.0587**	-0.0589	-0.159**	-0.117*	-0.0794*
	(2.01)	(1.00)	(2.48)	(1.76)	(1.93)
mother migrant	-0.0787*	-0.222***	-0.202***	-0.195**	-0.226***
	(1.78)	(3.63)	(2.79)	(2.37)	(-3.82)
Student characteristics					
grade (1=grade 5th; 0=grade 4th)	0.0076*	0.0113		-0.0092	-0.0045
	(1.68)	(1.46)		(1.02)	(-0.71)
gender (1=male; 0=female)	0.0145***	0.0310***	0.0233**		0.0314***
	(3.19)	(3.82)	(2.50)		(4.91)
ethnic (1=non-han; 0=han)	0.002		0.0068	0.0074	0.0021
	(0.34)		(0.56)	(0.57)	(0.25)
Family characteristics					
siblings (no.)	-0.0057***	0.0012	-0.0077*	0.0018	-0.001
	(2.80)	(0.36)	(1.93)	(0.44)	(-0.35)
distance (km)	-0.0001	-0.0003	-0.0005	-0.0005	-0.0003
	(0.62)	(0.84)	(1.24)	(1.38)	(-1.04)
education of father (year)	0.0024***	0.0014	0.0018	0.0026**	0.0034***
	(3.57)	(1.31)	(1.32)	(2.02)	(3.74)
education of mother (year)	0.0017**	0.001	0.0037***	0.004***	0.0031***
	(2.40)	(0.77)	(2.66)	(2.71)	(3.23)
age of father (year)	-0.0012*	-0.0003	0.0001	0.0006	-0.0011
	(1.73)	(0.28)	(0.02)	(0.44)	(-1.09)
age of mother (year)	0.0018**	-0.0011	0.0001	-0.0014	-0.0007
	(2.17)	(0.86)	(0.06)	(0.91)	(-0.68)
asset (PCA index)					-0.0043**
					(-2.30)

Class and school characteristics					
diploma (year)	-0.0011	0.0186***	0.0225***	0.0137**	0.0109**
	(0.32)	(3.40)	(3.48)	(2.24)	(2.50)
teaching year (year)	0.0006*	0.003***	0.0037***	0.0029***	0.0025***
	(1.93)	(5.06)	(5.49)	(4.51)	(5.51)
library (1=yes; 0=no)	0.002	0.0621***	0.0302***	0.0496***	0.0552***
	(0.34)	(6.29)	(2.62)	(4.56)	(7.14)
computer room (1=yes; 0=no)	0.005	0.0294***	0.0152	0.0082	0.0171**
	(0.89)	(3.47)	(1.43)	(0.76)	(2.30)
county dummies	Y	Y	Y	Y	Y
constant	0.657***	-0.0282	-0.121	0.0283	0.0990
	(10.16)	(0.29)	(0.98)	(0.24)	(1.20)
Observations	3,977	4,928	3,694	3,919	7,648

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 2.5 Descriptive statistics of durable assets and its scoring factors

Durable assets		Ownership Rate (%)	Std. Dev.	Scoring factors	Scoring factors/SD[a]
1.	Bicycle (tricycle)	42	0.49	0.1329	0.27
2.	Electric bicycle	5	0.22	0.2096	0.95
3.	Motorcycle	62	0.49	0.1227	0.25
4.	Tractor	34	0.42	0.0986	0.23
5.	Truck	6	0.25	0.2039	0.82
6.	Car	8	0.27	0.2183	0.81
7.	Phone (fixed line)	50	0.50	0.1345	0.27
8.	Mobile phone	82	0.39	0.0955	0.24
9.	Tape recorder	35	0.48	0.2006	0.42
10.	Stereo system	16	0.37	0.2375	0.64
11.	Color telephone	71	0.46	0.1159	0.25
12.	VCD/DVD player	38	0.48	0.2469	0.51
13.	Gas-oven	20	0.40	0.2547	0.64
14.	Micro-wave oven	24	0.43	0.2605	0.61
15.	Refrigerator	19	0.39	0.2846	0.73
16.	Camera	10	0.30	0.2843	0.95
17.	Video camera	5	0.21	0.2613	1.24
18.	Computer	6	0.25	0.2660	1.06
19.	Electric fan	16	0.36	0.2834	0.79
20.	Air-conditioning	4	0.20	0.2386	1.19
21.	Washing machine	58	0.49	0.2353	0.48

Source: Authors' own survey

[a] All of the assets are recorded as 0 or 1, the interpretation of the weights is that a move from 0 to 1 changes the index by f_{1i}/SD_i here, f_{1i} are calculated scoring factors, 1 denotes the first component and *i* ranges from 1 to 21. SD_i is the standard deviation of each durable asset. For example, a household that owns a bicycle has an asset index higher by 0.54 than one that does not have

Table 2.6 Estimated results of the factors correlated to the migration decision

Independent Variables	Dependent variable: migration decision		
	First stage regression of equation (2)	First stage regression of equation (3)	
migration cluster	0.8964***		
	(11.33)		
predicted migration_father cluster		1.5299***	0.4298***
		(14.91)	(5.41)
predicted migration_mother cluster		3.489***	4.1504***
		(8.68)	(13.34)
grade (1=grade 5th; 0=grade 4th)	-0.0175	0.0005	-0.0001
	(1.55)	(0.05)	(0.01)
gender (1=male; 0=female)	-0.0287**	-0.0074	-0.0090
	(2.54)	(0.65)	(1.02)
ethnic (1=non-han; 0=han)	-0.0554**	-0.0139	-0.0147
	(3.61)	(0.88)	(1.2)
siblings (no.)	0.0017	-0.0041	-0.0023
	(0.34)	(0.32)	(0.61)
distance (km)	-0.0001	0.0001	0.0002
	(0.06)	(0.12)	(0.45)
education of father (year)	-0.0019	-0.0005	-0.001
	(1.22)	(0.30)	(0.84)
education of mother (year)	-0.0049**	-0.0026	-0.0022
	(3.07)	(1.47)	(1.60)
age of father (year)	-0.0050***	-0.002	-0.0026*
	(3.01)	(1.17)	(1.95)
age of mother (year)	-0.0021	0.0002	0.0007
	(1.12)	(0.12)	(0.5)
diploma (year)	-0.0007	0.0002	0.0004
	(0.09)	(0.03)	(0.07)
teaching year (year)	-0.0004	-0.0011	-0.001
	(0.50)	(1.29)	(1.53)
library (1=yes; 0=no)	0.0099	0.0138	0.0143
	(0.71)	(0.99)	(1.33)
computer room (1=yes; 0=no)	-0.018	-0.0065	-0.0075
	(1.36)	(0.48)	(0.72)
counties dummies	Y	Y	Y
constants	0.8008***	-0.0778	-0.022
	(5.75)	0.52	(0.19)
Adjusted R-square	0.0428	0.0551	0.0573
F-value, F (24,7623)	15.86		
correlation coefficient		0.4585***	
		(20.71)	

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

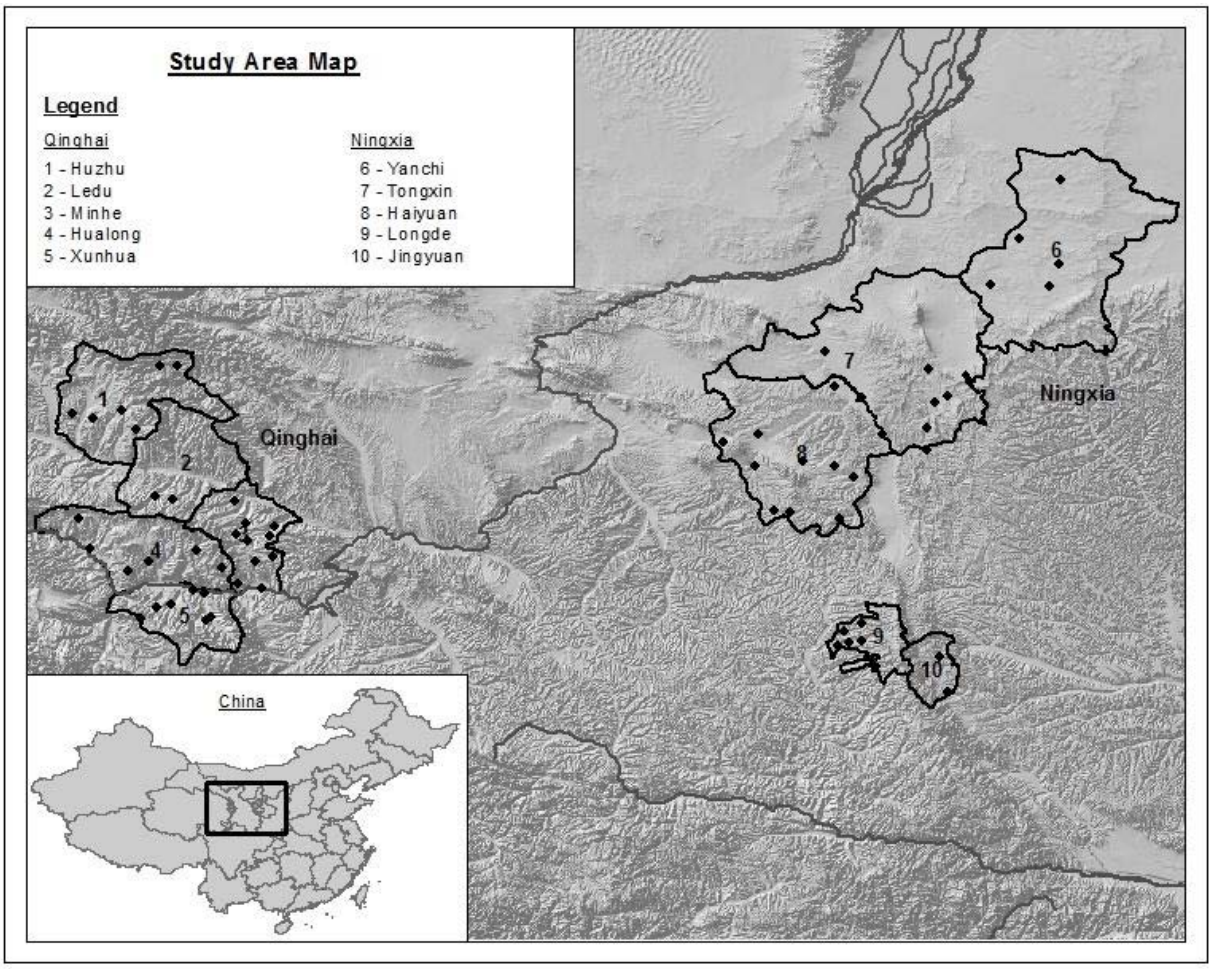

Figure 2.1 Location of sampled schools

Chapter 3. Effect of Nutrition Education for Reducing Anemia among Elementary Students in Northwest China

3.1 Introduction

Compulsory education up to junior high school (up to 9th grade) has assured high participation rates of children between grades 1 and 9 in rural China, however, there is still an urban rural gap regarding secondary schooling and university education. An indication for this gap is that considerably fewer rural than urban students pass the entrance exams *Zhongkao* and *Gaokao* to senior high school and university, respectively. Only 25-30% of junior high school students in poor rural areas go to senior high school (Wang *et al.*, 2011) and the ratio of students from poor rural areas going to college is even lower: about 5% (Liu *et al*., 2011).

There are many possible reasons for this problem. The low level of access to high school education in rural China may be resulting from high tuition and fees (Liu *et al*., 2009) which are less affordable for rural families given their considerably lower incomes. Other potential reasons are related to the quality of educational services: elementary school facilities may be inferior and qualifications of teachers are lower in rural areas (World Bank, 2001; Wang *et al*., 2011), as per student total spending is markedly lower than in urban centers (Tsang, 2005). Finally, there are strong indications that high school enrolment is relatively low because students' learning success during their elementary years was affected by health problems: if students are sick or malnourished, they may not be able to learn.

Anemia has been identified to be one of the most important health issues affecting the educational performance of students from rural areas. It is characterized by a lack of hemoglobin, the component of blood that carries oxygen from the lungs to the tissues. Hemoglobin deficiency, i.e. anemia, can lead to chronic fatigue and

further to respiratory and heart problems. Types of anemia, distinguished by their causes, are various, but iron deficiency anemia (IDA) is the most prevalent type. IDA risk varies a lot according to individual specific host factors such as age, gender, diet, and environment which determine iron intake requirements and iron production (Greer and Wintrobe, 2008). Young children (as well as women of reproductive age) from a group are particularly affected by IDA (Yip and Ramakrishnan 2002, Olivares and Pizarro 2001).

Anemia has been found to negatively affect students' physical and mental development as well as their behavior and school performance. Studies on a range of countries have established that children with iron deficiency anemia had weaker physical health, lower school attendance and lower academic performance compared to children with normal iron status, (Halterman *et al.*, 2001; Stoltzfus, 2001; Stoltzfus *et al.*, 2001; Miguel and Kremer, 2004; Bobonis *et al.*, 2006). IDA has been found to lead to many problems of teenagers and children, such as learning inattention, memory loss, reduced learning efficiency (Looker *et al.*, 1997; Pollitt, 1999; Halterman *et al*., 2001; DeMaeyer, 1989), and it is particularly serious, that the adverse effects of anemia on cognitive abilities are irreversible (Lozoff *et al.*, 2000).

Iron deficiency is one of the most prevalent nutritional deficiencies in the world and the global anemia databases of the World Health Organization (WHO) and international studies both show that IDA related problems are far more pervasive in developing than in industrialized countries. IDA prevalence is generally low in countries with high income levels (Gwatkin *et al*., 2007; Benoist *et al*., 2008). Estimates of IDA prevalence in China have been published in a number of studies focusing on different age groups and areas. The WHO (2008) reports that in 2002, the anemia prevalence among preschool age children was 20% in China. In 2002, the fourth Chinese Residents' Survey on Nutrition and Health has provided national level data on anemia prevalence. It reported that the average rate of anemia was 15.2%, and the anemia rate among babies and children was 24.2%. In 2002, the Anhui Provincial Maternal and Child Clinic took anemia tests for 3,648 children aged 0-12. The anemia

prevalence rate was 44.7%, including light, medium, and serve anemia with prevalence rates of 37.2%, 7.5%, and 0.1% respectively (Ren, 2004). Furthermore, according to a survey in 2008 in rural areas of Shaanxi Province, the average anemia rate was 38.3% across 66 elementary schools from 8 poor counties (Luo *et al*., 2011). These two studies were both focusing on rural areas, and reported higher anemia rates than the nationally representative studies of the WHO. This gives rise to concerns that anemia may be more serious in rural than in urban China. Even aside from hardships for anemic children and their families, prevalence of IDA endangers economic development. As these children are destined to be the future workforce of China, the negative impact of anemia on the quantity and quality of future human capital casts shadows on the prospect of sustainable economic growth and economic development in China.

The Chinese government has allocated considerable funds to programs aiming to improve education in rural areas. China now spends 3.5% of its GDP on education. While most of this spending is allocated to colleges and urban education, also a lot goes to rural education. Tuition from grades 1 to 9 is free and there are considerable financial aids offered for grades 10 and above. However, while these aids for students' families and increasing investment into school facilities, teachers and curriculum have improved some aspects of rural education they are unlikely to improve the health and nutrition situation because the incentives they provide for school management staff are counterproductive. Usually, the government allocates funds to the schools and the school principals can decide how to spend the money. Most of them spend the money on school buildings or technical infrastructure such as computer rooms or audio rooms. These physical investments are regarded as visible proofs of good professional performance of the principals on duty and to be potentially conductive to their career. The principals have little extrinsic incentive to invest in the health of students.

Another potential problem with regard to students' health is a lack of expertise on health and nutrition of people who are responsible for the students' meals, such as parents and school canteen staffs. They may be lacking nutritional knowledge

necessary to induce appropriate and cost effective action, particularly nutritious meals, to fight malnutrition and child anemia (Luo *et al.*, 2009; Yang et *al.*, 2009). This is the starting point of our study which aims to assess whether nutrition education for parents could improve children's health, in particular decreasing the anemia rate. Our study aims to assess whether nutrition education for parents could improve children's health, in particular decrease the risk for children to suffer from anemia.

Many studies were conducted on how to improve child nutrition and health. Among them, some addressed the impact of information intervention (such as nutrition education programs and campaigns to raise public awareness) on children's nutrition and health. In 1970s, the World Bank loaned to the Indonesia Community Nutrition Project. This project was focusing on nutrition education exclusively, without any other forms of transferring resources and it has improved the nutritional status of 40% of the children in the study (Berg, 1987). Müller and Krawinkel (2005) pointed out that providing micronutrient supplements alone is not sufficient to fight micronutrient deficiencies. They found that informing consumers which foods are particularly rich in protein and essential micronutrients is effective to improve their diet quality and emphasized that all nutrition interventions should be complemented by nutrition education campaigns. Webb and Block (2004) have confirmed what is actually known for decades: that the key to successful nutritional intervention for children is to increase their mothers' nutrition knowledge.

There are some studies using randomized control trials (RCT) validating the effect of nutrition education on health. RCT is a forefront tool to scientifically assess the effectiveness or impacts in general of administrative programs or interventions (treatments). By assigning study participants randomly to treatment and control groups, it can effectively solve the problem of selection bias and reduce systematic differences between the treatment groups and the control group. Estimating program impacts using RCT, can contribute to assess their cost effectiveness. Kapur *et al*. (2003) launched a four months RCT project to compare the different effects of parents' nutrition education and iron supplement on the iron status of children in urban slums

in Delhi. This study found that that the mean nutrition knowledge score increased after 16 weeks in the intervention group and suggested that nutrition education can improve iron intake and have a positive effect on the iron status. In China, Han et.al. (2011) used the cyanmethemoglobin method to take hemoglobin tests for 1,200 children aged 0-6 in Beijing. They found that parents' nutrition knowledge had a significant impact on the balance of their children's diet structure and other aspects. Through six months of parental nutrition education, their children's anemia rates have significantly declined from 12.4% to 5.8%.

However, we are not aware of any existing studies addressing the effectiveness of nutritional education programs to alleviate child anemia in rural China. Given the pervasiveness of child anemia in rural China, given the severity of the problem from individuals' as well as societal perspective and given positive evidence on the effectiveness of well-designed nutritional education programs in other contexts we conclude high desirability of empirical evidence on the issue.

There are some unsolved problems remaining in the current literature. Most RCT studies use difference in differences (DID) methods to mimic the experimental research design using observational study data. DID is used to measure the change induced by a particular treatment or event at a given period in time. It calculates the effect of a treatment on an outcome by comparing the average change over time in the outcome variable for the treatment group to the average change over time for the control group. Although the RCT approach resolves the problem of endogeneity that can affect the reliability of observational studies estimating the effect of nutrition education on health, some RCT based studies did not examine whether the parallel trend assumption which posits that the average change in the control group represents the change in the treatment group if there were no treatment were violated. For example, there are usually some samples aren't able to be tracked during the evaluation survey, the attrition may leads to a violation of the parallel trend assumption, that is when something other than the treatment changes in one group but not the other at the same time as the treatment, it cannot guarantee the accuracy of the

DID estimate.

Furthermore, when measuring parents' knowledge, items were scored by using number correct score. This method suggests that the standard error of those items assumed to be the same for all examinees which cannot help us make accurate predictions of how well individual examinees might do on a test item. To address this issue, this paper uses item response theory (IRT) model to measure the knowledge score. We used a data from a random control trail in northwestern China and use difference in difference technique to quantitatively analyze the question of whether and how the parental nutrition education lead to better health of their children. From this analysis, we could make general assessments of the benefits that the nutrition education program imposes on students.

The rest of this paper is organized as follows. First, we describe the dataset and introduce the experimental project. Second, by using an item response theory model measuring parents' nutritional knowledge, we examine whether or not the information intervention increases their knowledge. Then we will show how the nutritional knowledge affects children's anemia through the changing of dietary. Finally, we conclude by summarizing the findings and offering policy implications.

3.2 Data and research design

The overall effect of nutrition education on health is assessed by comparing hemoglobin level changes between a sample of pupils whose parents receive a nutrition education treatment and a control group of pupils whose parents do not undergo such education. This effect can be regarded as composed of three sub effects: of (a) an effect of education on parents' nutrition knowledge, (b) the parents' response on increased knowledge in terms of actions, guidance, food provision, etc. and (c) the bio physiological impacts of these actions on their children's health as indicated by the anemia status. Our study addresses in two separate analyses the overall effect and the sub effect i.e. the impact of the education treatment on parents' nutritional

knowledge and the impact on children's anemia status.

To assess those effects, we conducted a randomized controlled trial (RCT) to assess the effect of parents' education on their children's health using a sample of pupils in poor counties in Ningxia Autonomous Region and Qinghai Province. The two wave survey, conducted in October 2009 and May 2010, included fourth and fifth grade pupils from 42 rural primary schools in 10 counties in Qinghai and Ningxia. The level of economic development in these two provinces is relatively low. According to official statistics (NBSC, 2010), per capita incomes of rural households in Ningxia and Qinghai in 2009 were 21.4% and 35.1% below the national average level, respectively. By using an income stratified random sampling method, we select 31 towns from each province.[1] In each township only the schools which had fourth and fifth grade classes and enrolled more than 400 students were selected for this project. In total, 42 schools were involved in our project, and 2,475 students from fourth and fifth grade were selected. The flow of experimental project participants through each stage of the study is shown in figure 3.1.

During baseline survey, we first collected the most important information which is the students' anemia status. Usually the anemia is assessed by measuring the hemoglobin concentration in the blood (measured in gram per liter). This is what has been followed by our survey teams that used the HemoCue system, collecting blood in disposable cuvettes and measuring the hemoglobin value with a portable photometer. The minimum values below which a person is categorized anemic ('cut off values') are age specific (for adults also gender specific) and have to be compared

[1] We have actually used the local per capita gross value of industrial output (GVIO) to proxy income since data on GDP are not available on township level. The GVIO, which indicates aggregated output of all economic sectors, has been found in other studies to reflect the local standard of living and development potential more reliably than available data on per capita net rural income (Rozelle, 1996).

to measure hemoglobin values adjusted for the effect of altitude[2]. According to WHO (WHO, 2008), for our sample of children being 9 to 11 years of age, we use a cut off value of 115 g/L and for the children being 12 to 14 years old, we use 120 g/L as the cut off. The distribution of hemoglobin values among the students in our sample is described in figure 3.2. With a mean value of 126.7 g/L, the prevalence of anemia in the sample is 22.7%.

Following the baseline survey, we randomly assigned 27 schools to the treatment group and 15 schools to the control group and implemented the nutrition education intervention in November 2009. It included provision of three types of information: (a) severity of anemia of the area which means the average anemia rate of their children's school[3], (b) descriptions of effective methods for reducing iron deficiency anemia (including vitamin supplementation, adding more meat in meal, as well as other dietary changes), (c) anemia's effect on school attendance, academic performance and cognitive development. The second and third type of information will be printed in the nutrition manuals and be distributed to the parents. Schools were located an average of 30 km apart to exclude the possibility of the parents and students in control groups get to know about the nutrition education.

Six months after the intervention, in May 2010, we implemented the evaluation survey. By the time of evaluation, although we intended to track every student, we still had an attrition rate of 10.4%[4]. We were able to track 596 students in the treatment group and 1,623 students in the control group. We interviewed each child's

[2]Because the oxygen content per liter of air decreases with altitude, higher hemoglobin concentration in the blood is necessary at higher altitudes to ensure adequate oxygen supply to the tissues. Hence, hemoglobin cut-off values are higher for people living at higher altitudes.

[3] Parents will not be informed by their child's hemoglobin value or anemia status in order to prevent they will give additional intervention or measures we are not aware of. If the child's hemoglobin value is lower than 70 g/L, we will tell parents that they should consult a doctor for ethical reason.

[4] We have taken notes that why the students were missing, 1). transferred to another school, most commonly they had moved to other counties or cities with their parents; 2). absent for sick or other reasons during the survey day; 3).drop out also be a reason but only account for a very small part.

household collecting information about students' characteristics, household socioeconomic characteristics, etc. Table 3.1 shows variable means by trial arm. By comparing these characteristic, we found that older students, students belonging to ethnic minorities, students with lower hemoglobin level and the ones who lived more far from school were more likely to attrite (table 3.2, column 2). The estimates are only unbiased if the assignments of treatment and control groups are balanced, meaning the characteristics composition such as gender, age group, etc. are identical. The attrition may lead to differences in these characteristics between the control and treatment groups. Fortunately, when checking those students who were remaining, we find that the attrition of students from the sample are independent to the assignment of the intervention, in other words, there are no systematic differences in key variables between the students in the control and treatment groups (table 3.2, column 3).

3.3 Impact of nutrition education on knowledge

3.3.1 Measuring knowledge

We designed 8 multiple choice questions about nutrition and anemia to measure parents' nutritional knowledge, such as, "*Which is the most prominent reason for children to have iron deficiency or anemia, respectively", "In what way does alleviate anemia improve the academic performance of the student?"*etc. Based on the parents' responses to these multiple choice knowledge tests we can assign each parent a nutritional knowledge test score.

We applied an item response theory (IRT) model based on probability theory which ensures that varying levels of difficulty among questions and differing probabilities are appropriately accounted for. The IRT gives the probability that a person with a given ability level will answer correctly. Persons with lower ability have less of a chance, while persons with high ability are very likely to answer correctly (Demars, 2010). We can suppose that the test scores are highly correlated with the respondents' true nutritional knowledge. The most common model for dichotomous

items is the three parameter logistic (3PL) model. Demars (2010) recommended samples of at least 1,000 to estimate 3PL model. And according to (Woods, 2008), the accuracy of the estimation of the 3PL needs the sample size of 2,000. Although our sample can meet the requirements of the data, our items are only eight, less than the recommendation of fifteen to twenty items for item parameter estimation (Demars, 2010). However, Stone (1992) estimated the two parameter logistic (2PL) model and indicated that the degree of bias will be reduced as sample size increased. He showed that the MML estimates of item difficulty (*b*) were generally precise and stable in small samples (N=250), short items (10). MML estimates of item discriminations (*a*) were precise and stable as the samples increase from 250 to 500 in short 10 items. So we use the 2PL model:

$$P(\theta_j) = \frac{e^{1.7a_i(\theta_j - b_i)}}{1+e^{1.7a_i(\theta_j - b_i)}} \quad (1)$$

Where $P(\theta_j)$ indicates the probability of correct answers given ability θ and the item parameters, *i* indicates the nutritional questions and *j* indicates the examinees (parents). *e* in the function is the exponential function and 1.7 is a scaling parameter to avoid changing the scale of the *a* parameter. *a* is the discrimination parameter which tells how steeply the probability of correct answer changes at the steepest point of the curve[5]. *b* is the difficulty parameter which indicates how difficult the question is. Difficulty indicates the ability that is needed to be more likely to answer the question correctly than answering it wrongly. For example, if b equals zero, it means that half of the people who answered the question correctly. The higher the value of *b* is, the harder of the question is.

The parameters were estimated using maximum marginal likelihood in software BILOG-MG3. Figure 3.3 reflects the distribution of nutritional knowledge test scores among the parents in the sample. The distribution of scores suggests considerable heterogeneity among households regarding nutritional knowledge. The vertical lines

[5]Actually the discrimination parameter is *a* times 1.7, but *a* is often refers as the slope simply. The 1.7 puts the logistic parameters into the same metric as the normal model's parameters.

indicate –SD (standard deviation) and + SD respectively.

3.3.2 Empirical approach and result of nutrition education on knowledge

We intend to examine the impact of nutrition education on parents' knowledge, measured by the IRT model. Main estimation strategy follows the differences in differences (DID) strategy, and the basic econometric model is,

$$y = \alpha_0 + \beta_1 D1 + \beta_2 D2 + \gamma D1 \cdot D2 + \varepsilon \quad (2)$$

where y is the dependent variable, here it denotes the standardized parents' knowledge score. The dummy variable *D1* captures differences between the treatment and control groups. The time period dummy, *D2*, captures aggregate factors that would cause changes in *y* according to the time change. The coefficient of interest, γ, multiplies the interaction term, *D1·D2* which is a dummy variable equal to one for those observations in the treatment group in evaluation, the difference in differences estimate is:

$$\hat{\gamma} = (\bar{y}_{11} - \bar{y}_{10}) - (\bar{y}_{01} - \bar{y}_{00}) \quad (3)$$

The first term $(\bar{y}_{11} - \bar{y}_{10})$ is the change in outcome for the treatment group and the second term $(\bar{y}_{01} - \bar{y}_{00})$ is the change in outcome for the control group. All the assumptions of the OLS model apply equally to DID estimation. In addition, DID require a parallel trend assumption. The parallel trend assumption will be violated when there is something other than the treatment changes in one group but not the other at the same time as the treatment. As we have discussed in section 3.2, there are no systematic differences in key variables between the students in the control and treatment groups across the baseline and evaluation, so this assumption is held.

To improve the efficiency of the estimation, we built on the unadjusted model in equation (3) by including a set of control variables and county fixed effects to compare the relative change in parents' knowledge in treatment groups compared to

control groups,

$$y = \alpha_0 + \beta_1 D1 + \beta_2 D2 + \gamma D1 \cdot D2 + \delta X + \theta C + \varepsilon \qquad (4)$$

where $y, D1$ and $D2$ are the same as those in equation (2), in addition, X is a vector of exogenous which includes students' characteristics such as, gender, ethnicity, the distance from home to school; and household characteristics, eg, household wealth[6], both parents education and parents' age, etc. County fixed effects C control for all invariant factors that differ between counties. The coefficient of interest in equation (4) is γ, which is the estimated impact on parents' knowledge after the treatment. The assumption sign of it is positive which indicates that the nutrition education will improve parents' knowledge.

As expected, the estimated treatment effect on parents' knowledge is equal to 0.18 standard deviations of knowledge score and it is significant at the 1% level (table 3.3). Such a result means that the information intervention increased parent's knowledge, and considering that the program only ran for about half a year, the increase of nutrition knowledge can be counted as significant.

3.4 Impact of nutrition education on anemia

3.4.1 Mechanism of nutrition education on anemia

We are more interested in whether the nutrition education can help to alleviate the anemia. We first seek to understand the potential mechanisms that are driving parental nutrition education program's impact on children's anemia status. The

[6] In this study, we are not able to record income, because most households were not willing to reveal their true incomes. Following the principal components analysis used by Filmer and Pritchett (2001), we used the possession of certain rural durable assets as a proxy of household wealth. First, we asked about the household's ownership status of 21 assets including bicycles, refrigerators, televisions, cameras, and so on. If a household owned a specific asset, it was recorded as 1, otherwise as 0. Second, using the principal components analysis, we calculate the scoring factors for 21 assets.

education may motivate parents to understand more about anemia, in this case, parents knew which kinds of foods will prevent or alleviate the anemia. Their family eating behavior change and it will improve their diet within family. So it may lead to the increases in children's hemoglobin values, thus it may alleviate anemia.

In order to figure out whether the improving of parents' knowledge will change the family diet, we compared the parents' behavior regarding diet provision for their children before and after the intervention. We asked in the survey form the basic information about children's diet; questions include "*how many times did the student eat meat or fish in recent 5 days?*", "*how often does the student eat meat or fish?*", "*How often does the student eat fruit?*" etc. There are 32.89% boarding students in our sample, for the boarding students, they only live at home during the weekend, the effect of parents' nutrition education on changing their children's diets may be little for them. So we only include the non-boarding students in the analysis. As shown in the last column of table 3.4, it seems that the frequencies of eating meat or fruits for the students in treatment group are higher than their counterparts in control group.

3.4.2 Empirical approach and result on effect of nutrition education on anemia

We still use DID to measure the changes before and after the treatment. The probit model is constructed as follow:

$$\mathrm{Prob}(y = 1) = \Phi(\alpha_0 + \beta_1 D1 + \beta_2 D2 + \gamma D1 \cdot D2 + \delta X + \theta C) \qquad (4)$$

where y is a binary variable, measuring the probability of anemia, when the student is anemic, it equals to one and zero otherwise.$\Phi(.)$ is the cumulative density function, the main variable of interest is *D1·D2* which indicates treatment status. X is still a vector of exogenous which includes students' and household characteristics. County fixed effects C control for all invariant factors that differ between counties.

The estimation results using equation (4) are presented in table 3.5. The results show that the parental nutrition education leads to a 26.17% decline in possibility of

anemia. This result implies that employing parental nutrition education programs may be effectively reducing anemia rate in rural China. When we include boarding students in our analysis, we found that although parental nutrition education has impact on child's anemia status, it is not significant (table 3.5, column 3).

Since the early 2000s, School Merger Program has been implemented in rural primary schools, the idea was that with fewer schools, the quality of the facilities and teaching staffs could be more effectively raised by concentrating investments. However, our results show that the rise of boarding schools has exacerbated the malnutrition problems, similar results have been found in the studies of (Luo *et al*., 2009; Luo *et al*., 2010; Shi *et al*. 2009). In this case, the government should also take active measures including curriculum or training about nutrition and health for school canteen staffs, which would be helpful in promoting better nutrition and health for rural boarding students.

3.5 Conclusion

There is a performance gap between urban and rural students, and one possible reason may be iron deficiency anemia. IDA seriously affects the school success of school age children. By the end of 2009, there were 56.6 million rural pupils (NBSC, 2010), and according to our data, 22.7% of students are anemic, if our sample counties are representative of China's poor rural areas, it will be 12.8 million pupils are estimated to be suffering from anemia in rural China. Beside the direct nutritional supplement, such as micronutrient supplements or subsidies, the relationship between parental nutritional knowledge and children's anemia status should also be paying attention given that interventions accompanying nutrition education are more effective (Webb and Block, 2004; Müller and Krawinkel, 2005). Unfortunately, there is little empirical evidence available to understand the extent of parental nutrition education to reduce anemia in rural China.

Drawing upon a unique survey dataset collected in Qinghai Province and the

Ningxia autonomous region in China, by taking a RCT and using IRT model to measure the knowledge score, this study seeks to explain the role of nutritional knowledge for anemia reduction. Evaluation of the impact of intervention on parental nutrition knowledge indicated an overall improvement in the nutritional knowledge score. We found that the nutrition education program increase parents' knowledge. Furthermore, when only including non-boarding students in study, we find that nutrition education did have a positive effect on anemia status. Our results hint at a possible impact pathway of the possible mechanisms through the program had influenced students eating at home. For example, the increased hemoglobin values may be a result of the dietary of students in treatment group improved due to their parents understanding more about the anemia and then change the food provision. That is, the children's anemia alleviated by improving their dietary intake after their parents taking nutrition education.

Our paper has several policy implications. First, one way to effectively reduce anemia rate in rural China may be to employ nutrition education programs. Although the effect size is not huge, considering the short term and the cost efficiency of the program, it should encourage education officials in China to continue exploring the effectiveness of additional nutrition education programs. Second, the results are a vindication of the decision to create centralized schools at the town and county level. It gives extra impetus to that the nation should put extra emphasis on managing boarding schools, especially on the nutrition education for the people who responsible for meals of boarding students. If a way could be made to attenuate the negative boarding school effect, students might be able to take more advantage of the additional resources—teaching and facilities. In this way, government policies may be better tailored to more effectively and cost efficiently promotes the education of the poor.

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Table 3.1 Comparison of student and family characteristic between the treatment and control group

Variables	Treatment group		Control group		P value of the t test
	Mean	Std.Dev.	Mean	Std.Dev.	
hemoglobin value	126.3	0.64	127.2	0.36	0.18
gender (1=male; 0=female)	0.52	0.02	0.52	0.01	0.86
ethnic (1=non-han; 0=han)	0.74	0.02	0.65	0.01	0.01
agemonth (months)	138.67	0.66	138.39	0.37	0.74
distance (km)	7.19	0.55	5.74	0.3	0.02
asset (PCA index)	0.3	0.08	0.02	0.05	0.01
age_father (year)	38.12	0.23	38.59	0.14	0.09
age_mother (year)	35.62	0.21	36.01	0.12	0.07
edu_father (year)	6.08	0.17	6.7	0.1	0.01
edu_mother (year)	3.37	0.17	3.79	0.10	0.04

Source: Authors' own survey

Table 3.2 Comparisons of the characteristics between the attrite students and those remaining in the sample and the characteristics of remaining students between the treatment and control group

Independent variables	Sample: remaining + attrition observations	Sample: remaining observations
	Dependent variable: attrition (1=attrite; 0=remained)	Dependent variable: treatment (1=treatment; 0=control)
hemoglobin value	-0.0007	-0.0005
	(1.26)	(0.67)
irt score		-0.0109
		(0.70)
gender (1=male; 0=female)	-0.0106	0.0077
	(0.73)	(0.44)
ethnic (1=non-han; 0=han)	-0.0756***	-0.0872***
	(3.95)	(3.74)
agemonth (months)	0.0014***	0.0008
	(2.65)	(1.03)
distance (km)	0.0012**	0.0023***
	(2.02)	(3.10)
asset (PCA index)	0.0003	-0.0087*
	(0.07)	(1.73)
age_father (year)	0.0018	-0.00433
	(0.80)	(1.65)
age_mother (year)	-0.0006	0.0039
	(0.23)	(1.30)
edu_father (year)	-0.0016	-0.0072***
	(0.75)	(2.86)
edu_mother (year)	-0.0027	0.00049
	(1.3)	(0.19)
county dummies	Y	Y
constant	0.212*	1.399***
	(1.83)	(10.09)
observations	2,280	334

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 3.3 Estimation results of nutrition education on parents' nutrition knowledge

Independent variables	Dependent variable: knowledge score
group (1=treat, 0=control)	-0.0312
	(0.57)
wave (1=evaluation, 0=baseline)	-0.112***
	(3.36)
treatment (group*wave)	0.181***
	(2.69)
ethnic (1=non-han; 0=han)	-0.0961**
	(2.16)
household asset (PCA index)	-0.016*
	(1.66)
age_father (year)	0.0004
	(0.08)
age_mother (year)	0.0014
	(0.25)
edu_father (year)	0.0251***
	(5.20)
edu_mother (year)	0.0163***
	(3.36)
county dummies	Y
constant	-0.173
	(1.05)
observations	3,892

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 3.4 Diet of non-boarding students

Questions	Baseline		Evaluation		DID: (Treat_eva-Treat_base)-(Control_eva-Control_base)
	Control	Treatment	Control	Treatment	
How many times did the student eat meat or fish in recent 5 days	1.52	1.49	1.83	2.12	0.32
How often does the student eat meat or fish? (1=everyday, 2=once every two to three days, 3=once every week,4=once every month)	2.84	2.81	2.99	2.79	-0.17
How often does the student eat fruit?	2.53	2.71	1.94	1.88	-0.24

Source: Authors' own survey

Table 3.5 Estimation results of nutrition education on the children's anemia status

Independent variables	Dependent variable: anemia status	
	non-boarding students	all students
group (1=treat, 0=control)	0.22	0.1068
	(1.70)	(1.11)
wave (1=evaluation, 0=baseline)	-0.1826*	-0.1794***
	(2.50)	(2.90)
treatment (group*wave)	-0.2617*	-0.1378
	(1.67)	(1.16)
gender (1=male; 0=female)	-0.1051	-0.1051
	(1.39)	(1.39)
ethnic (1=non-han; 0=han)	0.1429	0.2005**
	(1.33)	(2.40)
agemonth (months)	-0.0002	0.0023
	(0.06)	(1.02)
distance (km)	-0.0006	0.001
	(0.16)	(0.35)
household asset (PCA index)	-0.0392*	-0.0413***
	(1.83)	(2.33)
age_father (year)	-0.0011	-0.0044
	(0.1)	(0.48)
age_mother (year)	0.0036	0.004
	(0.28)	(0.38)
edu_father (year)	-0.0028	0.0033
	(0.25)	(0.35)
edu_mother (year)	-0.0233**	0.0142**
	(2.15)	(1.6)
county dummies	Y	Y
observations	2,612	3,892

Source: Authors' own survey

Note: The value of t statistics is reported in parentheses; ***,**, *indicate significance levels of 1%,5% and 10%, respectively

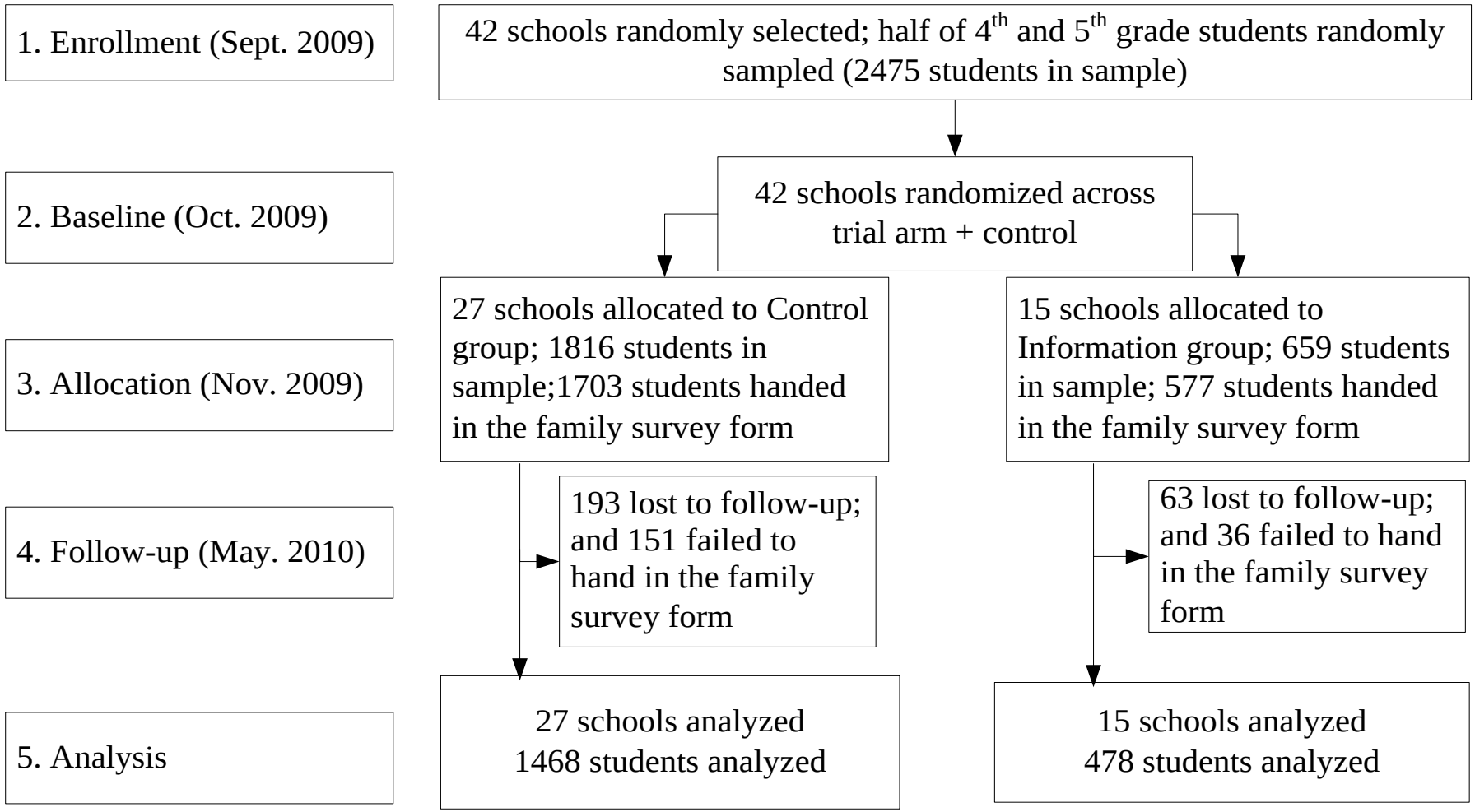

Figure 3.1 Flow of participants through study

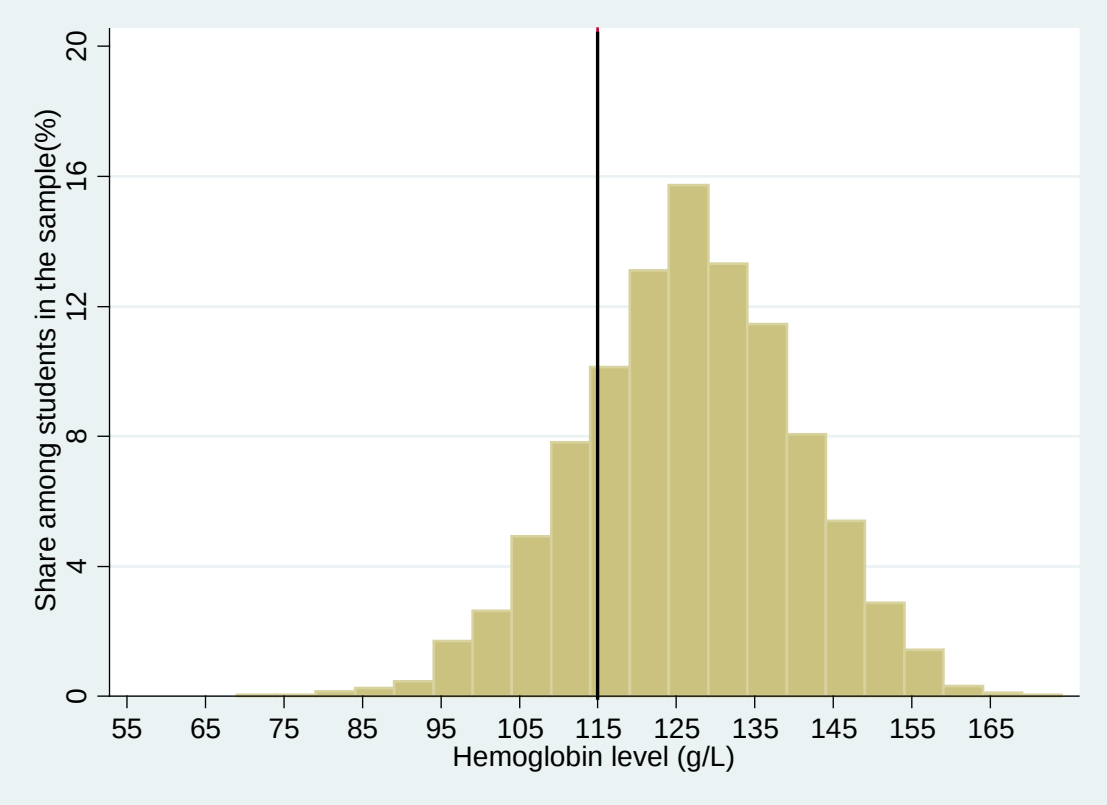

Figure 3.2 Distribution of (altitude adjusted) hemoglobin levels (g/L) across the sample

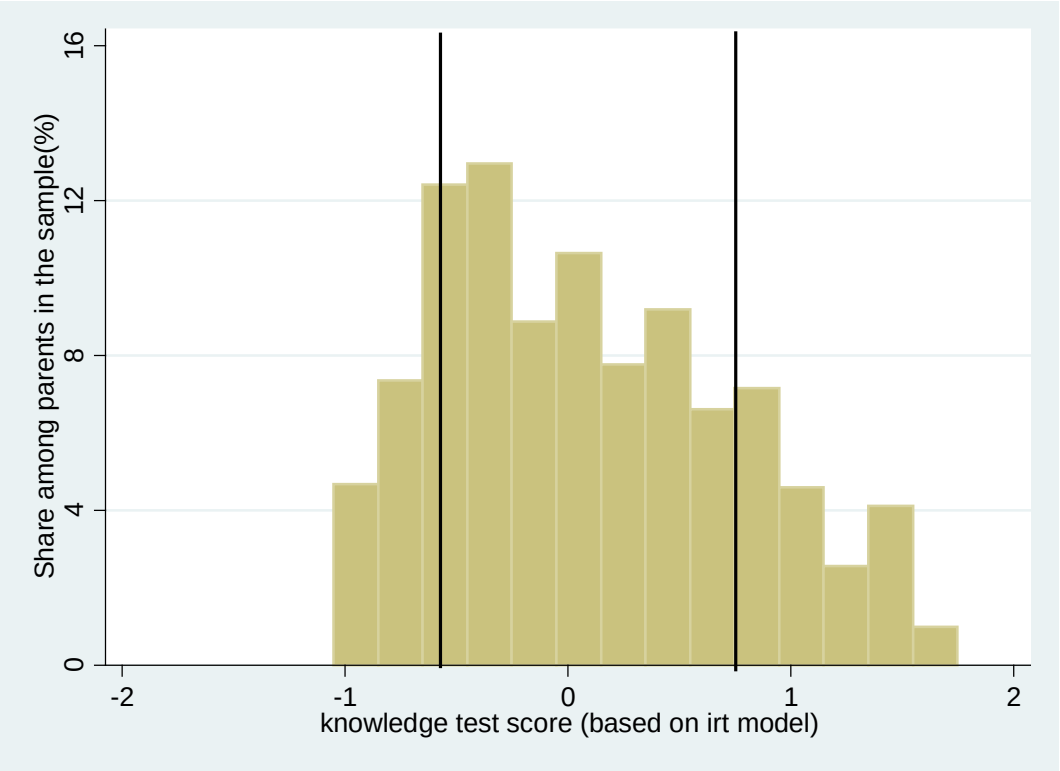

Figure 3.3 Distribution of nutritional knowledge score across the sample

Chapter 4. The New Rural Social Pension Program in Rural China: Participation and its Correlates

4.1 Introduction

Due to a worldwide decline in fertility and a corresponding increase in life expectancy, more and more countries have begun to enter what is being called an era of “aging society” (United Nations Population Fund, 2006). China is no exception. In fact, China’s population is currently aging more rapidly than nearly any other country on earth. In 1982 only 4.9% of China’s population was over the age of 65; by 2011 this proportion had almost doubled, reaching 9.1% (NBSC, 2012). By 2050 it is expected that more than a quarter of the world’s people who are over 65 will live in China (Salditt *et al.*, 2008).

As this demographic shift has accelerated in recent decades, China’s government has struggled to effectively deal with the needs of its rapidly aging population. In developed countries, public social pension expenditures typically account for about 6 to 18% of a country's GDP (United Nations, 2005). In China, however, despite an increasing government focus on social security and other services for the elderly, nationwide pension expenditures amount to only 4.1% of the country's GDP in 2011 (NBSC, 2012; NBSC& MOHRSS, 2012). Even though that is a significant increase from the 0.96% expenditure a decade ago (NBSC, 2002; NBSC& MOHRSS, 2002), it is almost certainly still not enough to meet the future needs of the country’s population.

The problems that arise from an underdeveloped pension system (in a rapidly aging society no less) are especially acute in China because such a large proportion of the nation’s elderly live in rural areas. In fact, of the elderly over 60

in China, according to 2010 Sixth National Census Data Bulletin (NBSC, 2011), there were 68 percent reside in the countryside. This means, of course, that there are about 99.3 million rural elderly. Because China's rural residents are generally poor and have not been able to accumulate much wealth during their lifetimes, they typically do not have sufficient savings on which to rely in old age. In the past the elderly in rural China have largely relied on their children for financial support as they aged. Unfortunately, the rapid social changes taking place in China are weakening this traditional form of support. The rise of off farm employment and rural to urban migration as well as increased social mobility are changing the nature of the extended family in rural China, often leaving the elderly to live on their own without the familial support enjoyed by previous generations (Benjamin et al., 2000; Pang *et al.*, 2004; Zhang and Goza, 2006; Giles *et al.*, 2010).

As a result of these social changes, rural people are (and will be) increasingly reliant on some form of pension to maintain their standard of living in their old age. Unfortunately, not only is China's pension system, in general, underdeveloped and underfunded, until now old age security benefits provided to rural and urban residents are imbalanced. While many urban residents more or less enjoy pension security, rural residents do not. Given the sheer number of rural elderly in China, as well as the weakening of traditional forms of financial support and the unequal benefits they receive as compared to their urban counterparts, reforming, expanding and improving the pension funds of the rural old age security are keys to solving the problems of the aging population in China.

China's government is well aware of the looming social security crisis facing its rural population and has taken steps to help mitigate it (Herd *et al.*, 2010). In the early 1990s China launched its first initiative to create a rural social pension system (*laonongbao*). However, due to problems with system design and implementation (and absence of funding), the participation rate was low and the system's capabilities were very limited. With the rural old age security service

problem growing increasingly severe, in 2009 China's government issued guidance regarding the development of the New Rural Social Pension Program (NRSPP). The program was first piloted in a small geographic region and then gradually extended across the whole country (State Council, 2009).

All the rural residents who are 16 years old or above, are not students and are not enrolled in the urban pension programs may voluntarily participate in the NRSPP. Since its inception, participation in the NRSPP has been steadily gaining. However, it is uncertain whether the program can sustain this momentum and successfully meet the needs of the nation's growing aging population. There were several researchers from China use micro level data to study the participation decision of the NRSPP pilot among different regions (Li and Fan, 2010; Liu et al., 2011; Meng and Yan, 2012). There were also studies about the institutional design of the NRSPP, such as (Zhang, 2011), the study indicates that the NRSPP lacks of effective institutional arrangements to encourage to participate and to choose the higher premium. Although these studies discuss the factors that affect an individual's decision to participate in the pension program, they lack any quantitative analysis that identifies the different factors that are correlated with participation, and moreover, they are not the national representative analyses.

The overall objective of this study is to analyze the development of and participation in China's NRSPP, especially to analyze the effect of NRSPP policies on the participation. Using data from 2011, the paper provides a detailed description of the system and an assessment of the factors that affect people's decision of whether to participate in the pension program. The paper also seeks to identify the correlates of participation. To meet the objectives, the empirical analyses use a nationally representative survey of 2,020 households collected in five provinces in rural China. The data show that the NRSPP has expanded rapidly since 2009, with an average participation rate of 79% by the end of 2011, and with significant variations between and within provinces.

The rest of paper is organized as follows. In next section we briefly describe the historical development of China's pension programs. In the third section we introduce the survey methods and present the basic information of the data set. In the fourth section we make a descriptive statistic to describe the factors which affect the participation, and then providing an analysis of the NRSPP, followed by a discussion of factors which affect people's decision to participate in the pension program. The fifth section will discuss whether the NRSPP will affect the work of elderly people. The final section concludes by summarizing the paper's findings and discussing policy implications.

4.2 The rural pension program in China

4.2.1 The old rural pension program

A social pension system based on the Soviet model was first introduced to China in 1951. This system was anchored on the principles of lifetime employment and association with state owned enterprises (Salditt et al., 2008). Coverage applied to nearly all urban workers, but did not apply to the majority of the nation's workforce: rural population. It was not until 1986 that China's government began to explore implementing a rural social pension program. In 1991, following directives from the State Council, a rural social pension program was piloted in Muping County in Shandong province. The pilot proved successful and in 1992 county level rural social pension programs were gradually promoted across the country. However, this pension system was mainly funded by personal contributions. In the absence of any subsidies, the system essentially degenerated into a voluntary savings system for farmers. In1999 the State Council stopped the program, pointing out that rural area lacked the proper conditions for a successful universal social pension program.

4.2.2 The new rural pension program

A decade later the Chinese government introduced the NRSPP as a revamped, voluntary and highly subsidized rural pension scheme. The NRSPP is a system that combines individual contributions, collective subsidies and government subsidies. The NRSPP carries out a combination of social pooling and individual accounts in order to guarantee the basic livelihood of rural elderly residents. In order to encourage participation, the NRSPP has several major improvements over the previous pension system. The most important improvement is the addition of basic pension benefits paid by the central government as well as the premium subsidy provided by local governments. For those who are already 60 or older, they can get the basic pension every month without making any contributions. People between 45 and 60 years old had to contribute each year until they reach 60. Those under 45 years old should contribute each year for 15 years or more. Figure 4.1 illustrates the NRSPP's payment scheme.

Figure 4.1 gives an image for different phases of the pension program. Rural people who are older than 16 and are not enrolled in the urban pension programs may voluntarily participate the NRSPP. Funding for the pension comes from two sources: government subsidies and an individual premium. The government subsidies are contributed by both the central and local governments. Local governments are required to contribute a minimum of 30 RMB per year per person, with the subsidy increasing along with higher premium levels. The individual premium is broken down into five levels: 100, 200, 300, 400, and 500 RMB per year per person. Each premium level has its own payment schedule, and the person is free to choose the pay category and pay more for much and it is supposed to be adjusted according to rural residents' increase in per capita annual income. The higher the premium paid, the higher the subsidy from the local government, thus the higher the pension payments received in the future.

The pension benefits are also paid in two parts. First, after reaching age 60 pensioners receive a monthly payment from the central government. Currently the central government subsidy is 55 yuan per month for the basic pension. The local governments can raise standards in accordance with the actual situation, the increasing part is paid by local government, for example, the highest amount is 45 yuan per month in our sample. Individual premiums and local government subsidies are accumulated in individual accounts according to the one year saving rates of individuals and the interest is compounded yearly. Once individuals turn 60 they will receive a monthly payment equal to 1/139 of the total amount accumulated in their individual accounts. All accumulated individual funds are inheritable, except for the local government subsidy. Thus, if a beneficiary dies before 71.5 (60 years old +139 months), the accumulated premium will be transferred to the inheritor while the local government subsidy will return to the common account. Big part of pension is from government (55 yuan / month), pension from individual account is based on the different premium level. If it is the lowest premium (100 yuan), the pension from individual account will be around 20 yuan per month. It means that total pension will be about 75 yuan per month, which is less than half of the average poverty line income[7].

4.3 Survey region and data

The data used in this paper were collected in a survey in April, 2012. The fieldwork team conducted the data collection effort in five provinces, 25 counties, 50 townships and 101 villages and the final dataset can be considered as a nearly nationally representative sample. The sample villages were selected as follows. First, one province was randomly selected from each of China's major agro

[7] According to Central Poverty Alleviation and Development Conference on November 29, 2011, the per capita net rural income of 2,300 yuan is the new national poverty line.

ecological zones: Jiangsu represents the eastern coastal areas (Jiangsu, Shandong, Shanghai, Zhejiang, Fujian and Guangdong); Sichuan represents the southwestern provinces (Sichuan, Guizhou and Yunnan) plus Guangxi; Shaanxi represents the provinces on the Loess Plateau (Shaanxi and Shanxi), Inner Mongolia and the rest of the provinces in the northwest (Gansu, Ningxia, Qinghai and Xinjiang); Hebei represents the north and central provinces (Hebei, Henan, Anhui, Hubei, Jiangxi and Hunan); and Jilin represents the northeastern provinces (Jilin, Liaoning and Heilongjiang).

After the five provinces were selected, the second step of the sample selection involved choosing the counties, towns and villages. Five counties were selected from each province, one from each quintile of a list of counties arranged in descending order of per capita gross value of industrial output (GVIO). The GVIO, which indicates aggregated output of all economic sectors, has been found in other studies (Rozelle, 1996) to reflect the local standard of living and development potential more reliably than available data on per capita net rural income. Within each county, we also chose two townships, following the same procedure as the county selection. In each sample township, according to the different levels of poverty, two administrative villages were randomly selected, and we random selected 20 households from each village. The final survey sample contains 101 administrative villages[8] and 2,020 households.

The survey collected a great deal of information about NRSPP affairs. In addition to survey enumerating the basic characteristics of households, such as the gender, age, education, employment, household asset, land, etc, there were three sections of the survey that collected information that forms the basis of this analysis. First, the survey had a section that asked details about the scheme specifying how the NRSPP policy was implemented in the respective area.

[8] There are two villages in Jilin province merged and then separated, therefore, both of these two villages are included in our sample.

Relevant issues are whether people get involved in the pension system by household or by individual, whether people can get more pension if they contribute more than 15 years, the amount of pension payout, etc.

Second, there was a long section on the understanding and participation of the NRSPP. During this part of the survey, enumerators asked the respondent a series of questions about the NRSPP. The understanding of the NRSPP, starting dates of participation, reason for not participating, how much the premium paid and other characteristics were enumerated. Enumerators also ask question like: supposing that the government will give you money in one of two ways: one is giving you 1000 yuan today; another is giving you 1,250 yuan a month later, which one do you prefer to test their time preference.

Third, the survey also had a section about the general living conditions of the elderly, whether they are still working, their health status, etc. By 2011, there were five counties (one is in Jilin, one is in Sichuan and three are in Hebei) in our sample have not carried out the NRSPP, so we exclude the observations in these regions in the following analysis. Finally the sample include 4,569 people and because the people who are older than 60 did not need to pay the premium but can get pension, in some of our analysis the sample will exclude them which include 3,589 people. Table 4.1 show the definition and descriptive statistics of the variables, such as gender, age, education, whether is the village leader, household asset, self-reported health status, average area of land, whether have been involved in the old pension program, etc.

4.4 Factors affecting participation of NRSPP

4.4.1 Participation and policies about NRSPP

On the basis of our data, when the NSRPP started since 2009, only 27%

villages were implementing the program. This share increased to 64% in 2010 and by the end of 2011, 80% of our sample villages implemented the NSRPP (table 4.2).

According to our survey data, 4,569 people were divided into two categories: participating and not participating in the NRSPP. The survey results show that by the end of 2011, 79%[9] of people were in the NRSPP (table 4.3), with participation increasing significantly from 2009 to 2011. However, there are still differences in the participation rate at individual level among provinces. Hebei has the highest participation rate of the five provinces we surveyed is 87%, and it is about 20% higher than the participation rate of Sichuan province.

One reason for significant variations in NRSPP participation among provinces is that participation may vary depending on the different pension policies in a given province or county. NRSPP is the most important program for rural population in China today and that it was launched with specific policy design innovations to improve on the previous, failed pension system, so it is necessary to look beyond behavior analysis and further analyze the possible effect of particular pension policies on individual's decision to enroll in the NRSPP. For our analysis we identify two critical NRSPP policies that may influence program participation.

One policy ("policy 1") regulates whether people can enroll in the pension system by household or individually. The other policy ("policy 2") regulates that for those who contribute for more than 15 years, whether their basic pension will increase. As shown in table 4.4, specific policies are implemented differently in different counties, for example, among five counties in Shaanxi province there are two counties taking policy 1, so it is 40%.

There is another important policy which also may affect the participation:

[9] If excluding the people who are older than 60, the participation rate is 74%.

how much the basic pension is. According to our survey data, the basic pension subsidy (from central government) is from 55 yuan per month to 100 yuan per month among the different counties. According to Table 4.5, more than half the counties which have a basic pension for 55 yuan, all counties in Sichuan and Jilin are on the level of 55 yuan. In Jiangsu province, the lowest pension is 60 yuan and the highest pension is 100 yuan which indicates that some county governments improve the basic pension based on their actual situation.

4.4.2 Statistical methods

We use probit analysis to analyze participation in China's NRSPP, the specification of the econometric model is:

$$\text{Prob}(y = 1) = \Phi(\alpha_0 + \beta P + \gamma X + \delta D)$$

where y is a binary variable, measuring the probability of participation, if people are participating the program then y is one, otherwise y is zero.$\Phi(.)$ is the cumulative density function, *P* is vector of variables which denote the policies about pension program. The coefficients β are the coefficients for policies and measure the impact of policies on the probability of people to participate in the pension program. X is a vector of exogenous control variables, comprising gender, age, education, whether people are village leaders or communist party members, whether people have non-agricultural income, household assets, time preference, self-reported health condition and the amount of land, etc, and the coefficient γ is the related coefficient vector. Furthermore, in order to control for the unobservable heterogeneities from the dimensions of provinces, district dummies *D* is added to capture the regional effects.

As shown in table 4.6, we report the descriptive statistics the sample of younger than 60. Due to people who are older than 60 will participate the NSRPP automatically, the following discussion will be based on the sample of those

younger than 60. It shows that some of the variables, such as pension policies, whether the respective person is the village leader, member of the Chinese Communist Party, whether the household had non-agricultural income, whether people from same village got the pension and self-reported health status seem to be associated with the participation in our sample. For the variable age, in order to compare easily, and according to the NSRPP design, people will contribute the premium each year until they reach 60 for at least 15 years, so we use the 45 as the cutoff, and it shows that the probability of participation is significantly higher for the people who are older than 45. An interesting finding is that for those who had higher education, the participation rate is lower which seems against the common sense. We will discuss it in the following.

In running the model, the regression equation appears consistent with our descriptive analysis, that all the coefficients make sense and are consistent with our assumption. There are significant differences in participation probabilities for different policies, age, time preference, social and economic conditions, etc.

The most important parameter is the coefficient for the variable of policy. As shown in table 4.7, if people live in a location that only allows participation in the pension scheme by household (rather than individually), the probability of participation will be about 12% higher. This may be because usually the decision of the whole family is decided by the head of the household, and among our sample, more than 70% heads of household are older than 45 who are more likely to prefer to participate the NRSPP. The policy that if contributing to more than 15 years, their basic pension will increase also had positive significant effect on the probability of participation for about 5% due to the incentives. Furthermore, the higher the pension payout, the higher the participation is. If the pension payout increases by 10 yuan, it will increase by 5 percentage points. This can be explained by the higher expected return. All of these results show that the policy design of NRSPP increased the participation.

When looking at personal characteristics, some significant effects in the descriptive analysis are no longer significant anymore. For example, the education, in the descriptive analysis it has negative correlation with the participation, however, after controlling for age and other factors, it is not significant. One possible reason could be that those who had higher education are younger, for example, in our sample, the average education year for people who are younger than 25 is 9.5 years, and it decreased to 7.7 years for people who are older than 25 and younger than 45. For people who are between 45 and 60, the average education year is only 5.9 year. Both the descriptive analysis and the multivariate analysis show that the probability of participation decreases with the age. It proves that the requirement for 15 years' contribution for people who are younger than 45 years does affect those farmers' (especially young people) participation decision (because these young people think that the pension is far away) which indicates that this kind of policy design will bring the adverse selection.

An interesting result is that people's time preference had impact on the participation. There is no absolute distinction of "high" and "low" time preference and the "high" and "low" is a comparing with others. For example, someone with a high time preference is focused on his well-being in the present relative to the average person, while someone with low time preference prefer his well-being in the further than average person. For understanding easily, it could perhaps be circumscribed as someone's degree of impatience. For those people who prefer to get 1,250 yuan one month later rather than preferring get 1,000 yuan immediately, the probability of participation will be 3% higher. This may be because that a person usually evaluates new alternative by integrating it with exist plans. When a new choice being considered, it is not evaluated in isolation, but in light of how it changes the aggregate consumption in all periods.

Other results include that people who are village leaders or members of the Chinese Communist Party have a higher probability to participate in the NRSPP

than non-leaders and non-communist members respectively. The higher the value of household durable assets is, the higher is the probability of participation. And among people who have people from same village had got the pension, the possibility of participation is 25.9% higher. This indicates that confidence in the pension program is also an important factor in the participation decision.

4.5 The effect of the NRSPP on the work of rural elderly

Some studies show that the existence of a national pension program will lead to a decrease in the work force, especially in developed countries (Börsch-Supan and Schnabel, 1998; Palme, 1999). However, there are also studies that show that in China elderly people typically continue working right up until the end of their life (Pang *et al.*, 2004). Our data indicate that among the rural population in China over 60, people generally continue to participate in the labor force until they are at least in their seventies. We also find that there is not a significant difference in the probability of elderly people to continue income generating work between those involved and not involved in the pension program (table 4.8).

Of all the elderly people (over age 60) in our sample, 76% are still working in the formal workforce (include either on the farm, working for a wage or running their own off farm businesses). Among 60 to 69 year olds, 78% still work. While the proportion of people who are older than 70, 37% are working. As shown in table 4.8, It is clear from the data that elderly people have similar participation rates in the workforce whether they are involved in the NRSPP or not.

One of the main potential determinants of the age at which someone drops out of the workforce is their individual health status. In our sample, a person was considered ill (usually means the person has a chronic health condition) on the basis of a response to a self-reported question about their general health status. The importance of health as a determinant of income generating work is confirmed

by our data (table 4.9). In all age categories there is a strong correlation between health status and working. Among people who are enrolled in the NRSPP and report being ill, the working rate is 19% lower than it is for people who report being ill but are not enrolled in the NRSPP. Even more striking, we find that even for those who are enrolled in the NRSPP and report being ill, a full 35% continue to work. This may indicate that the pension payment is so low that some elderly pension subscribers are economically unable to forgo working, even when they are ill.

4.6 Conclusion

In order to promote the development of the rural population and to cope with the problems of a rapidly aging society, the Chinese government has repeatedly emphasized its willingness to implement a functioning public pension system in rural areas. Since the NRSPP pilot began at 2009 many decisive reforms have followed and further solidified the pension program's framework. By the end of 2011, the number of NRSPP participants reached 326 million and the number of NRSPP beneficiaries reached 89 million. That same year the pension payment across the whole country totaled 58 billion RMB (NBSC, 2012). Despite these gains, however, participation in the NRSPP was far from universal, and there was a clear need to better understand the factors (both behavioral and policy related) influencing individual participation in the program.

Using a survey dataset collected across China involving five provinces, 25 counties, 50 towns, 101 villages and 2,020 households, we provide a detailed description of China's current pension program. According to our data, the NRSPP has expanded rapidly since 2009, with an average participation rate of 79% by the end of 2011, and for those who are less than 60; the participation rate is 74%. By employing a probit model we are able to look at the factors influencing people's

decision to participate in the NRSPP or not.

We particularly looked at the effect of some NRSPP policies on participation. In areas that implemented a policy that mandated enrollment in the NRSPP by household (rather than individually), we found the possibility of participation to be 12% higher than in areas that allowed enrollment on the individual level. The policy to encourage contributing more than the minimum 15 year also had significant effect on the participation. And the higher the pension payout, the higher the participation is.

Other results of our analyses include that the age, social status, household asset, people's time preference and the confidence of the NRSPP had affected the participation rate. It suggests that the government should take into account these individual heterogeneities when designing pension policies and take active measures to build a more effective system.

Furthermore, the NRSPP did not affect the work of rural elderly, as the majority of both those enrolled in the program and those not enrolled in the program continued to work well into their seventies. However, among the elderly who became ill, participation in the NRSPP decreased their working rate, as they were much more likely to leave the labor force than non-participants who became ill, which proves that to a certain extent, the NRSPP improved the welfare of the elderly by way of decreasing the working rate of rural elderly.

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Table 4.1 Definitions and descriptive statistics of variables (Sample: age 16 - 60)

Variables	Description	Mean	Min	Max
participation	0=participating;1=not participating	0.74	0	1
female	0=male;1=female	0.5	0	1
age	age (Unit: years)	39.2	16	59
education	educational years	7.4	0	16
leader	village leadership function: 0=not;1=yes	0.04	0	1
communist	member of CCP: 0=not;1=yes	0.04	0	1
non_ag_income	non-agricultural income: 0=do not have;1=have	0.6	0	1
asset	value of household durable assets (Unit:10000 Yuan)	0.4	0.1	19
time_preference	0=prefer now;1=prefer future	0.5	0	1
unhealthy (self reported)	0=good or normal health status;1=bad health status	0.1	1	1
land_mean	average areas of land within the household (Unit: Mu)	1.7	0	20
old_insur	participation in former pension scheme: 0=participated;1=un-participated	0.05	0	1
v_getpension	0=not;1=yes (people from same village get pension)	0.95	0	1

Source: Authors' own survey

Table 4.2 Participation rate among villages in different provinces

Province	Total villages	Accumulative percent of villages participating pension system		
		2009	2010	2011
Jiangsu	20	50%	100%	100%
Sichuan	20	10%	60%	75%
Shaanxi	20	65%	80%	100%
Jilin	21	10%	62%	81%
Hebei	20	0%	20%	45%
Total	101	27%	64%	80%

Source: Authors' own survey

Table 4.3 Participating rate of individuals among different provinces

Province	Accumulative rate of individuals participating pension system in the region which has implemented the NRSPP		
	2009	2010	2011
Jiangsu	76%	75%	79%
Sichuan	60%	57%	68%
Shaanxi	53%	83%	86%
Jilin	34%	60%	73%
Hebei	-	85%	87%
Total	58%	75%	79%

Source: Authors' own survey

Table 4.4 Policies about pension program

Province	Total counties	Policy 1: people participate the pension program by household rather than personal	Policy 2: for those people contribute to more than 15 years, their basic pension will increase
Jiangsu	5	0%	40%
Sichuan	4	0%	25%
Shaanxi	5	40%	40%
Jilin	4	0%	0%
Hebei	2	50%	0%
Total sample	20	15%	25%

Source: Authors' own survey

Table 4.5 Pension payout among different provinces (Sample: 20 counties)

Pension (Yuan)	Total	Jiangsu	Sichuan	Shaanxi	Jilin	Hebei
55	55%		100%	40%	100%	50%
60	20%	80%				
70	5%					50%
90	5%			20%		
100	15%	20%		40%		

Source: Authors' own survey

Table 4.6 Definitions and descriptive statistics of explanatory variables (Sample: age 16 - 60)

Variables	Description	Participation		P-value
		=1	=0	
policy1	0= people participate the pension program by personal; 1= by household	82%	72%	0.0000***
policy2	0= for those people contribute to more than 15 years, their basic pension will not increase; 1= basic pension will increase	75%	74%	0.4019
pension_group	0=55 yuan; 1=above 55 yuan	83%	67%	0.0000***
female	0=male;1=female	74%	74%	0.9865
age_group	0=younger than 45; 1=45 and above	90%	65%	0.0000***
education_group	0=elementary and below;1=high school and above	72%	86%	0.0000***
leader	0=not;1=yes	90%	73%	0.0000***
communist	0=not;1=yes	89%	73%	0.0001***
non_ag_income	0=do not have;1=have	71%	78%	0.0000***
asset_group	0=below the average; 1=above the average	80%	78%	0.244
time_preference	0=prefer now;1=prefer future	75%	73%	0.4264
unhealth	0=good or normal health status;1=bad health status	80%	73%	0.0034***
land_group	0=below the average; 1=above the average	78%	79%	0.5632
old_insur	0=participated;1=un-participated	69%	74%	0.9873
v_getpension	0=not;1=yes (people from village get pension)	76%	48%	0.0000***
district	0=Jiangsu, Jilin, Hebei;1=Sichuan, Shannxi	75%	74%	0.5614

Source: Authors' own survey

Note: The p value of t-statistics is reported; ***, **, * indicate the significance levels of 1%, 5% and 10%, respectively

Table 4.7 Estimation results of factors on people's decision of pension system (Sample: age 16 - 60)

Independent variables	Definition	Dependent variable: participating pension system (marginal effect after probit)
		age<60
policy1	0=no, 1=yes	0.117***
		(0.0170)
policy2	0=no, 1=yes	0.0458**
		(0.0179)
pension	pension payout (Unit:10 Yuan)	0.0477***
		(0.0048)
female	0=male, 1=female	-0.0078
		(0.0158)
age	age (Unit: year)	0.0256***
		(0.0043)
age_square	age*age	-0.0002***
		(5.59e-05)
education	educational years	-0.0039
		(0.0025)
leader	0=no, 1=yes	0.0822**
		(0.0386)
communist	0=no, 1=yes	0.0724*
		(0.0371)
non_ag_income	0=do not have;1=have	0.0006
		(0.0172)

asset	Household durable asset (Unit:10000 Yuan)	0.0350**
		(0.0146)
time_preference	0=prefer now;1=prefer future	0.0344**
		(0.0151)
unhealth	0=good or normal health status;1=bad health status	-0.0200
		(0.0269)
land_mean	average land within the household (Unit: Mu)	0.0009
		(0.0040)
old_insur	0=participated;1=un-participated	-0.101
		(0.0882)
v_getpension	0=not;1=yes (people from village get pension)	0.273***
		(0.0398)
district	0=Jiangsu, Jilin, Hebei;1=Sichuan, Shannxi	-0.0285
		(0.0181)
Observation		3,554

Source: Authors' own survey

Note: The value of standard error is reported in parentheses; ***, **, * indicate significance levels of 0.1%, 1% and 5%, respectively

Table 4.8 Share of working elders (age>=60) among all elders

Age Categories	All elderly	Got pension	No pension	P-value
60-69	78%	78%	86%	0.2763
70 and above	37%	38%	29%	0.4096
all	76%	76%	79%	0.3390

Source: Authors' own survey

Note: The p value of t-statistics is reported; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

Table 4.9 Working status of healthy and unhealthy old people (age>=60)

Healthy

Age Categories	All elderly	Got pension	No pension	P-value
60-69	80%	80%	85%	0.4510
70 and above	40%	40%	30%	0.3652
all	78%	78%	80%	0.6557

Unhealthy

Age Categories	All elderly	Got pension	No pension	P-value
60-69	45%	40%	80%	0.0934*
70 and above	11%	11%	11%	0.9743
all	39%	35%	54%	0.0842*

Source: Authors' own survey

Note: The p value of t-statistics is reported; ***, **, * indicate significance levels of 1%, 5% and 10%, respectively

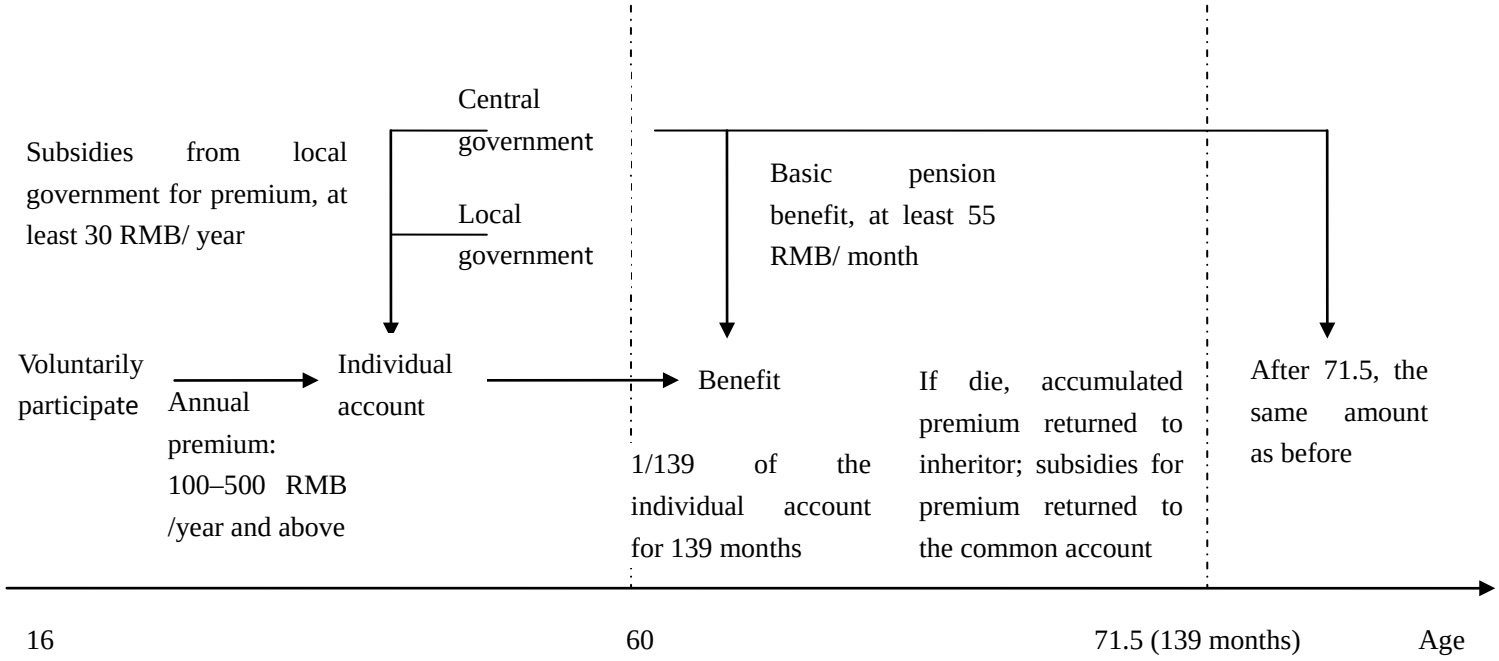

Figure 4.1 The New Rural Social Pension Program Scheme

Chapter 5. Conclusions and Discussion

The three essays comprising this volume highlight studies on different aspects of socioeconomic conditions in rural China. Two studies were carried out aiming to identify pathways to an improvement of rural education. They focus on different problem areas of elementary education, the outmigration of parents from their families' rural homestead and children's nutrition as a prerequisite of successful schooling. The third study addresses the rural pension program recently introduced to improve material security for rural population in retirement age. The three studies are based mainly on empirical data from rural surveys in China.

Chapter 2 of this dissertation presented a study trying to understand how the parental migration may have affected the academic performance of students by analyzing rural elementary students. Motivated by controversies about the benefits and costs of rural-urban migration, the results show that at least in our study counties, there is negative effect when students have migrant parents. Having parental migrants can marginally reduce a child's math test score, and this negative effect is particularly large when it is the students' mother who migrated. Other findings include that female students and students in ethnic minority areas do not perform well in math exams, with discrimination against girls, poor educational facilities and unqualified teachers in minority areas likely to be the main reasons.

Policy wise, the study has several implications. First, the Chinese government should take active measures to dismantle rural to urban institutional barriers, for instance by abolishing the current household registration system, and by creating a better learning environment in cities for the children of migrants. Second, the government should implement more constructive policies to eliminate gender discrimination and increase investment in schools situated in minority areas to promote the education of female students and ethnic minorities.

Chapter 3 presented the results from a randomized control trail (RCT) field experiment of a nutrition education program in rural areas in northwest China. By taking RCT, this essay investigated the anemia problem in rural China and explored the effectiveness of a parental nutrition education program on their children's anemia status. The main intervention of the program involved the distribution of manuals instructing parents about effective methods for reducing iron deficiency anemia of their children and consequently anemia's effect on school performance.

The program is shown to improve parents' knowledge by comparing the score changes between a treatment group and a control group after the intervention. More important, the results indicate that the nutritional education program has significant beneficial effects on students' anemia status and that impacts are greater for non boarding students whose nutrition is fully provided by their families. The study provides important information for policy makers who are interested in using nutrition education program to improve health and nutrition of rural students more efficient and more equitable. The results indicate employing nutrition education programs is one way to effectively reduce the anemia rate in rural China. Although this result is only for ten counties in two provinces, the effect size should encourage education officials in China to continue exploring the effectiveness of additional nutritional education programs.

Chapter 4 presented a study that aimed to gain a better understanding on how China's New Rural Social Pension Program worked since 2009, which factors affect the participation and what is its effect on the working of rural elderly. As China is in an era of "aging society", China's government responded to it by taking a series of pension policies. However, while many urban residents more or less enjoy pension security, rural residents do not. Furthermore, as a result of rising off farm employment and rural to urban migration, rural people are increasingly reliant on some form of pension to maintain their standard of living in their old age. In 2009 China's government issued guidance regarding the development of the New Rural Social Pension Program (NRSPP). The program was first piloted in a small geographic

region and then gradually extended across the whole country.

Given the nature and high importance of NRSPP, there is surprisingly little empirical evidence on it. Therefore, the goal of our study was to gain a better understanding of which rural population (with what characteristics) were most likely participating the pension program. The empirical analysis found that pension policies, age, social status, household asset endowment, people's time preference and the confidence in the NRSPP had affected the participation rate. The results also demonstrated that the NRSPP did not affect the work of rural elderly, as the majority of both those enrolled in the program and those not enrolled in the program continued to work into their seventies. Furthermore, the results also indicated that participation in the NRSPP further decreasing the working rate among the elderly who became ill, as people were much more likely to leave the labor force than non-participants who became ill, which proves that to a certain extent, the NRSPP improved the welfare of the elderly.

Eidesstattliche Erklärung / *Declaration under Oath*

Ich erkläre an Eides statt, dass ich die Arbeit selbstständig und ohne fremde Hilfe verfasst, keine anderen als die von mir angegebenen Quellen und Hilfsmittel benutzt und die den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht habe.

I declare under penalty of perjury that this thesis is my own work entirely and has been written without any help from other people. I used only the sources mentioned and included all the citations correctly both in word or content.

05.11.2014

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Unterschrift des Antragstellers / *Signature of the applicant*

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