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Is the ADB's Conjecture on Upward Trend in Poverty for China Right? An Analysis of Income and Multidimensional Poverty in China

Jing Yang[1] · Pundarik Mukhopadhaya[2]

Abstract

In order to investigate the Asian Development Bank's (ADB) finding of increasing trend in income poverty in China since 2000, this paper studies income and multidimensional poverty in China between 2000 and 2011 using China Health and Nutrition Survey data. It is observed the ADB proposed approach, adjusted for vulnerability, demonstrates an upward trend in *income* poverty. Income poverty is decreasing, however, for the World Bank's poverty cut-offs ($1.25 or $1.90). To measure multidimensional poverty, along with income (with ADB's adjusted Asian poverty line and World Bank's poverty lines), other indicators such as health, education and living standards are considered in this paper. The evident disparities and diversities in rural and urban *multidimensional* poverty are further examined. Per capita net income, highest level of education and flush toilet are found to be major contributors to both rural and urban poverty. The rural–urban disparity in terms of *mild* and *moderate* poverty appears to have decreased in the period before 2009, however, there have been increases since then, and the gap in terms of *severe* poverty remained quite high in this decade. We find that food insecurity does not play a major role in the rural–urban disparity in poverty. In the recent period, health insurance has become more prominent in explaining urban destitution, while the rural population is found to be more vulnerable to income fluctuations. Our results also show *long-term* poverty to be highly influenced by health. Our findings raise questions about the adequacies in the provision of health insurance and the quality of education, particularly in rural China.

✉ Pundarik Mukhopadhaya
   pundarik.mukhopadhaya@mq.edu.au

   Jing Yang
   soutechust@163.com

[1] Financial College, Jiangxi Normal University, Nanchang, China

[2] Economics Department, Macquarie University, Sydney, Australia

1 Introduction

China has made remarkable progress in reducing income poverty over the past 2 decades. The World Bank's database (*povcalNet*)[1] reports that the national poverty headcount in China decreased by around 12.84% annually between 1981 and 2013.[2,3] In addition, the overall decrease in urban poverty is greater than that for rural poverty in this period,[4] with the rural subgroup remaining poorer irrespective of the measures used.[5] The poverty line used does not affect this poverty trend: when the lower poverty-line measure is used, a slightly smaller incidence of poverty is reported (Yao et al. 2004; Khan 2004; Zhang and Wan 2006). Using equivalent scales, Zhang and Wan (2006) demonstrate that the poverty trends are quite robust for six different poverty lines. Recently the Asian Development Bank (ADB 2014) measured poverty in China using a poverty line of $1.51 and further considering food insecurity and rising vulnerability in its estimation of poverty. It has been observed that if food insecurity (measured by rising food prices) is adjusted, the increase in the percentage of poor during 2005–2010 in China, for example, is quite large. After further taking into account the natural, economic and other (socio-political) shocks to income and expenditure, the ADB adjusted their $1.51 Poverty line (the Asian Poverty line) by employing a risk factor proportional to income. With these adjustments, ADB (2014) notes that from the year 2000 the poverty rate in China rose by 15.2, 17.2 and 16.9% points in 2005, 2008 and 2010 respectively. The observation of this reverse trend is the motivation for an investigation into this changing trend in poverty for the period 2000–2011 using ADB's adjusted Asian poverty line. Data from the China Health and Nutrition Survey (CHNS) are used for our poverty measurement. Appreciating the policy proposal from the government of China in *Outline for Development-oriented Poverty Reduction for China's Rural Areas (2011–2020) [Outline (2011–2020)]*, our paper adds further value by incorporating other dimensions of poverty beyond simply that of income to contrast the trends and characteristics between rural and urban poverty in China. As the ADB report considers only national trends in poverty, our investigation of both rural and urban poverty has important policy implications. We use the capability framework (Sen 1985), and the counting approach (hereafter AF approach) developed by Alkire and Foster (2008) for our measurements.[6]

The CHNS dataset has been popular in studies of the socio-economic and health research on China because the project collects adequate information on factors such as income, employment, education, and modernization, as well as others related to health, nutritional and demographic measures. Labar and Bresson (2011) used the multidimensional stochastic dominance procedures on the joint distribution of income, education and

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[1] The *PovcalNet* can be accessed from: http://iresearch.worldbank.org/PovcalNet/index.htm.

[2] The poverty line is $1.90 per person per day for the 2011 Purchasing Power Parity (PPP) exchange rate.

[3] The measurements conducted by Chen and Ravallion (2008) and Ravallion and Chen (2007) show a continuous decline over the period 1980–2004, and reveals a more dramatic reduction in poverty than that reported in Chinese official accounts. Additionally, the declining trend is quite prominent in other research, such as Khan (2004), Zhang and Wan (2006), and Goh et al. (2009).

[4] The urban headcount ratio decreased by 16.32% while the rural headcount ratio deceased by 11.01% during the period.

[5] Similar observations are made by Ravallion and Chen (2007), Yao et al. (2004), Khan (2004), Goh et al. (2009), among others.

[6] United Nations Development Programme (UNDP) uses this method to compare multidimensional poverty across countries.

health based on CHNS data (1991–2006). They found that multidimensional poverty had decreased during the period; however, the decrease is statistically significant only in the period 1994–2004. Ray and Mishra (2012) used the CHNS data (1993, 2000 and 2006) to compare multidimensional poverty in India and China, and found that rural poverty was much worse in India, but the level of urban poverty in the two countries was similar. Yu's (2013) study focussed mostly on the provincial trend of multidimensional poverty. Di and Wu (2014) used the CHNS dataset to measure child poverty in China and found that children's living standards improved from 1989 to 2009, but there remained significant regional disparities.[7] We explore rural urban disparity by identifying the ingredients of poverty, which is quite different from the existing literature.

Previous studies on multidimensional poverty in China[8] either do not consider income as one dimension/indicator (Wang and Alkire 2009; Zou and Fang 2011; Gao 2012), or consider income with the cut-off set at the official poverty line (Jiang et al. 2011; Sun et al. 2012; Chen 2012; Chen and Zhang 2013; Yu 2013).[9] Thus, the influence of income vulnerability or food price fluctuation on poverty is not investigated. In recent research, Ward (2016) measures vulnerability and rural *income* poverty in seven Chinese provinces using 375 balanced panel samples. The present paper examines the trends in multidimensional poverty from 2000 to 2011, and includes income as one indicator (accounting for the influence of vulnerability and food price fluctuations), covering more than 4000 samples across rural and urban China. Thus, the examination undertaken in this paper has wider coverage and applies improved methods. Unlike other studies, we go one step further by exploring the long-term factors contributing to multidimensional poverty.

An additional purpose of this paper is to explore the contribution of the indicators to the rural–urban disparity. Many studies on China's income inequality report that the rural–urban income gap has increased over time and that this has become the most significant factor contributing to overall inequality (Sicular et al. 2007; Li and Luo 2010).[10] Thus, questions of whether or not there is significant diversity in multidimensional poverty between urban and rural China and, if there is, which indicators contribute most to this diversity, are worthy of consideration. By using the adjusted Asian poverty line, we are able to provide an indication of the relative vulnerability of rural and urban people in China. The inclusion of the vulnerability factor helps explain the adequacy and quality issues of various indicators of poverty, which have not so far been considered in studies of multidimensional poverty in China.

The rest of the paper is organized as follows. The second section introduces the data set used in this paper, and computes the trends of income poverty in China using various poverty cut-offs. Section 3 briefly describes the AF method of computation of poverty and explains the indicators, cut-offs and weights that are used to identify a multidimensionally poor household. Section 4 shows trends in and contributions to urban and rural multidimensional poverty and discusses the rural–urban disparity. The fifth section explores the state of deprivation further by explaining the contribution of each indicator to rural–urban

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[7] For a detailed discussion of multidimensional poverty using CHNS data, see Yang and Mukhopadhaya (2016).

[8] See Yang and Mukhopadhaya (2016) for a detailed list.

[9] Yu (2013) uses different poverty lines for urban and rural samples. The urban poverty line (3014 Yuan) was higher than the rural (2300 Yuan). The official poverty line is used for the rural measurement, while for the urban the Minimum Income Guarantee line is applied.

[10] See also Mukhopadhaya et al. (2011) and Li et al. (2014).

disparities, and further employs a logit regression to examine the long-run factors influencing multidimensional poverty in rural and urban China. The last section discusses the implications of the results and concludes.

2 Income Poverty in China

2.1 The Data Used in this Study

China Household Nutrition Survey (CHNS) data is developed through an international collaborative research project between Carolina Population Centre at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Centre for Disease Control and Prevention. Since 1989 ten waves of surveys are conducted to collect data under this project. The CHNS includes the community-level, household-level and individual-level surveys. This paper uses five waves (2000–2011) of the household and individual-level surveys (adult and child) of the CHNS.[11] Nine provinces are included for all the five waves, comprising three Eastern (Liaoning, Jiangsu and Shandong), four Central (Heilongjiang, Henan, Hubei and Hunan) and two Western (Guangxi and Guizhou) provinces.[12] After treating for missing values, there are 3773, 4174, 4205, 4334 and 4301 samples for the years 2000, 2004, 2006, 2009 and 2011 respectively, where 32% of households are from urban regions.[13] This dataset contains enough information on socio-economic and other factors related to poverty in a longitudinal format. We further note that in this dataset nearly 12–17% household samples were dropped in each wave of survey and the dropped households are replaced by new households. Thus the total sizes of samples are quite stable, and more than 80% of the household samples are kept from the previous waves.

2.2 Is Poverty in China Increasing?

To examine the trends in income poverty in China, ADB's "$1.51 per day" poverty line is primarily used. Moreover, for adjusting food insecurity, the per capita household income is attuned according to the food consumer price index (CPI) instead of the general CPI in different waves and provinces in China.[14] The vulnerability-adjusted poverty line of each wave is computed and reported in Table 1.[15]

Table 2 and Fig. 1 show that poverty in China between 2000 and 2011 has decreased for the World Bank's $1.25 and $1.90 and ADB's Asian poverty line (except when adjusted for vulnerability). The result showing that poverty in China increases for the fully adjusted Asian poverty line is similar to the observation made by the ADB. According to the ADB

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[11] The CHNS dataset is available at the CHNS official website: http://www.cpc.unc.edu/projects/China.

[12] Three more provinces—Beijing, Shanghai and Chongqing—were covered in the 2011 wave, but in order to make a comparison between waves, these three provinces are dropped in the 2011 wave in our calculation.

[13] Because of missing values of explanatory variables, the regression samples (that are used in Sect. 5) are 3269, 3629, 3620, 3910 and 3789 for each wave respectively.

[14] A similar trend is observed using the OECD equivalent adult scale (not presented in the paper).

[15] In the estimation of the vulnerability-adjusted poverty line, the coefficient of constant relative risk aversion is 3, as suggested by the ADB (2014). We have used a multiplicative model of vulnerability. Note that our vulnerability factor is in a range somewhat higher than the ADB estimates.

(2014), the measure of poverty using headcount with the adjusted poverty line moves from 40.7% in 2005 to 45.8% in 2008 to 45.6% in 2011.[16]

It can be noted from Table 2 that the headcount ratio decreased from 2006 in the vulnerability-adjusted poverty line with general CPI, but not for food CPI. This observation indicates that from 2006 income poverty, particularly adjusted for vulnerability and food CPI, is no less important in China. However, unlike the ADB (2014) observation, we note here that the poverty trend as a whole is decreasing for the $1.51 poverty line adjusted only for food prices. This reveals that in our period of study the adverse effects of vulnerability due to income fluctuation has a much greater impact on poverty in China than that of food price fluctuation (see rows (7) and (8) in Table 2).

3 Measurement Techniques for Multidimensional Poverty

3.1 The Method

Initially for the measurement of multidimensional poverty two dimensions (income and leisure) were used. Researchers gradually introduced a framework with three categories of measurement strategies: the item-by-item analysis strategy; the non-aggregative strategy; and the aggregative strategy (Brandolini 2009).[17] The latter is appreciated more by researchers nowadays because it builds up a composite index of multidimensional poverty so that the breadth, intensity and severity of multidimensional poverty can be compared. For example, Chakravarty et al. (1998), Tsui (2002) and Bourguignon and Chakravarty (2003) applied an axiomatic method for the measurement of multidimensional poverty to set up composite indices which are similar to those of the Foster–Greer–Thorbecke (FGT) index in unidimensional poverty. Moreover, the MPI is based on the counting method, known also as the Dual Cut-offs method (AF-method), developed by Alkire and Foster (2008), which has been adopted by the UNDP to measure and compare multidimensional poverty across countries. An alternative measurement of poverty based on convex analysis applies mathematical or geometrical concepts (also statistical techniques) in deriving the measures. The fuzzy method is one such framework for poverty measurement.[18]

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[16] While for the $1.25 poverty line, measures are 16.3%, 13.1% and 11.6% in the respective years.

[17] The item-by-item analysis strategy proposes to assess the deprivation in each dimension or indicator separately. Alkire et al. (2015) called it the dashboard method. Its advantage is in its simplicity, but comparison of dimensions become hard when the number of the dimensions is large. The non-aggregative strategy includes the dominance method and multivariate statistical method. The dominance method was introduced into the measurement of multidimensional wellbeing by Atkinson and Bourguignon (1982). Duclos et al. (2006) extended it to a multidimensional poverty context. Its advantage is to make a comparison on the basis of the entire vectors of functionings and avoid arbitrary specifications. But the sample size needs to increase exponentially with the number of dimensions. Thus, when the set of dimensions is large, empirical research faces problems. The multivariate statistical method can help deal with the choice of dimensions, including principal component analysis (PCA), cluster analysis, and factor analysis (FA). For example, Klasen (2000) applied a PCA approach to South Africa, and Asselin and Anh (2008) built a multiple correspondence analysis (MCA) composite for Vietnam. However, its weakness is that the result depends largely on methodological choices such as the number of components to retain.

[18] See Deutsch and Silber (2005), Betti and Verma (2008), Betti and Lemmi (2013).

Table 1 The vulnerability-adjusted poverty lines—various years

Year	z_0	Vulnerability[a]	z_2 (Dollar)
2000	$1.51	1.13	$1.70
2004	$1.51	1.40	$2.12
2006	$1.51	2.01	$3.03
2009	$1.51	2.57	$3.88
2011	$1.51	2.83	$4.27

z_0 is the $1.51 poverty line (poverty line under certainty), while z_2 is the vulnerability-adjusted poverty line. The ADB's (2014) vulnerability-adjusted poverty lines were 1.88, 2.15 and 2.26 for 2005, 2008 and 2010, respectively. The variation is due to the use of different datasets

[a] A general homothetic utility function is used to measure vulnerability, which is denoted by $1 - [\delta(1-\delta)\frac{\sigma_R^2}{2}]^{-\frac{1}{1-\delta}}$. The σ_R^2 is estimated as the difference between the variance of observed incomes and the variance of long-term distribution of income using $\delta = 3$

Table 2 Poverty headcount (%)—various years, various poverty lines

Years	2000	2004	2006	2009	2011
(1) $1.25 poverty line adjusted for General CPI	21.15	18.90	17.29	10.13	10.79
(2) $1.90 poverty line adjusted for General CPI	33.55	28.49	27.80	15.97	15.23
(3) $1.51 poverty line adjusted for General CPI	26.08	22.98	22.02	12.69	12.51
(4) $1.51 poverty line adjusted for Food CPI	26.08	24.87	24.26	16.50	17.04
(5) Vulnerability-adjusted poverty line using General CPI	29.31	32.27	42.43	35.63	33.50
(6) Vulnerability-adjusted poverty line using Food CPI	29.31	34.69	45.92	45.80	46.69
(7) Effect of variation on food prices [(6) − (5)]	0.00	2.42	3.49	10.17	13.19
(8) Effect of vulnerability due to income fluctuations [(6) − (4)]	3.23	9.29	20.41	22.94	20.99
(9) Total effect [(8+(7) or (6) − (3)]	3.23	11.71	23.9	33.11	34.18

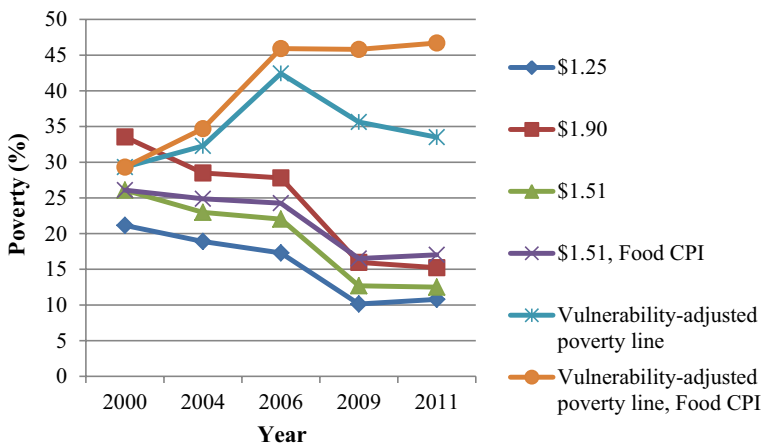2000 is the base year for general and food CPI

Fig. 1 Trends in national income poverty (various poverty lines)

The AF method of measuring multidimensional poverty is used in this paper.[19] Poverty is measured for n household (denoted by i) with d indicators (denoted by j). Two cut-offs are used to identify the multidimensionality of poor households:

(a) Deprivation cut-off $Z_j(Z_j > 0)$ is proposed such that if the achievement of household i is higher than the cut-off ($X_{ij} \geq Z_j$), household i is not considered deprived in indicator j otherwise deprived (where X_{ij} is the achievement of household i in indicator j for all $i = 1$, 2, …, n, and $j = 1,2,…d$). We use the deprivation status value g_{ij} to reflect the situation. If household i is not deprived in indicator j, then $g_{ij} = 0$. Otherwise, $g_{ij} = 1$ denotes that household i is deprived in j.

(b) The second cut-off is the poverty cut-off $k(0 < k \leq 1)$. There are two steps involved in identifying a poor household. First, to get the weighted deprivation status value $w_j g_{ij}$ and the deprivation score c_i: $c_i = \sum_{j=1}^{d} w_j g_{ij} = w_1 g_{i1} + w_2 g_{i2} + \cdots w_d g_{id}$ by giving weight w_j to each indicator j such that $\sum_{j=1}^{d} w_j = d$. Then, by comparing the deprivation score c_i and the poverty cut-off k (referring to a certain proportion of the total number of indicators) we identify the status of the household i. Household i is considered poor if $c_i \geq k$, otherwise not poor.

After the identification, the headcount ratio can be obtained as:

$$H = \frac{q}{n} \tag{1}$$

Here, q is the number of poor households.

And the average poverty gap (A) is calculated by standardizing the summed proportion of the total deprivation score that each poor household suffers from:

$$A = \frac{\sum_{i=1}^{n} c_i(k)/d}{q} = \frac{\sum_{i=1}^{n} c_i(k)}{dq} \tag{2}$$

Here, $c_{i(k)}$ is the deprivation score of poor households with poverty cut-off k.

Based on these two measurements, the adjusted headcount ratio (M_0) can be obtained as:

$$M_0 = H \times A \tag{3}$$

The M_0 can be decomposed by subgroups. Assuming that the size of the urban subgroup X_1 is n_1, while the size of the rural subgroup X_2 is n_2, the overall M_0 is the weighted sum of M_0 in each subgroup:

$$M_0(X) = \left(\frac{n_1}{n}\right) M_0(X_1) + \left(\frac{n_2}{n}\right) M_0(X_2) \tag{4}$$

3.2 Indicators of Deprivation, Their Cut-offs and Weights Used

Based on Alkire (2007), we selected ten indicators for our analysis of multidimensional poverty. We have paid further attention to the key tasks of the *Outline (2011–2020)* and the indicators used in the MPI of the United Nations (see Table 3). Alkire (2007) suggests five methods to choose dimensions and indicators: (1) existing data; (2) normal assumptions;

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[19] This subjective poverty index has been criticised by Ravallion (2011, 2012), Rippin (2012) and others [see Yang and Mukhopadhaya (2016)]. However, this measure is extremely popular [for example see Wagle (2014) and Rogan (2016)], and also used by the UNDP for the computation of the MPI.

Table 3 The indicators, their weights and the cut-offs used

Indicator	Weight	Deprived if …	Justification
Net income per capita[a]	1/10	The net income per capita is less than the "$1.51 per day" poverty line.[b] Moreover, vulnerability and food insecurity is incorporated in the poverty line	There is no more appropriate proxy than income to present the poor's ability to buy food and clothing. Also, the *Outline (2011–2020)* proposes that the growth of net income per capita of the residents in the poor rural regions will be higher than the national average
School attendance	1/10	Any child aged from 6 to 15 is not attending school	*Outline (2011–2020)* proposes consolidation of 9-year compulsory education with the aim of no young adult illiteracy by 2015. The school attendance indicator is widely used to indicate the educational functioning of the household in the existing studies
Highest level of education	1/10	No adult member has completed primary school	Although completing primary school as the highest level of education is not the best indicator to reflect the quality of education, we have to adopt it as proxy due to the lack of information on adult illiteracy in the CHNS dataset
Health insurance	1/10	No member has the health insurance	Health insurance indicator is listed in the key tasks of the *Outline (2011–2020)*, which proposes that the participation rate of villagers in the New Cooperative Medical Care System will be above 90% by the end of this decade
Body Mass Index (BMI)	1/10	The BMI of any adult member of the household is $< 18.5 \text{ kg/m}^2$	MPI includes mortality and nutrition in its health dimension. BMI indicates health status in terms of nutritional diet. According to the criterion of WHO, an adult with BMI < 18.5 kg/m² faces health risks
Electricity	1/10	The household has no electricity	The cut-off is set according to MPI and *Outline (2011–2020)*
Drinking water	1/10	The household does not have access to in-house or in-yard water or clean drinking water from plants or wells over 5 m in depth	The cut-off is according to the MPI and government initiatives as discussed above
Toilet	1/10	There is no flush toilet	These are according to the MPI
Cooking fuel	1/10	The household does not use clean cooking fuel	
Consumer durables	1/10	Household does not have even one electrical appliance	This indicator is included in the MPI and in most previous studies. Note that the CHNS dataset lists 18 electrical appliances[c]

[a] Use of an OECD class of equivalence scale to adjust the incomes of households of different size and composition is an alternative to per capita income. However, any such scale is based on the normative assumptions about individuals' needs, the economies of scale of household size, and the availability of data (Buhmann et al. 1988). Visaria (1980), using information from Sri Lanka, Taiwan, Malaysia and China, observed that the correlation of results on poverty using various other equivalence scales and per capita income is very high. We did not find any difference of trend by adjusting income for OECD equivalent scale

[b] Estimations with other income poverty cut-offs (like World Bank's $1.25 and $1.90) are also used for comparison. Note that during the period of study the official poverty line of China changed twice (in 2008 and 2011)

[c] The list of electrical appliances changed a little over different waves of the survey. In 2000, there is no cell phone or satellite dish. In 2004, there is no satellite dish. In 2009 and 2011, radio, tape recorder and black/white television do not feature in the list

(3) public consensus; (4) ongoing deliberative participation and (5) empirical analysis. Yang and Mukhopadhaya (2016) have combined the first four methods to develop a theoretical construct in selecting dimensions and indicators. We used the above theoretical framework to determine the feasible set of indicators appropriate for CHNS dataset.[20]

As the counting deprivation score is the weighted mean of the deprivation status values, it is also needed to weight each indicator.[21] The equal weights method is popular in the multidimensional measurement of well-being indices. We use equal weights (as used in the normative weights approach) by giving equal weight to each indicator.[22,23]

In accordance with the weighting structure, the poverty cut-off (k) varies from 1/10 to 1. In the following section, we report our estimates of poverty for $k = 0.4$, which means the household that is deprived in at least 40% of all indicators (four out of ten indicators) is deemed to be multidimensionally poor.

4 Trends in Multidimensional Poverty in China

4.1 The Trends in National Multidimensional Poverty

Table 4 presents the urban, rural and national multidimensional poverty measurements (including H, A, and M_0) in each wave using the ADB's adjusted income poverty line. Figure 2 shows the trends in multidimensional poverty for the World Bank's \$1.90 and \$1.25 income poverty lines (Table 10 in the "Appendix" provides the detailed results). It can be seen that the headcount ratio (H) decreased sharply during the period, but the average poverty gap (A) seems to have stayed stable. Which means that the number of households that were deprived in more than 40% of indicators became small, while the situation of poor households did not improve much. The average poverty gap (A) dropped (by 7.66%) only in 2009. Overall, the adjusted headcount ratio (M_0) shows a decreasing trend in the study period.

It can also be observed from Fig. 2 that multidimensional poverty (irrespective of the income poverty line) has been decreasing over the period. However, the rate of decrease is different for different income cut-offs. The adjusted headcount ratio (M_0) with the \$1.90 income poverty line was highest in 2000, but the M_0 that uses ADB's adjusted poverty line is the highest since 2004. Moreover, in 2011 the M_0 with \$1.90 and \$1.25 poverty lines are very close. Accordingly, the rate in decease of the M_0 with ADB's adjusted poverty line is the lowest, while the rate is highest with the \$1.90 poverty line. Thus, it is clear

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[20] Yang and Mukhopadhaya (2017) reviewed 56 papers analysing multidimensional poverty in other developing countries or regions and found that 33.93% of them used the income or expenditure as dimension or indicator. Besides, there are 30.77% of another 13 papers which analysed the multidimensional poverty in China used income. Further, we found that the multidimensional poverty measurement is robust whether income is selected or not. We decided to add the income in the list of indicators because our result shows that if income is dropped from the list the income poverty is poorly correlated with the multidimensional poverty.

[21] Decancq and Lugo (2013) suggest three approaches to set the weights: data-driven weights, normative weights and hybrid weights.

[22] Yang and Mukhopadhaya (2016) observed using CHNS that the trend in multidimensional poverty in China is robust for various weights.

[23] Yu (2013) used four waves of CHNS (2000–2009) using different sets of dimensions/indicators with much lesser weight on water, electricity, toilet and cooking fuel. Our set of indicators are wider ranged and we consider that all indicators are equally important, particularly after the adjustment of food price and vulnerability due to income fluctuations.

that, generally speaking, multidimensional poverty has reduced significantly in the last decade.[24] The largest decrease occurred in the sub-period 2006–2009. This result shows that the bleak scenario of poverty trends in China portrayed by the ADB should be considered with care. There is little doubt that income fluctuation generates vulnerability and that people near the income poverty line are at risk, but improvements in health, education and living standards have created extraordinary progress in China.

4.2 The Diversity Between Urban and Rural Poverty

The ADB (2014) does not examine both rural and urban poverty. This paper adds further value by studying the disparity of poverty at the rural and urban levels using the ADB-adjusted poverty line.

Figure 3 (developed from the information presented in Table 4) shows that the major achievement in reduction in poverty was in headcount ratios both in rural and urban areas, however, the intensity of poverty (measured by A) did not change much. The rural–urban gap in poverty (measured by M_0) is still high. In order to make comparisons, we demonstrate the rural–urban disparities in multidimensional poverty by way of the rural-to-urban ratio of the aforementioned poverty indices (see Table 5). If the ratio is more than 1, rural multidimensional poverty is worse (if less than one, then better) than urban poverty, while the value of the ratio 1 implies no disparity in terms of multidimensional poverty. It can be seen from Table 5 that multidimensional poverty in rural areas remains 3 to 4.5 times greater than that in urban areas ($k=0.4$). As a robustness test of our observation, we present estimates of poverty for various values of poverty cut-offs (k). We make at least three annotations by comparing the rural–urban ratio between different poverty indices in different waves.

First, the rural–urban disparity in terms of incidence of poverty (H) becomes larger, but the disparity in intensity (A) becomes smaller with higher values of k. This indicates that when the poverty cut-off (that is k) increases, more households in rural compared with urban areas are deemed poor,[25] but the intensity of deprivation of poor households in urban and rural areas remains similar. As a result, the rural–urban gap measured in terms of M_0 widened during the whole period when k increased (except in 2009 for k increasing from 0.4 to 0.6). Since we know that with higher k the deprivation of poor households becomes more severe, we define *severe* poverty as a situation when people are poor in 6 or more indicators (i.e. $k \geq 0.6$), *mild* poverty when households' poverty cut-off is 0.2, while *moderate* poverty is indicated as $k=0.4$. Table 5 shows that the disparity in severe poverty was mostly higher than that of moderate poverty (except in 2009). In general, the disparity in mild poverty was lower than that in moderate poverty.

Second, rural multidimensional poverty in terms of intensity seems in most cases to be worse than that in urban areas. This indicates that rural people are always more vulnerable than their urban counterparts. A comparison of poverty figures for two different income cut-offs (World Bank and adjusted-ADB) re-establishes this further.

Third, the rural–urban disparity in terms of mild and moderate poverty shows a decreasing trend before 2006 and 2004 respectively, but shows increases since then, while disparity in terms of severe poverty remains quite high in this period (with exceptional drops in 2004 and 2006). There is no doubt that the trend in the rural–urban disparity is in

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[24] The decrease is larger with the higher poverty cut-off (k)—for brevity Table 4 does not report figures of poverty with higher cut-offs.
[25] Except in the case when the disparity in H has become smaller for the increase in k from 0.4 to 0.6 in 2009.

Table 4 The multidimensional poverty index—various years ($k = 0.4$)

Year	H			A			M_0		
	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
2000	0.0874	0.3841	0.2897	0.4295	0.4607	0.4577	0.0376	0.177	0.1326
2004	0.0843	0.3417	0.2597	0.4402	0.4564	0.4547	0.0371	0.1559	0.1181
2006	0.0637	0.2595	0.1967	0.4314	0.4625	0.4593	0.0275	0.12	0.0903
2009	0.0201	0.0921	0.069	0.4214	0.4244	0.4241	0.0085	0.0391	0.0293
2011	0.0137	0.0645	0.0481	0.4211	0.4335	0.4324	0.0058	0.028	0.0208
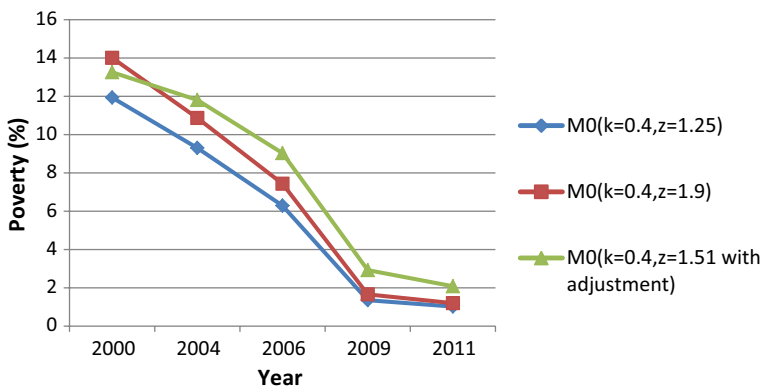
Fig. 2 Trends in national multidimensional poverty—various methods

accordance with the trend in multidimensional poverty (listed in Table 4), which indicates that urban poverty has decreased faster than rural poverty.

Figure 4 presents the ratio of raw headcount measures of income poor in rural and urban areas. We observe that irrespective of poverty lines, the number of income poor in rural areas decreased faster than in urban areas. Moreover, the trends are similar for the first four poverty lines, which indicate that the rural–urban disparity in income does not change much if the poverty lines vary. However, it should be noted that the ratio for vulnerability-general CPI and vulnerability-food CPI adjusted poverty lines increased in 2009 and 2011 respectively, indicating that the rural group has become more vulnerable recently. Table 10 in the "Appendix" reveals that rural–urban income disparity is more prominent now and is increasing, particularly due to the vulnerability of income fluctuation, but is not due to variation in food prices. That means that the rural–urban disparity cannot be explained by food insecurity. Health and education are expected to moderate the long-term fluctuations of income—thus our results raise questions on the adequacy and quality of the health and education of rural people in China. We discuss this further in the next section.

Fig. 3 Rural and urban multidimensional poverty—various years

Table 5 Ratio of multidimensional poverty index (rural and urban)—various years with different values of k

Year	k	World Bank's $1.25 poverty line			$ADB vulnerability-adjusted poverty line		
		H	A	M_0	H	A	M_0
2000	0.2	1.82	1.27	2.31	1.76	1.28	2.25
	0.4	4.73	1.07	5.07	4.39	1.07	4.71
	0.6	12.97	0.98	12.41	14.97	0.98	14.32
2004	0.2	1.97	1.20	2.37	1.82	1.24	2.25
	0.4	4.21	1.04	4.36	4.05	1.04	4.20
	0.6	5.45	1.01	5.49	5.57	1.02	5.65
2006	0.2	1.89	1.19	2.25	1.70	1.21	2.06
	0.4	4.34	1.06	4.62	4.07	1.07	4.36
	0.6	11.14	0.99	10.93	13.77	1.00	13.58
2009	0.2	2.40	1.06	2.55	2.03	1.11	2.25
	0.4	3.37	1.00	3.37	4.58	1.01	4.60
	0.6	2.00	1.00	2.00	2.86	1.00	3.00
2011	0.2	2.70	1.06	2.85	2.45	1.09	2.68
	0.4	4.33	1.01	4.39	4.71	1.03	4.83

The rural–urban ratios of the multidimensional poverty index with $k = 0.6$ in 2011 are not listed in this table because there was no urban poor household (although there were rural poor households)

5 Poverty by Indicators and Long-term Factors

A comparison of urban and rural multidimensional poverty establishes the persistence of rural–urban disparity in poverty in China. To develop necessary policy prescriptions, we examine the causes of this disparity by studying each indicator separately.
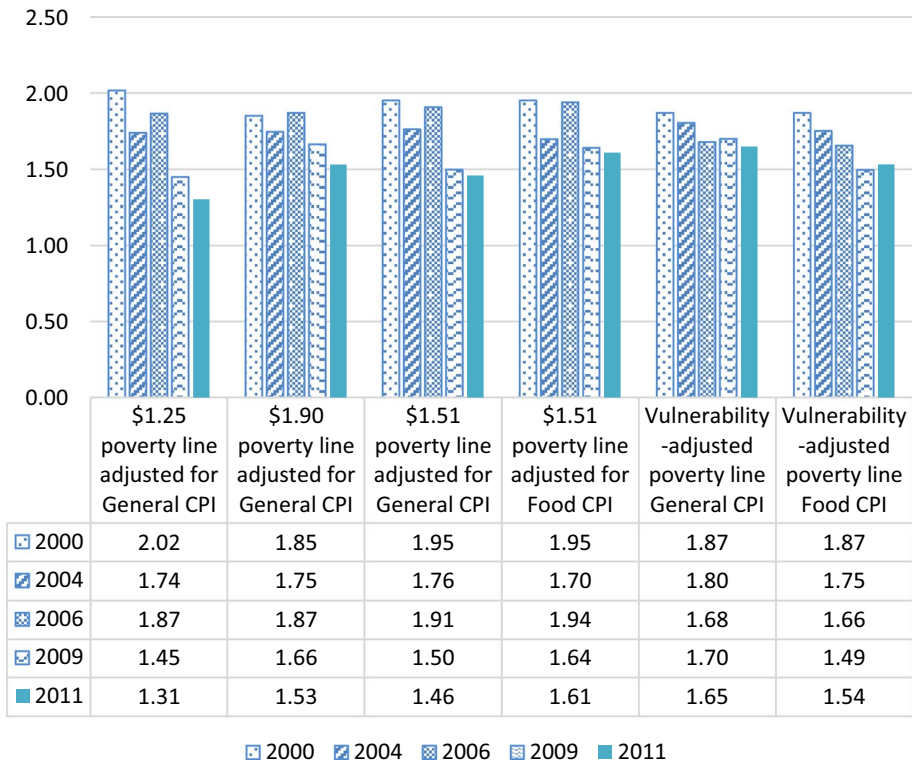
	$1.25 poverty line adjusted for General CPI	$1.90 poverty line adjusted for General CPI	$1.51 poverty line adjusted for General CPI	$1.51 poverty line adjusted for Food CPI	Vulnerability -adjusted poverty line General CPI	Vulnerability -adjusted poverty line Food CPI
▣ 2000	2.02	1.85	1.95	1.95	1.87	1.87
▨ 2004	1.74	1.75	1.76	1.70	1.80	1.75
▦ 2006	1.87	1.87	1.91	1.94	1.68	1.66
▨ 2009	1.45	1.66	1.50	1.64	1.70	1.49
■ 2011	1.31	1.53	1.46	1.61	1.65	1.54

▣ 2000   ▨ 2004   ▦ 2006   ▨ 2009   ■ 2011

Fig. 4 Rural–urban raw headcount ratios of income—various income poverty lines and years. *Note*: For the computation of both General CPI and Food CPI, the year 2000 is considered as the base

5.1 Deprivation in Each Indicator

The deprivations in most indicators are worse in rural areas, except for in health insurance and electricity (Table 6). The raw headcount ratio in health insurance in rural areas dropped rapidly in 2006 and became less than that for urban people; the most likely reason for this is the establishment of the New Cooperative Medical Care System in 2003. Despite the fact that the new urban medical care system was extended to the unemployed, students and children in 2007, the deprivation in health insurance is still higher in urban areas since 2006. The low-level poverty headcount of rural people in health insurance, however, does not correspond to the fluctuation of their income leading to vulnerability. This shows that although rural people are covered by health insurance, there is insufficiency in the amount particularly in the cases of expensive long-term and life-threatening diseases.

Health insurance, toilet and cooking fuel are the three indicators in which people were the most highly deprived for both the urban and rural groups in 2000. Since 2004 for urban and 2006 for rural China, income has become one of the highest indicators. Since 2009, health insurance dropped out of the highest three deprived indicators, while cooking fuel came back to the list in 2009, and highest level of education crept into the list in 2011. It is worth noting that deprivation in income increased from 2000 to 2006 for both rural and urban groups, decreased slightly in 2009, but increased again in 2011 for the rural group,

Table 6 The raw headcount ratio of each indicator [using ADB's adjusted Asian poverty line]—various years

Indicator	2000		2004		2006		2009		2011	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Net income per capita	18.40	34.41	22.95	40.18	31.78	52.61	34.29	51.24	34.25	52.61
Child school attendance	1.42	2.45	0.08	0.63	0.15	0.53	0.14	0.34	0.07	0.62
Highest level of education	7.74	8.67	10.53	11.74	10.59	16.67	9.27	15.15	8.72	16.44
Health insurance	78.77	91.95	73.14	85.91	64.30	58.49	26.60	14.17	14.42	8.75
BMI	12.16	13.14	10.31	13.29	9.70	12.78	10.64	13.90	9.23	10.36
Electricity	0.33	1.13	0.30	0.32	0.22	0.39	0.29	0.31	1.23	0.86
Drinking water	3.25	21.35	5.57	17.96	4.89	15.87	2.66	13.39	1.95	11.29
Toilet	27.81	79.98	21.44	73.08	17.26	70.37	12.22	62.18	10.02	58.54
Cooking fuel	19.40	51.13	13.92	41.51	10.37	28.65	5.03	15.22	4.25	11.36
Consumer durables	0.42	4.35	0.15	2.92	0.15	2.35	0.29	0.95	0.22	0.89

while it decreased in 2011 for the urban group.[26] This is a direct manifestation of income vulnerability leading to transient poverty, particularly for rural people.

5.2 Contribution of Each Indicator

For the urban group, before 2006, the indicator that made the greatest contribution to multidimensional poverty was health insurance.[27] Since then, this has been replaced by income (see Table 7). The situation for the rural group is more complex. Although the indicator that contributed most to multidimensional poverty before 2006 was also health insurance, toilet became the most important from 2006 to 2009, and by 2011 it was income.

The pattern of trends in the rural–urban disparity can be analysed with the computed figures from the contribution and deprivation of each indicator for both urban and rural groups. In the sub-period 2000–2004, health insurance was the indicator in which people were the most deprived, it was also the indicator that contributed most to poverty levels for both groups; however, in 2006 health insurance was not the indicator of highest deprivation for the rural group. Considering its high contribution to rural multidimensional poverty, rural poverty decreased faster than urban poverty, and the rural–urban disparity narrowed in this sub-period. However, rural health poverty decreased less than that of the urban group after the introduction of the new urban medical care system in 2007. Moreover, rural people became more income poor than those in urban areas. As a result, this disparity has increased since 2006. Table 10 in the "Appendix" shows that income is less important as a contributing factor to poverty, both in rural and urban areas, when a lower poverty cutoff (i.e. $1.25) is applied. The increase in poverty with the inclusion of vulnerability (in

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[26] Yu (2013) found the rural–urban gap was largest in 2004, which became narrower afterwards. He explained that the increased income difference between rural and urban was compensated by a reduction in the gap in deprivation in the other dimensions. However, we found that the trend of rural–urban disparity fluctuated for the $1.25 poverty line: the disparity increased in 2006 and then decreased. For the ADB adjusted poverty line the disparity decreased before 2011 and increased slightly afterwards. Our results are different from those presented in Yu (2013) because of the use of different income poverty lines, indicators and weights in that paper. The decreasing trend in the sub-period 2004-2009 is, however, of a similar nature.

[27] Analyses in this section and the next section are based on the ADB-adjusted Asian poverty line.

adjusted Asian poverty line) in the income cut-off demonstrates that the quality of education and coverage of health insurance were not enough to shield poor people from the risk of income fluctuation. The presence of health insurance as a cut-off for multidimensional poverty is popularly used in the measurement of poverty in China. The effects of vulnerability, as observed in our results, show that the health insurance indicator cannot reveal the real picture of the transitory nature of poverty. The BMI indicator shows that an increasing number of people (nearly 10%) consistently remained poor for the whole decade.

5.3 Long-run Factors Determining Multidimensional Poverty in Rural and Urban China

In this section, to explore the long-run determinants of multidimensional poverty, we employ a regression model. The following independent variables have been taken into account: per capita income in logarithmic terms[28]; the education level of the head of the household (defined by a polytomous variable from 0 to 6, such as 0 for never gone to school, 1 for primary school and so on); the health status of the head (defined by a dummy variable with 1 meaning healthy and 0 otherwise); the average levels of education and health status of other members; the household size and its square.

Table 8 reports the logit regression results using a random-effects model.[29] While Model I includes the above variables, Model II comprises an interaction of per capita income and the household head's education.[30] It can be noted that all the listed variables are significant for mild poverty (both rural and urban), and only the squared household size is insignificant for urban moderate poverty. The results show that the estimated coefficients of per capita income, household head's education level and health status, as well as the other members' average levels of education and their health statuses have negative impacts on poverty. This means that if income or level of education of the head or other members is higher, or the health status of the head or other members is better, the probability of the household being in multidimensional poverty is lower. Also, the absolute value of the coefficient of the head of the household's health is largest in all four regressions, indicating that the head's health status is the most important determinant. The positive coefficient of the dummy variable of each wave shows that multidimensional poverty decreased in the period.

Irrespective of poverty status (mild or moderate), the health of the household head is much more important than income, and this is more highly prominent in rural areas than in urban areas. More specifically, other things remaining the same, if the urban household head is unhealthy, the household has a 92% chance of being in mild poverty, and if he/she is from a rural area, there is a 95% chance. The health of other household members is equally important for rural and urban people. Although education has a significant effect on reducing poverty, the impact is much smaller. The regression results thus confirm our previous conjecture that in the longer term, any risk of falling into poverty may originate from the health factor, and this is more likely in rural rather than urban China. Thus the mere availability of health insurance is not enough to reduce this

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[28] In our data for 69 observations, income is negative. For those we use the formula $y = -\log(-x)$ to transform negative incomes (in this way the ranking is preserved).

[29] The fixed-effect model regression drops too many samples. Thus, we adopt a random-effect model. Moreover, the likelihood-ratio test rejected the pooled logit model.

[30] We add the interaction terms because there are positive associations of education and family income with self-rated health (Xu and Xie 2017). Some other interaction terms are added in three other models where the estimated coefficients of the terms are mostly insignificant. The results are available in the "Appendix".

Table 7 The contribution of each indicator (%): Urban and rural—various years

Indicator	2000		2004		2006		2009		2011	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Net income per capita	17.96	14.81	18.46	16.97	21.83	19.23	23.73	21.65	21.25	22.09
Child school attendance	1.11	1.14	0.00	0.32	0.27	0.29	0.00	0.26	0.00	0.86
Highest level of education	8.43	4.02	11.97	5.50	13.48	9.48	14.41	12.78	12.50	15.21
Health insurance	22.62	21.51	22.31	21.37	21.02	17.54	17.80	6.78	15.00	4.79
BMI	7.32	5.05	6.49	5.57	6.47	5.54	6.78	8.17	10.00	8.71
Electricity	0.00	0.55	0.00	0.11	0.00	0.26	0.00	0.26	0.00	1.35
Drinking Water	3.55	9.34	5.07	9.02	4.58	9.48	2.54	11.13	3.75	9.33
Toilet	19.51	21.35	18.05	21.15	15.63	21.01	19.49	22.43	20.00	21.84
Cooking fuel	18.85	19.79	17.44	18.17	16.17	15.38	14.41	14.26	13.75	13.50
Consumer durables	0.67	2.44	0.20	1.83	0.54	1.78	0.85	2.26	3.75	2.33

vulnerability issue; proper attention to the quality and adequacy of health support is also required.

In Model II, we find that the interaction terms of per capita income and head's education level is significant for the rural group, but not for the urban group. As the coefficient of the interaction term modifies the effect of education by income (which is the difference between the log-odds ratios corresponding to an increase in the education of one level for two homogenous groups, which differ by the per capita income for Yuan 1), the results show that the head's education level will affect income significantly for the rural group, but the effect is not significant for the urban group. This means that if the head of a rural household has a higher level of education, he or she can find a job in an urban area with relative ease, and can therefore earn more. In this case, remittances of the rural migrants are thus able to reduce multidimensional poverty. This result points to the necessity of appropriate training and education for rural people.

6 Summary and Conclusion

Irrespective of the income poverty line, we observe that health insurance, toilet, cooking fuel and per capita income were the major contributors to urban poverty until 2009 (see Table 9). In 2011, the results were somewhat different for two income poverty lines. The highest level of education is one major contributor when the $1.25 poverty line was used. The contributable indicators to rural poverty were similar to those of urban poverty. The highest level of education is into the list of prominent contributors in 2009 and 2011. Thus, our results suggest that policymakers need to pay more attention to these indicators. We also notice that people in rural areas are more vulnerable to income fluctuations, and this justifies calls for measures to stabilize such fluctuations, and to identify the target groups and the actual causes.[31] Micro-level surveys in the most vulnerable areas are therefore crucial.

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[31] Yu (2013) found that the contribution of income in multidimensional poverty is relatively stable, while we found that for the rural group this contribution increased from 14.81 to 22.09% between 2000 and 2011.

Table 8 Results of logit regression

Variable	Model I						Model II					
	Urban			Rural			Urban			Rural		
	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio
Mild poverty (k=0.2)												
Income per capita	−1.41***	0.08	0.24	−1.35***	0.06	0.26	−1.43***	0.14	0.24	−0.97***	0.09	0.38
Education of head	−0.35***	0.04	0.70	−0.37***	0.04	0.69	−0.44	0.46	0.64	1.77***	0.44	5.87
Health of head	−2.59***	0.33	0.08	−2.94***	0.33	0.05	−2.59***	0.33	0.08	−3***	0.33	0.05
Education of other member	−0.28***	0.05	0.76	−0.46***	0.04	0.63	−0.29***	0.05	0.75	−0.47***	0.04	0.63
Health of other member	−2.45***	0.26	0.09	−1.84***	0.22	0.16	−2.45***	0.26	0.09	−1.88***	0.23	0.15
Household size	0.71***	0.21	2.03	0.38***	0.12	1.46	0.71***	0.21	2.03	0.36***	0.12	1.43
Household size square	−0.05**	0.03	0.95	−0.02*	0.01	0.98	−0.05**	0.03	0.95	−0.02*	0.01	0.98
Wave 2000	0.76***	0.14	2.14	1.69***	0.11	5.42	0.76***	0.14	2.14	1.7***	0.11	5.47
Wave 2004	0.73***	0.14	2.08	1.5***	0.11	4.48	0.73***	0.14	2.08	1.52***	0.11	4.57
Wave 2006	1.06***	0.14	2.89	0.97***	0.1	2.64	1.06***	0.14	2.89	0.99***	0.1	2.69
Wave 2009	0.00	(omitted)		0.00	(omitted)		0.00	(omitted)		0.00	(omitted)	
Income*Education of head							0.01	0.05	1.01	−0.24***	0.05	0.79
Income*Health of head												
Constant	15.7***	0.96	6.58E+06	16.95***	0.72	2.30E+07	15.9***	1.36	8.04E+06	13.71***	0.94	9.00E+05
Wald chi2(8)	568.46			1107.55			568.54			1086.9		
Prob>chi2	0.00			0.00			0.00			0.00		
Moderate poverty (k=0.4)												
Income per capita	−0.35***	0.05	0.70	−0.45***	0.03	0.64	−0.36***	0.09	0.70	−0.59***	0.05	0.55
Education of head	−0.73***	0.12	0.48	−0.51***	0.05	0.60	−0.81*	0.45	0.44	−1.24***	0.23	0.29
Health of head	−2.00***	0.45	0.14	−2.09***	0.18	0.12	−2.00***	0.45	0.14	−2.08***	0.18	0.12
Education of other member	−0.78***	0.12	0.46	−0.79***	0.05	0.45	−0.79***	0.12	0.45	−0.79***	0.05	0.45
Health of other member	−1.8***	0.42	0.17	−1.63***	0.16	0.20	−1.8***	0.42	0.17	−1.63***	0.16	0.20
Household size	0.81**	0.38	2.25	0.65***	0.13	1.92	0.82**	0.39	2.27	0.65***	0.13	1.92

Table 8 (continued)

Variable	Model I						Model II					
	Urban			Rural			Urban			Rural		
	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio	Coef.	SE	Odds ratio
Household size square	−0.06	0.04	0.94	−0.04***	0.01	0.96	−0.06	0.04	0.94	−0.04***	0.01	0.96
Wave 2000	2.27***	0.4	9.68	3.09***	0.15	21.98	2.27***	0.4	9.68	3.10***	0.15	22.20
Wave 2004	2.21***	0.39	9.12	2.8***	0.14	16.44	2.21***	0.39	9.12	2.80***	0.14	16.44
Wave 2006	1.61***	0.40	5.00	1.96***	0.14	7.10	1.61***	0.4	5.00	1.96***	0.14	7.10
Wave 2009	0.00	(omitted)		0.00	(omitted)		0.00	(omitted)		0.00	(omitted)	
Income*Education of head							0.01	0.05	1.01	0.09***	0.03	1.09
Income*Health of head												
Constant	1.03	1.00	2.80	3.06***	0.42	21.33	1.12	1.11	3.06	4.22***	0.56	68.03
Wald chi2(8)	127.81			912.56			128.1			917.01		
Prob>chi2	0.00			0.00			0.00			0.00		

(1) The variable Wave 2009 is omitted because of collinearity. (2) ***, ** and * denotes significances at 1%, 5% and 10% levels respectively. (3) The exponential function of estimated parameters is called odds ratio, which indicates the percentage change in the odds of being in multidimensional poverty if the explanatory variable changes by one unit. For example, the estimated coefficients of per capita income and health of the head are −1.41 and −2.59 for the urban group when k = 0.2 in Model I. Thus, we can get the odds ratio as 0.24 and 0.08 respectively, which means the odds of an urban household with an increase of per capita income of 1 Yuan being in mild poverty decrease by 76% and an urban household when healthy has an 8% chance of being in mild poverty

Table 9 The top 3 contributable indicators—various years: rural and urban [figures in parentheses are the contributions]

Year	Area	$1.51-adjusted poverty line	$1.25 poverty line[a]
2000	Urban	Health insurance (22.62%) Toilet (19.15%) Cooking fuel (18.85%)	Health insurance (22.69%) Toilet (20.58%) Cooking fuel (20.05%)
	Rural	Health insurance (21.51%) Toilet (21.35%) Cooking fuel (19.79%)	Health insurance (21.65%) Toilet (21.53%) Cooking fuel (20.15%)
2004	Urban	Health insurance (22.31%) Income (18.46%) Toilet (18.05%)	Health insurance (22.61%) Toilet (19.15%) Cooking fuel (18.62%)
	Rural	Health insurance (21.37%) Toilet (21.15%) Cooking fuel (18.17%)	Health insurance (21.53%) Toilet (21.39%) Cooking fuel (19.02%)
2006	Urban	Income (21.83%) Health insurance (21.02%) Cooking fuel (16.17%)	Health insurance (20.73%) Income (17.48%) Cooking fuel (16.67%)
	Rural	Toilet (21.01%) Income (19.23%) Health insurance (17.54%)	Toilet (21.28%) Cooking fuel (16.35%) Income (11.81%)
2009	Urban	Income (23.73%) Toilet (19.49%) Health insurance (17.8%)	Income (20.38%) Toilet (19.44%) Health insurance (16.67%) Cooking fuel (16.67%)
	Rural	Toilet (22.43%) Income (21.65%) Cooking fuel (14.26%)	Toilet (22.18%) Highest level of education (15.18%) Cooking Fuel (14.98%)
2011	Urban	Income (21.25%) Toilet (20.00%) Health insurance (15%)	Toilet (23.26%) Income (16.28%) Highest level of education (16.28%)
	Rural	Income (22.00%) Toilet (21.84%) Highest level of education (15.21%)	Toilet (21.97%) Highest level of education (16.41%) Cooking fuel (15.91%)

[a]For the $1.90 poverty line the factors did not change

Although this is still an issue that is widely debated, most official reports and academic studies propose that rapid and steady economic growth, especially in rural areas, is the primary factor in reducing income poverty in China. Abolishing the agricultural tax, giving subsidies directly to grain growers for purchasing fine seeds and agricultural supplies are welcome policies that were implemented to promote agricultural production and raise rural income, which would also be expected to reduce vulnerability. Moreover, rural–urban migration and urbanization also improve rural income. All such strategies would benefit the rural population and help to narrow the rural–urban income gap. However, when accounting for vulnerability, it is observed that deprivation in income is increasing. In light of this, assessing vulnerable households and providing assistance to them should be a main focus for policymakers.

The New Cooperative Medical Care System was put in place to solve difficulties related to the rural population's high medical expenses. But issues such as low reimbursement rates and disparities in utilization between rich and poor households (Herd 2013; Zhu 2012) have hindered improvements. Our regression results identify health as having a significant

poverty-reducing effect. Thus, quality of provision and reasonable reimbursement for health care facilities could be the key to reducing vulnerability in the rural poor. On the other hand, the urban health insurance system is still underdeveloped. Firstly, although in 2007 the Basic Medical Insurance System was introduced to cover all types of urban residents, rural migrants to urban areas were not included. Secondly, the Basic Medical Insurance System is not universal in urban areas. Most employees of the government and public institutions were not a part of the system, but still enjoyed free medical care until 2010. Although these groups have become part of the Medical Insurance System since 2012, there are still differences in cover between employees of the government and public institutions, and other urban residents. As a result, the coverage of health insurance is narrow in urban areas. Establishing a universal health insurance system in order to improve coverage is another policy prescription to address the challenges of poverty reduction.[32]

The generally lower living standards in rural groups, especially the lack of improved toilets, contribute even more to rural multidimensional poverty. Since urban infrastructures are much better than those of rural areas, the government has tried to improve rural infrastructures, and in 2009, the Ministry of Health published the "Management of Improvement of Toilet in rural areas". Moreover, the government gives subsidies to households to improve their toilet facilities. In fact, construction of infrastructure in rural areas for the provision of energy, information and communication technologies, transport, as well as water and sanitation is of critical importance to growth and poverty alleviation and for narrowing the rural–urban gap.

Our findings indicate that the contribution of education to both rural and urban poverty in China is substantial. Although the 9-year compulsory education policy was established in 1986, it is still weak, particularly in rural areas. The long-term influence of education on poverty, although lower than that of health, is significant and higher for the rural population. In view of that, the government should consider providing quality education that is appropriate for multiple jobs. In urban areas development of a trained workforce is also necessary. Thus, besides compulsory education, vocational education will enhance both rural and urban human capital in two ways: training the labour force, and educating new entrants to a different kind of labour market (for example, the migrants in the cities)—thus providing higher quality skills and strong business capabilities. Despite earnest efforts made in this regard, there are disparities in the quantity and quality of education between urban and rural regions. One possible reason for this gap in educational outcomes is the decentralized fiscal system; thus, instead of a county-based funding and management structure, which is unable to provide adequate funds, a much wider centralised system for disbursing educational funds to both rural and urban regions could be an option to reduce poverty.

The Chinese government started its new anti-poverty strategy in 2014, which specifically targeted poverty alleviation. Under this program, all levels of government take targeted measures to help people lift themselves out of poverty. The approach includes accurate identification of poor households, accurate aid and efficient management. Five major ways to help the poor have been introduced: through industrialization and employment, relocation, ecological compensation, education and the social security system (*Dibao*). Our results suggest that the strategies are on the right track for ameliorating poverty and reducing the rural–urban disparity, but there is a need for further review of health insurance and quality of education issues. Availability of more comprehensive information related to

[32] Yu (2013) observed a sharp reduction of the contribution of health insurance in both rural and urban China in 2009; however, our results show a much smaller reduction.

health issues will also be helpful in the research of multidimensional poverty. Government initiative in this regard is necessary.

Appendix

See Tables 10 and 11.

Table 10 The raw headcount ratio of income (%)

Years	2000	2004	2006	2009	2011
$1.25 poverty line adjusted for General CPI					
Urban	12.49	12.57	10.89	7.76	8.94
Rural	25.19	21.86	20.32	11.25	11.67
National	21.15	18.90	17.29	10.13	10.79
$1.9 poverty line adjusted for General CPI					
Urban	21.23	18.89	17.48	11.00	11.18
Rural	39.31	32.97	32.68	18.31	17.16
National	33.55	28.49	27.80	15.97	15.23
$1.51 poverty line adjusted for General CPI					
Urban	15.82	15.12	13.63	9.49	9.52
Rural	30.87	26.64	25.99	14.20	13.93
National	26.08	22.98	22.02	12.69	12.51
$1.51 poverty line adjusted for Food CPI					
Urban	15.82	16.85	14.81	11.50	12.04
Rural	30.87	28.61	28.72	18.86	19.42
National	26.08	24.87	24.26	16.50	17.04
Vulnerability-adjusted poverty line using General CPI					
Urban	18.40	20.84	29.04	24.16	23.22
Rural	34.41	37.61	48.76	41.05	38.40
National	29.31	32.27	42.43	35.63	33.50
Vulnerability-adjusted poverty line using Food CPI					
Urban	18.40	22.95	31.78	34.29	34.25
Rural	34.41	40.18	52.61	51.24	52.61
National	29.31	34.69	45.92	45.80	46.69
Effect of vulnerability					
Urban	2.58	6.10	16.97	22.79	22.21
Rural	3.54	11.57	23.89	32.38	33.19
Rural–urban difference	0.96	5.47	6.92	9.59	10.98
Effect of food price					
Urban	0.00	2.11	2.74	10.13	11.03
Rural	0.00	2.57	3.85	10.19	14.21
Rural–urban difference	0.00	0.46	1.11	0.06	3.18

Table 11 The logit regression result using interaction terms

Variable	Model III						Model IV					
	Urban			Rural			Urban			Rural		
	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio
Mild poverty (k=0.2)												
Income per capita	−3.61***	0.78	0.03	−1.94***	0.51	0.14	−0.95***	0.13	0.39	−1.27***	0.09	0.28
Education of head	−0.35***	0.04	0.7	−0.37***	0.04	0.69	−0.34***	0.04	0.71	−0.37***	0.04	0.69
Health of head	−22.81***	7.1	0.00	−8.32*	4.71	0.00	−2.68***	0.34	0.07	−2.95***	0.33	0.05
Education of other member	−0.28***	0.05	0.76	−0.46***	0.04	0.63	1.62***	0.49	5.05	0.00	0.42	1.00
Health of other member	−2.46***	0.26	0.09	−1.85***	0.22	0.16	−2.54***	0.26	0.08	−1.87***	0.23	0.15
Household size	0.71***	0.21	2.03	0.38***	0.12	1.46	0.71**	0.21	2.03	0.38***	0.12	1.46
Household size square	−0.05**	0.03	0.95	−0.02*	0.01	0.98	−0.05*	0.03	0.95	−0.02**	0.01	0.98
Wave 2000	0.76***	0.15	2.14	1.69***	0.11	5.42	0.74***	0.15	2.10	1.69***	0.11	5.42
Wave 2004	0.74***	0.14	2.10	1.50***	0.11	4.48	0.74***	0.14	2.10	1.51***	0.11	4.53
Wave 2006	1.07***	0.14	2.92	0.96***	0.10	2.61	1.06***	0.14	2.89	0.97***	0.10	2.64
Wave 2009	0.00	(omitted)		0.00	(omitted)		0.00	(omitted)		0.00	(omitted)	
Income*Education of other member							−0.22***	0.06	0.80	−0.05	0.05	0.95
Income*Health of other member	2.24***	0.78	9.39	0.59	0.51	1.80						
Constant	35.66***	7.12	3.07E+15	22.27***	4.71	4.70E+09	11.93***	1.29	1.52E+05	16.25***	0.95	1.14E+07
Wald chi2(8)	560.85			1100.07			555.71			1105.78		
Prob>chi2	0.00			0.00			0.00			0.00		
Moderate poverty (k=0.4)												
Income per capita	−0.19	0.13	0.83	−0.65***	0.15	0.52	−0.25***	0.09	0.78	−0.49***	0.05	0.61
Education of head	−0.73***	0.12	0.48	−0.50***	0.05	0.61	−0.72***	0.12	0.49	−0.50***	0.05	0.61
Health of head	−0.62	1.17	0.54	−3.77***	1.21	0.02	−2.05***	0.45	0.13	−2.09***	0.18	0.12
Education of other member	−0.79***	0.12	0.45	−0.79***	0.05	0.45	−0.30	0.35	0.74	−0.99***	0.23	0.37

Table 11 (continued)

Variable	Model III						Model IV					
	Urban			Rural			Urban			Rural		
	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio
Health of other member	−1.84***	0.42	0.16	−1.63***	0.16	0.2	−1.78***	0.42	0.17	−1.63***	0.16	0.20
Household size	0.81**	0.39	2.25	0.65***	0.13	1.92	0.81**	0.38	2.25	0.65***	0.13	1.92
Household size square	−0.06	0.04	0.94	−0.04***	0.01	0.96	−0.06	0.04	0.94	−0.04***	0.01	0.96
Wave 2000	2.28***	0.40	9.78	3.09***	0.15	21.98	2.27***	0.4	9.68	3.09***	0.15	21.98
Wave 2004	2.20***	0.39	9.03	2.80***	0.14	16.44	2.19***	0.39	8.94	2.80***	0.14	16.44
Wave 2006	1.62***	0.40	5.05	1.96***	0.14	7.10	1.57***	0.40	4.81	1.96***	0.14	7.10
Wave 2009	0.00	(omitted)		0.00	(omitted)		0.00	(omitted)		0.00	(omitted)	
Income*Education of other member							−0.06	0.04	0.94	0.03	0.03	1.03
Income*Health of other member	−0.18	0.14	0.84	0.21	0.15	1.23						
Constant	−0.14	1.33	0.87	4.68***	1.23	107.77	0.28	1.14	1.32	3.37***	0.53	29.08
Wald chi2(8)	124.95			911.22			126.63			913.69		
Prob>chi2	0.00			0.00			0.00			0.00		

Variable	Model V					
	Urban			Rural		
	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio
Mild poverty (k=0.2)						
Income per capita	−1.33***	0.37	0.26	−1.64***	0.3	0.19
Education of head	−0.35***	0.04	0.7	−0.37***	0.04	0.69
Health of head	−2.59***	0.33	0.08	−2.94***	0.33	0.05

Table 11 (continued)

Variable	Model V					
	Urban			Rural		
	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio
Education of other member	−0.29***	0.05	0.75	−0.46***	0.04	0.63
Health of other member	−1.74	3.44	0.18	−4.54*	2.73	0.01
Household size	0.71***	0.21	2.03	0.38***	0.12	1.46
Household size square	−0.05**	0.03	0.95	−0.02*	0.01	0.98
Wave 2000	0.76***	0.14	2.14	1.69***	0.11	5.42
Wave 2004	0.73***	0.14	2.08	1.50***	0.11	4.48
Wave 2006	1.06***	0.14	2.89	0.97***	0.1	2.64
Wave 2009	0.00	(omitted)		0.00	(omitted)	
Income*Education of other member						
Income*Health of other member	−0.08	0.38	0.92	0.30	0.3	1.35
Constant	15.01***	3.45	3.30E+06	19.56***	2.75	3.12E+08
Wald chi2(8)	569.14			1104.03		
Prob>chi2	0.00			0.00		
Moderate poverty (k=0.4)						
Income per capita	−0.28*	0.14	0.76	−0.98***	0.18	0.38
Education of head	−0.73***	0.12	0.48	−0.50***	0.05	0.61
Health of head	−2.01***	0.45	0.13	−2.09***	0.18	0.12
Education of other member	−0.78***	0.12	0.46	−0.78***	0.05	0.46
Health of other member	−1.19	1.26	0.3	−6.11***	1.48	0.00
Household size	0.81**	0.38	2.25	0.66***	0.13	1.93
Household size square	−0.06***	0.04	0.94	−0.04***	0.01	0.96
Wave 2000	2.27***	0.4	9.68	3.09***	0.15	21.98
Wave 2004	2.21***	0.39	9.12	2.79***	0.14	16.28

Table 11 (continued)

Variable	Model V					
	Urban			Rural		
	Coef.	SE	Odd ratio	Coef.	SE	Odd ratio
Wave 2006	1.62***	0.4	5.05	1.96***	0.14	7.1
Wave 2009	0.00	(omitted)		0.00	(omitted)	
Income*Education of other member						
Income*Health of other member	−0.08	0.15	0.92	0.55***	0.18	1.73
Constant	0.50	1.42	1.65	7.40***	1.49	1640.39
Wald chi2(8)	126.86			913.88		
Prob > chi2	0.00			0.00		

(1) The variable Wave 2009 is omitted because of collinearity. (2) ***, ** and * denotes significances at 1%, 5% and 10% levels respectively

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