# Multidimensional Poverty in China: Some Preliminary Findings Based on CHNS 2000-2009

**Jiantuo Yu** *

(Draft, comments are welcome)

**Abstract** This paper estimates multidimensional poverty in China by applying Alkire and Foster's methodology using the China Health and Nutrition Survey 2000-2009 data. Five dimensions are included: income, education, health, social security and living standard. Results show that economic growth did not have a uniform pro-poor effect across provinces, which further demonstrates that economic growth does not automatically transfer into poverty reduction. It is also found that the dimension-adjusted head count ratio of multidimensional poverty in rural areas is 1.4~1.5 times of that in urban areas. Moreover, the contribution of the rural areas to overall multidimensional poverty is about 8 percentage points higher than its share of population. Dimension-break down suggests that deprivation in social security was the major sources of multidimensional poverty before 2006, and its contribution to overall poverty measure decreased dramatically during 2006~2009. Finally, province-decompositions suggest Henan, Hunan and Guangxi should be provinces on which poverty alleviation policies focused more.

**Keywords**: multidimensional poverty; poverty measurement; counting approach; China; CHNS
**JEL Classification:** D31, I32, O53.

* Jiantuo Yu, China Development Research Foundation and Center for Human and Economic Development Studies of Peking University. F4 Tunlien Tower No,8 East Avenue Deshengmen Xicheng District Beijing 100009 China.
email: yujiantuo@hotmail.com

## 1. INTRODUCTION

POVERTY has traditionally been seen as a status of lacking income (or consumption). However, during the last three decades, thanks to the seminal works of Townsend (1979), Streeten (1981), and Sen (1981, 1985), this uni-dimensional concept of poverty has been challenged and it is now widely accepted that poverty is a multidimensional phenomenon. Income is an insufficient measure on which the estimation of human deprivation is based. One can mention two main reasons for this: In the first place, as demonstrated in many case studies, there often are the high errors of inclusion and exclusion between those who are income poor and those who are capability poor (Baulch and Masset 2003; Laderchi et al. 2003). Secondly, monetary-metric income approach may include inaccuracies because not all non-monetary attributes can be directly measured due to the lack or imperfections of related markets, as it is the case in many less developed countries (Bourguignon and Chakravarty 2003). Therefore, although income is an important prerequisite condition for human development, it should be supplemented by some other key attributes or dimensions when measuring human deprivation such as literacy, life expectancy, provision of public services, and access to clean water.

In a pioneering paper of Sen (1976), poverty measurement is conceptualized as involving two steps: *identifying* the poor and *aggregating* the poor into a society-wide measure. In addition, Sen (1976) also proposes an axiomatic approach to poverty measurement. Since then, more axioms have been introduced and a wide range of poverty measures have been developed. [1] In a multidimensional context, the *identification* and *aggregation* of poverty are more complicated than in the uni-dimensional one. However, some of the axioms of the uni-dimensional context can be analogously extended to the multidimensional one (see, e.g., Tsui 2002; Bourguignon and Chakravarty 2003; Alkire and Foster 2007).

This paper estimates multidimensional poverty in China applying the methodology developed by Alkire and Foster (2007) (hereafter "AF methodology"), which is a variant of that developed by Foster, Greer, and Thorbecke (1984) (hereafter referred to as "FGT"). The AF methodology has many attractive characteristics. First, it introduces a more inclusive approach for the *identification* of the poor, providing more choices than the two traditional approaches, the *intersection* approach and *union* approach. Second, the AF measures satisfy an array of convenient axioms, among them, the possibility of decomposing the measure in population subgroups as well as breaking it down into the dimension-specific contributions. These characteristics thus open a strong possibility of using AF methodology in both theoretical and practical analysis of multidimensional poverty.

Since the launch of the *Reform and Opening Up* in 1978, China has made brilliant progress in economic growth, with its real GDP growing annually at an average speed of 9.8% during the period 1978-2007. Benefiting from this phenomenal economic growth, China has also made outstanding achievement in alleviating income poverty. The proportion of people living on less than one dollar (PPP) per day dropped from 64% in 1981 to 7% in 2007 (World Bank Beijing Office 2008). Taking a

[1] For a survey on poverty axioms and measures see Foster and Sen (1997)..

multidimensional perspective allows analysing whether this outstanding performance in growth has translated into improvements in other dimensions.

Data used in this paper is from China Health and Nutrition Survey (CHNS) (2000, 2004, and 2006). Nine representative provinces (*Heilongjiang, Liaoning, Shandong, Jiangsu, Henan, Hubei, Hunan, Guangxi and Guizhou*) are included in the CNHS. Five dimensions are considered in estimating multidimensional poverty (*income, education, health, social security, and living standard*). The living standard dimension is constituted by four sub-dimensions including access to clean water, improved sanitation facilities, electricity, and improved cooking fuel. The rest of the paper is organized as follows: Section 2 introduces the data and samples used in this paper, and explains the indicators and cut-offs used for the identification of deprivation in specific dimensions; Section 3 decomposes the multidimensional poverty measure by province, and urban-rural areas and breaks it down by dimension. Finally, Section 4 contains the conclusions of the paper.

## 2. METHODOLOGY

The measurement of poverty involves two steps: (1) *identification*, defining the criteria for distinguishing whether a person is poor or not; (2) *aggregation*, bringing data on poor persons together to obtain an overall indicator of poverty (Sen, 1976). To present these steps in the AF methodology, let's first introduce some notation. Assume there is a society with $n$ people and each individual has $d$ dimensions of achievements. Then there is a $n \times d$ matrix y, $y = [y_{ij}]$, where each entry $y_{ij}$ represents the achievement of individual $i = 1, 2, \ldots, n$ in dimension $j = 1, 2, \ldots, d$. There is also define a $d$-dimension row vector of cut-offs for specific dimensions $z = [z_j]$, where $z_j$ is the cut-off below which a person is defined as deprived in dimension $j$.

### *2.1 Identification of multidimensional poverty*

The AF methodology uses a dual-cut-off structure to identify the poor: (1) a set of *dimension-specific cut-offs*, adopted to define whether a person is deprived with respect to each individual dimension; (2) a *multidimensional cut-off*, to define whether a person is poor in a multidimensional sense. Here the term "deprivation" means that a person is deprived in any specific dimension; and the term "poverty" means that the person is considered as multidimensionally poor.

Define $\rho(c_i; k)$ as the *multidimensional identification function,* where $c_i$ represents the number of deprivation suffered by person $i$ and $k$ refers to the *multidimensional cut-off*. The function only takes two values: $\rho(c_i; k) = 1$ if $c_i \geq k$ and $\rho(c_i; k) = 0$ otherwise. In words, a person is identified as multidimensionally poor if she/he is deprived in at least k dimensions.

Traditionally, there have been two main identification approaches in the multidimensional context. One is *intersection* approach, which defines a person as multidimensionally poor if she/he is deprived in every dimension. Clearly, with this criterion the number of the poor decreases as the number of considered dimensions increases. This can lead to an underestimation of the poverty when the number of considered dimensions is large. The other common approach is the *union* one, which defines a person as multidimensionally poor if she/he is deprived in at least one dimension. As opposed to the *intersection* approach, the *union* approach leads to an overestimation of the poverty status when the number of considered dimensions is large.

The identification approach proposed by Alkire and Foster (2007) is more inclusive than the two extreme approaches mentioned above. When all dimensions are equally weighted, the value of $k$ varies from 1 to $d$. When $k$ =1, identification corresponds to the *union* approach; when $k = d$, identification corresponds to the *intersection* approach. Other k values in between the two extremes ($1 < k < d$) can be chosen, depending on the specific context under analysis. When dimensions are differently weighted, weights need to add up to the total number of indicators used and the k value equivalent to the union approach corresponds to that of the minimum weight.

*2.2 Aggregation of multidimensional poverty*

Given the definition of the multidimensional identification function, the total number of people who are multidimensionally deprived is defined as:

$$q = \sum_{i=1}^{n} \rho(c_i; k) \qquad (1)$$

The headcount ratio of multidimensional poverty in a society is thus given by:

$$H_0 = q / n = \frac{1}{n} \sum_{i=1}^{n} \rho(c_i; k) \qquad (2)$$

$H_0$ indicates the proportion of people who are multidimensionally poor in a society. However, it does not reflect the *breadth* of deprivation the poor experience. For example, if a poor suddenly became deprived in an additional dimension, such change would not be is notreflected in $H_0$. In fact, $H_0$ violates the axiom of "dimensional monotonicity" (Alkire and Foster 2007).

One way to solve the mentioned problem is to include additional information on the *breadth* of deprivation suffered by the poor. To do so, define $c(k)$ as the *censored* vector of deprivation counts such that $c_i(k) = c_i$ if $c_i \geq k$, and $c_i(k) = 0$ otherwise. Note that $c_i(k) / d$ represents the *share of possible deprivations* experienced by the poor person $i$. Then, one can define the average deprivation share of the poor as:

$$A = \sum_{i=1}^{n} c_i(k) / (qd) \qquad (3)$$

$A$ increases whenever a poor becomes deprived in an additional dimension.
This two partial indices, *H* and *A* constitute the first member of the AF family of poverty measures, $M_0(y; z)$, named as the dimension-*adjusted* headcount ratio, since it is the headcount ratio times the average deprivation share among the poor:

$$M_0 = HA = \frac{1}{nd} \sum_{i=1}^{n} c_i(k) \qquad (4)$$

When all the considered indicators are cardinal, it is possible to use other members of the family that are sensitive to the *depth* of poverty in each dimension. However, as most of our variables are dichotomous, these other measures can not be implemented here.

It is worth noting that $M_0$ meets the requirement of *dimensional mononocity:* if a poor becomes deprived in one additional dimension, $M_0$ will increase. Another particularly useful attribute of this measure (as well as of the other members of the AF family) is that it can be decomposed into the contribution of sub-groups of population. For any two

achievement matrices $y_1$ and $y_2$, we have

$$M_0(y_1, y_2; z) = \frac{M_0(y_1; z) * n(y_1)}{n(y_1, y_2)} + \frac{M_0(y_2; z) * n(y_2)}{n(y_1, y_2)} \quad (5)$$

where $n(y_1)$ and $n(y_2)$ are the populations of two subgroups $y_1$ and $y_2$ and $n(y_1, y_2)$ is the sum of the two populations. This decomposability formula applies to any number of subgroups, and can be used to describe the profiles of poverty and to target certain population groups (Alkire and Foster, 2007).

## 3. DATASET AND INDICATORS

### *3.1 Data and Sample*

The dataset used in this paper is from the China Health and Nutrition Survey (CHNS), which is jointly conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill, and the Chinese Center for Disease Control and Prevention. The first round of CHNS was conducted in 1989, and six additional panels were collected in 1991, 1993, 1997, 2000, 2004, ~~and~~ 2006 and 2009. The CHNS covers 9 provinces: *Heilongjiang, Liaoning, Jiangsu, Shandong, Henan, Hunan, Hubei, Guangxi and Guizhou* (see Figure 1). Among the nine provinces, Heilongjiang was not covered by CHNS in 1989, 1991 and 1993; and Liaoning was absent from the 1997 survey. Only waves in 2000, 2004, ~~and~~ 2006 and 2009 included all nine provinces, that is the reason why only these four waves are considered in the paper.

Among the nine sampled provinces, *Heilongjiang and Liaoning*, located in Northeast China, are two of provinces with the highest level of industrialization and urbanization. *Shandong* and *Jiangsu*, located in the coastal areas of eastern China, are two of the most successful provinces in achieving rapid economic development since1978. *Henan, Hubei* and *Hunan* are representative provinces in Central China. *Guizhou* and *Guangxi*, located in Western China, are characterized as the most backward areas in China.

**Figure 1: Map of Surveyed Provinces**


Source: CHNS website. http://www.cpc.unc.edu/projects/china/proj_desc/chinamap.html. Areas in dark green are the provinces where CHNS were conducted.

A multistage, random cluster process was used to draw the sample surveyed in each

of the provinces. Counties in the sampled provinces were firstly stratified into three grades (low, middle, and high) by income. A weighted sampling scheme was used to randomly select 4 counties in each province. In addition, the provincial capital and a lower income city were usually selected, but two provinces used large cities rather than provincial capitals. Villages and townships within the counties as well as urban and suburban neighbourhoods within the cities were selected randomly. The sample sizes in each wave are shown in Table 1.

**Table 1 Number of Household Samples in CHNS 2000-2006**

| Year | Number of Sample Households |
|---|---|
| 2000 | 4,403 |
| 2004 | 4,387 |
| 2006 | 4,468 |
| 2009 | 4,521 |

The CHNS dataset is one of a few panel datasets that has collected data every 2-4 years for nearly two decades in China. CHNS uses a wide range of indicators at individual, household and community level, including income, employment, health and nutrition, consumption, water sources, sanitation, housing type, assets, demographic variables of household members, and access to improved road, etc. Such a wide-range of indicators facilitate the analysis of health-related issues and also multidimensional poverty. The panel structure of the dataset makes it possible to further investigate the poverty dynamics of China. Another reason to use this dataset is that it is the only large comprehensive panel dataset that is publicly available. In addition, CHNS includes samples in both rural and urban areas allowing comparison of multidimensional poverty between them, which is of extreme importance for policy intervention given the urban-rural dual structure of China's economy and society.

CHNS has been mainly used to analyze health status, health inequality, as well as health habits and their determinants (Doak, 2002; Kim et al., 2004; Popkin et al.,2006; Stookey et al., 2005, among others). Only a few used the data to analyze other issues like gender (de Brauw et al. 2007) and income poverty and inequality (Zhu et al. 2007). At the time of writing this paper, this dataset had not been used to analyze multidimensional poverty.

### *3.2 Dimensions, Indicators, Weights and Cut-offs*

Five dimensions and eight indicators are considered in measuring multidimensional poverty. Table 2 lists these dimensions and their corresponding indicators and cut-offs for identifying the deprivation in specific dimensions. Income, as one of the key prerequisites for human capability and one of the most widely used indicators, is selected as one dimension. Health and education, which are intrinsically valued components of human capability (Sen 1985; UNDP 1990), are also selected. Social security system provides a safety network for people to cushion the negative effects of social and economic risks (Sen 1999; China Development Research Foundation, hereafter CDRF 2009), so it is also included as one dimension.

**Table 2: Dimension, Indicator and Cut-off**

| Dimensions | Indicators | Deprivation Cut-offs (The household is deprived if) | Weights |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Income | Per capita income of household | Per capita income of the household less than RMB 1067 in rural areas and less than RMB 2100 in urban areas in 2007, adjusted according to prices in different waves and regions. | 1 |
| Health | Body Mass Index (BMI) | At least one adult member of the household with BMI less than 18.5 kg/$m^2$ | 1 |
| Education | Schooling Years | All adult members' schooling year is less than 5 years. | 1 |
| Security | Medical Insurance | No any household member has access to any kind of medical insurance | 1 |
| Living Standard | Access to Clean Water | No access to tap water in-house or in-yard | 0.25 |
| | Access to Improved Sanitation Facilities | No access to toilet facilities, no access to private restroom, or using open earth pit as toilet | 0.25 |
| | Access to Electricity | Not using electricity as a main energy source for lighting | 0.25 |
| | Access to Improved Cooking Fuel | Using wood, stick/straw, charcoal, etc. as main fuels for cooking | 0.25 |

Access to clean water, improved sanitation facilities, electricity and improved cooking fuel are chosen as four components of the living standard dimension. Unsafe water is a direct cause of many diseases in developing countries, and access to clean water has been widely seen as a basic right (World Bank 2003; UNDP 2006). Access to improved sanitation facilities has significantly positive effects on reducing the contagion of various diseases like Hepatitis, Cholera and Diarrheal (WHO and UNDP 2000; World Bank 2003). Without access to electricity, people are excluded from using of a wide range of facilities like television, refrigerator, telephone, and computer. Finally, the type of cooking fuel is closely linked with in-door air pollution, deforestation and greenhouse gas emissions. Incomplete and inefficient combustion of solid fuels results in the emission of hundreds of compounds, many of which are health-damaging pollutants or greenhouse gases that contribute to global climate change (Bruce et al. 2000; UNDG 2003). A nested weighting approach is adopted such that each dimension is given a weight of 1 and each indicator of the living standard dimension is given a weight of 0.25, as shown in Table 2.[2]

In accordance with the National Bureau of Statistics of China (NBS), we identify a rural household as deprived in income if the per capita income of the household is less than 998 China Yuan (CNY) per year in 2005. This is an updated poverty line defined by NBS and roughly equivalent to the World Bank's USD 1.08 per day line at the 1993 PPP dollars (or CNY 951 in 2005). [3] The urban income deprivation cut-off was CNY

[2] For further discussion on the nested weighting structure see Alkire and Foster (2007) and for discussion on the meaning of weights see Decanq and Lugo (2008).

[3] Traditionally the government used official *absolute poverty line* to monitor rural poverty, and the line in 2007 was set at CNY 785 per person per years. However, the standard is widely criticized and is thought to be too low to reflect the real picture of China's rural poverty (CDRF, 2007). In 2000, the government also introduced *the low income line* to monitor the situation of relative poverty of rural households, and the line was set at CNY 1067 in 2007. In 2008, the State Council Leading Group Office of Poverty

1,980 in 2005, which is slightly higher than the $2/day line proposed by the World Bank at the 1993 PPP dollars, and is about 1.5 times of the line proposed by Ravallion and Chen (2007). [4] This income deprivation cut-off was adjusted according to different CPI deflators among regions in the years concerned.

Body mass index (BMI), defined as weight/height$^2$, is conducive to the measurement of long-term nutrition status and health deprivation, and thus is widely used in different disciplines. Therefore, adult BMI is used to reflect the household's health level. If an adult's BMI is less than 18.5 kg/m$^2$ (this follows the WHO criterion)[5] the person is deprived in health. If there is at least one adult (aged 18 or above) has a BMI less than 18.5 kg/m$^2$, the household is defined as deprived in health.

A household is considered to be education-deprived if the maximum years of education completed by any member aged 15 or above is less than 5 years. Ideally, we should define illiteracy in a functional sense, for example, whether people can recognize a certain number of words and can do basic arithmetic. However, such information is not available and we have to rely on the traditional variable of years of education.

Regarding indicators on social security, ideally, we should include an array of indicators to reflect how the people are secured by social safety network. Unfortunately, the only available indicator is health insurance. Other indicators such as access to unemployment insurance, minimum living allowance, work injury insurance or old-age pension are not available. We consider that access to health insurance is an incomplete but reasonable proxy of access to social security. In this paper, we define a household as social security-deprived if no member of the household is covered by any kind of health insurance program.

Regarding the living standard dimension, the cut-off used for drinking water is access to piped water. This indicator is also monitored by the Chinese government. As for sanitation, a household is considered deprived if it has no access to any toilet facilities, no access to private restroom, or using open earth pit as toilet. This is a similar definition to that of the Millennium Development Goals, although not exactly equal due to differences in the options of the sanitation question. We proxy access to electricity by the type of lighting, as lighting is the most basic use of electricity. Finally, a household is considered deprived in cooking fuel if it uses wood, stick/straw or charcoal.

## 4. RESULTS

### *4.1 Headcount Ratios by dimension and Number of Deprivations*

Table 3 reports the dimension-specific headcount deprivation ratio in 2000, 2004 ~~and~~

Alleviation and Development announced to unify the two lines and used CNY 1067 in 2007 as the only poverty line..

[4] Urban poverty in China has not raised concerns widely until China accelerated the reform of state-owned enterprises in the late 1990s. Although many scholars and organizations input efforts in measuring urban poverty since then, there is no widely-accepted income poverty line in China's urban areas up to now. In this paper, we adopted the diagnostic line proposed by NBS, which was CNY 1875 in 2000 (Asian Development Bank, 2004). As price inflation in urban areas being considered, the urban poverty line was CNY 2100 in 2007.

[5] Compared to international normal range 18.5-24.99, Asian's range of normal BMI is lower, between 18.5 to 22.9 kg/m$^2$. Asians with BMI>=23.0 are considered to be overweight. Thus the international cut-off for censoring overweight and obesity is not applicable to China (Zhou 2002), but the cut-off for identifying underweight is still applicable to China and has been widely used to analyze health status of the Chinese people (see, e.g, Zhou 2002; Tang et al. 2007; Zhang et al. 2005).

2006 and 2009, based on the deprivation cut-offs defined in Table 2. Households' response rate on dimension-specific deprivation varied significantly, as reflected in Table 3.

**Table 3: Response rate on Dimension-Specific Deprivation in 2000, 2004 and 2006 (%)**

| Dimensions | 2000 | 2004 | 2006 | 2009 | Changes between 2000-2006 |
|---|---|---|---|---|---|
| **1. Income** | **13.12** (4,313)[a] | **11.78** (4,339) | **10.84** (4,370) | **8.12** (4,433) | **-5.00** |
| **2. Education** | **9.15** (4,368) | **13.15** (4,371) | **13.77** (4,439) | **13.51** (4,487) | **4.36** |
| **3. Health** | **14.39** (4,246) | **13.07** (4,287) | **11.98** (4,336) | **12.74** (4,428) | **-1.65** |
| **4. Social Security** | **66.15** (4,333) | **59.73** (4,369) | **39.95** (4,446) | **4.06** (4,507) | **-62.09** |
| **5. Living Standard** | | | | | |
| 5.1 Water | **30.11** (4,371) | **26.28** (4,373) | **23.03** (4,447) | **18.98** (4,500) | **-11.13** |
| 5.2 Sanitation | **32.12** (4,383) | **27.38** (4,370) | **23.15** (4,441) | **15.61** (4,497) | **-16.51** |
| 5.3 Electricity | **0.89** (4,339) | **0.32** (4,374) | **0.32** (4,439) | **0.36** (4,492) | **-0.53** |
| 5.4 Cooking Fuel | **27.76** (4,387) | **23.99** (4,336) | **22.01** (4,408) | **16.36** (4,481) | **-11.40** |
| **Total Number of Sample Households** | **4,403** | **4,387** | **4468** | **4521** | |

a The number of valid households reporting information about specific dimensions is listed in parenthesis.

Response rate of social security deprivation was the highest among all considered indicators. Nearly two thirds of the Chinese household did not have access to any kind of health insurance programs in 2000. In 2006, there were still about 40% of the surveyed households were not covered by any kinds of health insurance program. However, as China accelerated its step in establishing social security system, the Chinese households' access to health insurance programs has been universalized and more than 95% of Chinese household has participated in some kinds of health insurance programs.

Although significant achievements were made in alleviating deprivation related to the accesses to water, sanitation and improved cooking fuel, 15~19 % of the sample households were deprived in these sub-dimensions in 2009. Expansion of the electricity service allowed that virtually all Chinese households had access to electricity after 2000.

According to the response rates, more than 10% of the sampled households were still deprived in terms of education and health in 2009. Between 2000 and 2009, the deprivation in health was reduced slightly, with the response rates decreasing by 4 and 2 percentage points respectively. What surprising is that the response rate of education deprivation increased during the surveyed period from 9.15% in 2000 to 13.51% in 2009. Considering this definition of education deprivation, the maximum of adult schooling year in the family is less than five years, the increase of education deprivation seems a little bit confusing. One possible reason to explain the situation is the change of family member. With the growth of their age, the better educated young generation moved out the family because of marriage and migration during the period.

Another possible reason is the change of sample, there were about 10~15% percent of households dropped out of the sample and replaced by the new ones in each wave.

The above statistics provide an idea of dimensions-specific deprivation levels. To have a more comprehensive understanding of China's poverty status, we need to resort to the multidimensional approach, which evaluates simultaneous deprivations. Table 4 presents the percentage of households deprived in different number of weighted dimensions.[6]The percentage of non-deprived households increased from 17.5% in 2000 to 68.51% in 2009, which reflects the overall decreasing poverty trend in the country. Also note that, in the first three survey years, about 75% of the households were deprived in less than the equivalent of two dimensions, and in 2009 survey the ratio increased to 95%.

**Table 4: Distribution of the Number of Deprivation Dimensions**

| Weighted Number of Deprivation Dimensions (c) | Percentage of the Poor in 2000 | Percentage of the Poor in 2004 | Percentage of the Poor in 2009 |
|---|---|---|---|
| *0* | *17.50%* | *22.10%* | 44.70% |
| 0<c<1 | 9.43% | 9.61% | 23.81% |
| *1≤c<2* | *48.45%* | *44.30%* | *26.10%* |
| 2≤c<3 | 20.05% | 19.50% | 4.65% |
| 3≤c<4 | 4.23% | 4.04% | 0.69% |
| 4≤c<5 | 0.33% | 0.45% | 0.05% |
| 5 | 0.03% | 0% | 0% |
| **Valid Sample** | **4000** | **4185** | **4322** |

*4.2 Multidimensional Poverty Estimates*

As introduced in the methodology section, in constructing a measure of multidimensional poverty, one critical step is to choose the number of dimensions in which someone has to be deprived so as to be considered multidimensionally poor; in the AF terminology, the poverty cut-off $k$ . Under the nested weighting approach adopted in this paper, the value of $k$ can vary from 0.25 to 5. However, there is no consensus on an optimal value for $k$ , and the selection depends on the preference of the researcher or policy-makers, the specific context of a society and the purpose of the exercise a hand. Clearly, if $k$ is too low, there will be a large proportion of population being identified as poor, which might cause confusion and even arouse political displeasure. On the other hand, if the value of poverty cut-off $k$ is set too high, only a small proportion of people will be identified as multidimensionally poor, which could also mislead policymaking. Based on the results of Table 4, we select a poverty cut-off with $k$ =2.

Figure 2a shows the headcount ratio of multidimensional poverty ($H_0$) at national and provincial level respectively, using the poverty cut-off of $k$ =2.[7] Here both $H_0$ and $M_0$ are adjusted according to household size and regional population. As shown in ~~the~~ figure 2a, at national level, the proportion of people who were multidimensionally poor declined substantially between 2000 and 200~~6~~9. In 200~~6~~9, only about ~~1~~64% of the people were multidimensionally poor, according to the given poverty cut-off.

[6] Note that results in Table 4 are not weighted by the population of the provinces concerned.
[7] Here the word "national" only reflects poverty status based on nine sample provinces.

**Figure 2a: Evolution of $H_0$ between 2000 and 2009 (%)**

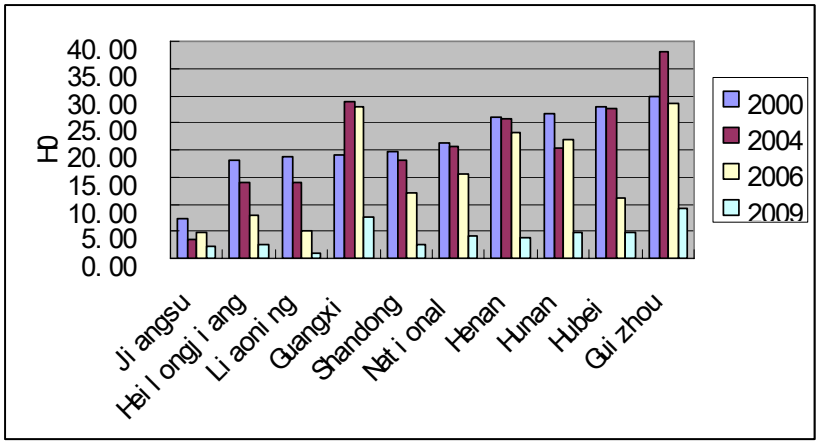
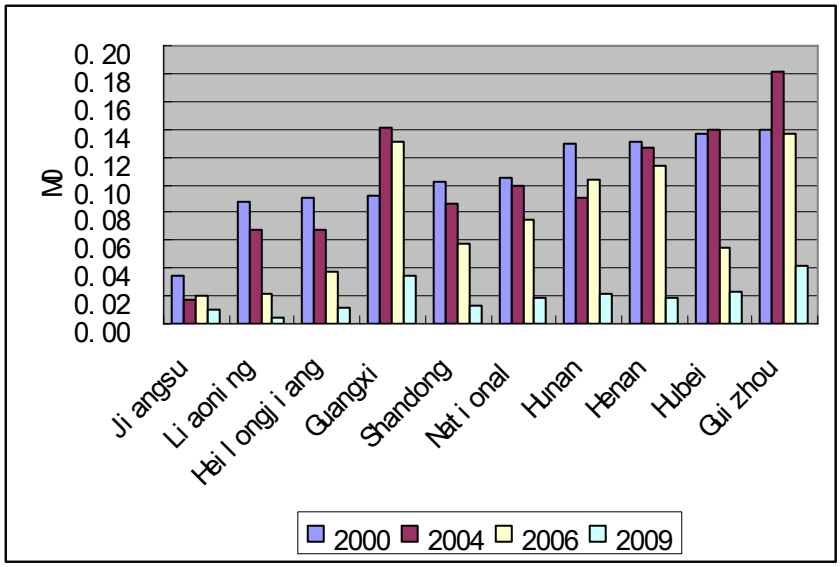



**Figure 2b: Evolution of $M_0$ between 2000 and 2009**



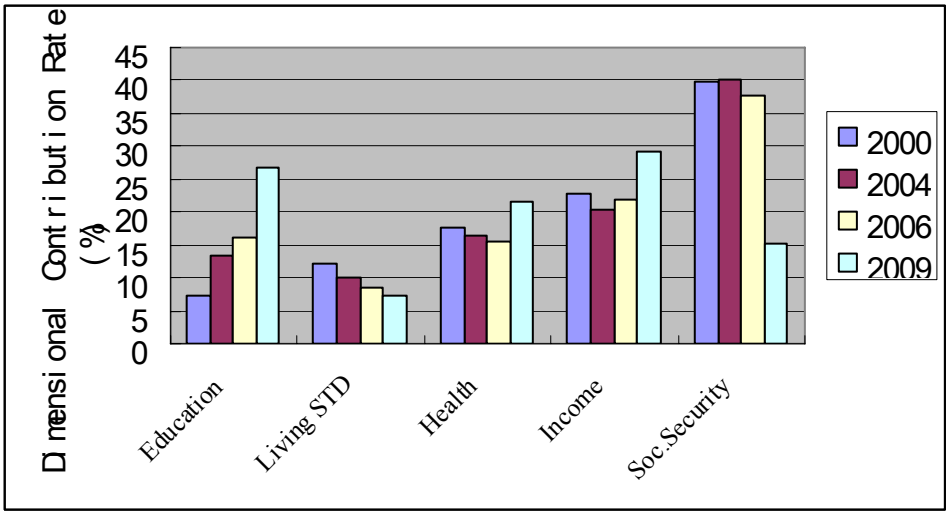

As indicated by Figure 2a and 2b, Hubei achieved the most outstanding progress in alleviating the proportion of multidimensional poor during the period 2000-2009, with a decrease of 23 percentage points of multidimensional poor. Liaoning also achieved impressive achievement, with a decrease of 95% of the multidimensional poor between 2000 and 2009. Guizhou and Guangxi were the provinces with the highest proportion of poor households in 2009, with the proportion of poor people as high as close to 10%. What surprising is, there were two provinces, Jiangsu and Hunan, witnessed an increase of proportion of poor people between 2004 and 2006, though these two provinces experienced a rapid economic growth rate during the period. Note that Jiangsu was the province that had achieved the most brilliant success in economic growth in China since late 1970s. The unusual increase of poverty demonstrates that rapid economic growth does not automatically transfer into poverty reduction. In addition, there was a significant decrease of multidimensional poverty in all provinces between 2006 and 2009, and the driving factor of this dramatic drop of multidimensional poverty should attribute to the rapid expansion of health insurance in both rural and urban areas.

*4.3 Analysing multidimensional poverty's composition*

4.3.1 Decomposing $M_0$ by dimension

One convenient property of the AF family of measures is that allows identifying the contribution of the poor's deprivation in each dimension to overall multidimensional poverty. Figure 3 presents such decomposition in the concerned years.

**Figure 3: Contribution Rate of Each Dimension to $M_0$**




As reflected in Figure 3, the social security dimension contributed the largest share to overall $M_0$ before 2006, accounting for nearly 40% in 2000 and more than one third in 2006. However, in the 2009 wave, the social security dimensional was not the largest contributor of overall poverty anymore, only contributing 15% to overall poverty. Income dimension was the second largest sources of $M_0$ in the first three waves, while its contribution increased significantly and had been the largest contributor to overall poverty in 2009.

Among five selected dimensions, health and living standard witnessed continuous decrease of their contribution rates. However, the contribution rate of education dimension tripled between 2000 and 2009. Considering the increase of household's response rate to education deprivation between 2000 and 2009, as reflected in the Table 3, this increasing contribution of education dimension to the overall $M_0$ should be paid more attention.

Decomposing the contribution rate of each dimension to the reduction of $M_0$ also provides some insights. As indicated by Table 5, to all sample provinces, increase of access to social security system had the largest contribution to the reduction of their $M_0$. Reduction of deprivation in income and health also had substantial contribution to reduction of provincial $M_0$. This decomposition is meaningful for policy makers to assess the effects of poverty alleviation policies and to identify the priority areas for policy intervention.

**Table 5: Contribution Rate of Each Dimension to the Reduction of Provincial $M_0$ (2000~2009) (%)**

| | Income | Education | Health | Social Security | Living Standard | $\Delta M_0$ |
|---|---|---|---|---|---|---|
| Liaoning | 21.62 | 2.82 | 25.16 | 41.97 | 8.42 | 0.0835 |
| Heilongjiang | 22.04 | 0.67 | 17.31 | 41.85 | 18.13 | 0.0796 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Jiangsu | 17.06 | 12.97 | 7.64 | 49.61 | 12.71 | 0.0255 |
| Shandong | 25.72 | 9.78 | 9.63 | 40.29 | 14.58 | 0.0889 |
| Henan | 25.84 | 0.82 | 14.09 | 44.34 | 14.92 | 0.1123 |
| Hubei | 19.46 | 1.23 | 17.09 | 46.88 | 15.34 | 0.1129 |
| Hunan | 24.45 | 4.47 | 17.75 | 44.38 | 8.95 | 0.1080 |
| Guangxi | 5.71 | -2.41 | 29.91 | 53.30 | 13.49 | 0.0577 |
| Guizhou | 11.69 | -2.17 | 26.74 | 55.16 | 8.59 | 0.0984 |

*4.3.2 Decomposing $M_0$ by Rural and Urban Areas*

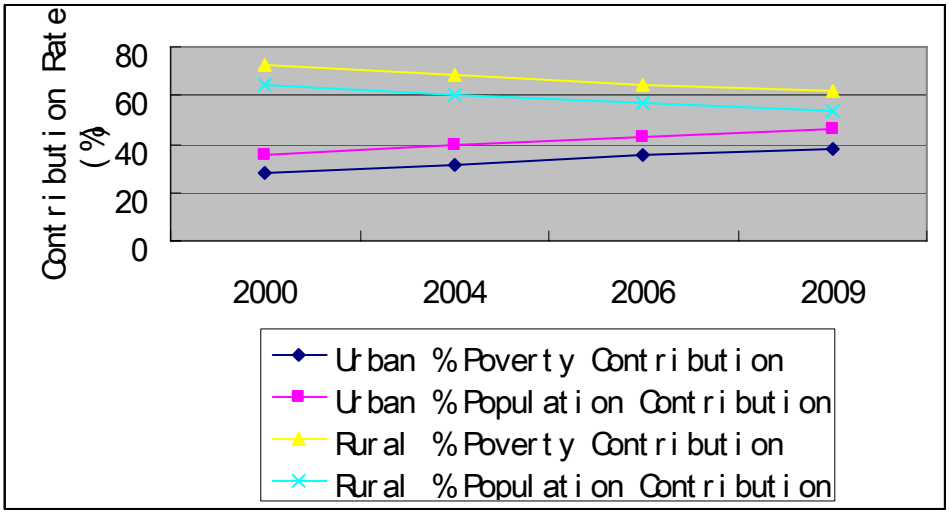
China is a country with typical urban-rural dual structure. Table 6 presents the evolution of the ratio of rural to urban multidimensional poverty over time, measured by $H_0$ and $M_0$. It is noteworthy that, though the urban-rural income ratio increased quite significantly from 2.79 in 2000 to 3.33 in 2009 (NBS, 2010), urban-rural gap in multidimensional poverty didn't expand during the stage, and there even was a slight decrease of $H_0$, suggesting that the increased gap in income between the two areas was compensated by a reduction in the gap in deprivation in the other considered dimensions. This may be related to the rapid growth in public investment and transfer schemes in rural areas by the Chinese government since 2003, under the slogan of "Constructing Socialist New Countryside". It is also worth noting that $M_0$ indicates a higher urban-rural disparity than $H_0$. $M_0$ in rural~~urban~~ areas was about 1.4~1.5 times that in urban~~rural~~ areas in survey years, suggesting that rural households are more severely deprived not only according to the width of poverty (higher proportion of deprived households) but also according to the breadth of poverty (more deprived dimensions).

**Table ~~8~~6: $H_0$ and $M_0$ in Urban and Rural Areas ($k$ =2)**

| | $H_0$ | | | $M_0$ | | |
|---|---|---|---|---|---|---|
| | **2000** | **2004** | **2009** | **2000** | **2004** | **2009** |
| Urban | 0.175 | 0.163 | 0.033 | 0.081 | 0.076 | 0.015 |
| Rural | 0.233 | 0.233 | 0.046 | 0.117 | 0.115 | 0.021 |
| Rural/Urban | 1.33 | 1.43 | 1.402 | 1.44 | 1.52 | 1.409 |

The data structure of CHNS allows comparing the poverty status between rural and urban areas. Figure 5 presents the evolution of the contribution of rural and urban areas to national $M_0$ alongside the evolution of the contribution to overall population, indicates that over the study period, rural areas contribute much more than urban ones (72% vs. 28% in 2000 and 62% vs. 38% in 2009). Also, rural areas' contribution to $M_0$ was about 8~10 percentage points higher than their population share, which reflects the higher prevalence of multidimensional poverty there. However, the figure also indicates that the contribution of rural areas to overall poverty declined alongside a reduction in their population contribution and (as a complement) the opposite happened for urban areas.

**Figure 5: Poverty Contribution of Rural and Urban Areas**




## 5. CONCLUSIONS

In this paper we have estimated multidimensional poverty in China using data from China Health and Nutrition Survey (CHNS) 2000-2009, applying the new methodology developed by Alkire and Foster (2007). In line with China's outstanding growth performance, the levels of multidimensional poverty found are relatively low. In fact, about 95% of the households were deprived in less than the equivalent of two dimensions of the five selected ones in 2009. Setting a cut-off of being deprived in two or more equivalent dimensions so as to be considered multidimensionally poor, we found that the proportion of poor households decreased from 21% to 4% between 2000 and 2009. The results show that Guizhou and Guangxi are two provinces who are most seriously deprived, according to the multidimensional poverty measure.

Decomposing multidimensional poverty by dimension reveals that social security was the largest source of poverty between 2000~2006, while the contribution rate of social security dimension to overall poverty decreased substantially between 2006~2009 because of the rapid expansion of China's social security system.

Decomposition of $M_0$ by rural and urban areas suggests that, rural households were more seriously deprived than their urban counterparts, according to both the width and breadth of multidimensional poverty. Fortunately, the expanding public investment in rural areas started to play positive effect in narrowing urban-rural disparity, in terms of multidimensional poverty. This effect has not been given enough credit yet in China.

As the first attempt of evaluating multidimensional poverty in China, this study could be further improved in many ways in the future: Firstly, more relevant indicators, like employment and shelter, could be included as additional dimensions; Secondly, better proxies could be adopted for selected indicators, for example, replacing the proxy of social security dimension (access to health insurance system) with better one (access to pension system); Thirdly, other weighting skill could be adopted in the process of identification and aggregation; Fourthly, skills like consistency analysis and robustness analysis could be introduced in the future to further justify the chose of cut-off;

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