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Measuring Rural Poverty in China: A Case Study Approach

Xiuqing WANG
Shujie YAO
Juan LIU
Xian XIN
Xiumei LIU
Wenjuan REN

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Xiuqing WANG (wangxq@cau.edu.cn)

College of Economics and Management, China Agricultural University

Shujie YAO (s.yao@mdx.ac.uk)

Middlesex University, London,

Juan LIU (jollyliu@126.com)

College of Economics and Management, China Agricultural University

Xian XIN (xinxian@cau.edu.cn)

College of Economics and Management, China Agricultural University

Xiumei LIU(liuxiumeinm@126.com)

College of Economics and Management, Inner Mongolia Agricultural University

Wenjuan REN(rwjwenjuan@sohu.com)

College of Economics and Management, China Agricultural University

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Abstract:

This paper measures rural poverty in Hubei Province and Inner Mongolia in China. The poverty lines we derived by Ravallion's method differ from the Chinese official poverty lines. The official pan-country poverty line underestimates rural poverty in Hubei Province and overestimates rural poverty in Inner Mongolia.

Poverty determinants are estimated by Logit model. Locating at a mountainous area, lack of better irrigation conditions, with big family size, few fixed assets, low per capita land, or make a living only on agriculture would make a rural household easy to fall into poverty. A rural household having students in senior high school or above would uneasy to fall into poverty. It is also found that the alms received by a household show no significant impact on poverty. This implies that the current poverty program does not target well on the poor.

The growth-redistribution decomposition reveals that for all the three FGT indexes in Hubei province, income growth devoted much to the alleviation of poverty, while the redistribution or inequality effects counteracted the growth effects and aid on the poverty formation. The poverty incidence decomposition results reveal that about one third of the growth effects had been counteracted by the redistribution effects. This implies that future anti-poverty program should pay much attention on how to solve the inequality problem in China.

Poverty dominance analysis also helps us better understand the poverty situation. It reveals that rural poverty in Inner Mongolia is more severe than that in Hubei, and the poverty in Hubei has been lessened in the period of 1997 to 2003, the same findings as those drawn from deriving poverty lines.

Keywords: Rural Poverty Line, Poverty Determinants,
Growth Redistribution Decomposition, Poverty Dominance, China

JEL classification: I32; D33; C43

Measuring Rural Poverty in China: A Case Study Approach

1. Introduction:

The most basic issue of poverty study is the measurement of poverty. This is also true in China. Fast economic growth in the last quarter century has improved people's living standards significantly. Per capita GDP rose over six folds and per capita rural income more than quadrupled. There is no doubt that poverty in china must have declined substantially as a result of rising average income. However, the exact extent of rural poverty is highly debatable, depending on which poverty line is used for measurement.

Currently there are three main sources of poverty lines to measure rural poverty for China. The first one is the standard international poverty line of $1/day (in 1990 prices) per person recommended by the World Bank. The second one is the official poverty line defined by the Chinese government at 637yuan/year (at current 2003 prices) per person. The third one is provided by a number of independent researchers. Table 1 lists a few estimates of poverty incidence for rural China in some selected years.

Table 1 Comparisons of alternative estimates of rural poverty in China Yuan/year

	Poverty line	Number of poor (million)	As % of Rural People	Poverty line (base on 1995)
A. World Bank (2004 for 2000)	1698	361	38.8	1440
B. Chinese official (2003)	637	30	3.2	530
Chinese official (1995)	530	61	7.1	530
C. Independent researchers				
1. Khan (1999 for 1995)	1157	240	28.6	1157
2. Yao (2004 for 1998)	877	187	20.1	732

Source: World Bank (2004); New Beijing Daily, 2004(for official estimate in 2003); Khan, 1999 (Khan's own estimate and the official estimate for 1995); Yao (2004), Table 9.12.

The official estimates are substantially lower than any of all the other estimates, primarily due to the use of a much lower poverty line. The government acknowledged that apart from the 30 million absolute poor in 2003, there were another 60 million low-income rural people

(882yuan/y.p.a.) who were highly vulnerable to poverty (New Beijing Daily, 2004). The estimate by the World Bank is substantially higher than both the official and independent estimates because they use an arbitrary international poverty line without considering the actual purchasing power of $1/day in rural China. The estimates by Khan (1999) and Yao (2004) are both based on the international poverty line adjusted by the actual purchasing power of $1/day in rural China. As a result, their estimates are significantly lower than that by the World Bank, but still substantially higher than the official figures.

Purchasing power should also be considered in poverty measurement.. But the estimates in Table 1 are subject to a common important drawback because they use the same poverty line for the whole country. Poverty incidence must have been underestimated in the rich provinces and overestimated in the poor regions because the prices of food and other daily necessities are usually positively related with per capita incomes.

Literature of poverty measurement has evolved into two closely connected but distinct branches: poverty measures and poverty orderings. The first branch is based on poverty line, and the other is ranked without poverty line. But in China, few researches concerns about poverty orderings. Based on the above discussion, there are a few important questions that need to be answered.

1) What is the real poverty situation in rural China?
2) How does the poverty estimates different in poverty lines?
3) What are the main determinants of rural poverty?
4) How can poverty index be decomposed into its income growth and redistribution components?
5) How to compare poverty distribution without knowing an exact poverty line?
6) What are the implications to the anti-poverty policy?

The objective of this research is to find answers to these questions through a systematic study using household data from Hubei and Inner Mongolia. The context is as follows: Section 1 is an introduction about the background. Section 2 provides literature review. Section 3 outlines the methodologies. Section 4 presents the results and Section 5 summarizes the main findings.

2. Literature review

Up till now, most of the rural poverty studies in China are done at given poverty line. Based on the National Bureau of Statistics (NBS) rural household survey data of four southern provinces, Guangdong, Guangxi, Yunnan, and Guizhou, over 1985-1990, Jalan and Ravallion (1998a) assess the impact of China's poor-area development programmes. They find that households in the targeted poor areas have significant higher rates of consumption growth than one would have expected, though still not enough to reverse their longer-term divergence from other areas. Without controlling for spatial externalities, the growth process entails a sizable underestimation of the welfare gain from the programme. Jalan and Ravallion (1998b, 2000) further investigate the issue of transient poverty in rural China. They find considerable transient poverty. One-half of the mean squared poverty gap and over one-third of the mean poverty gap is accounted for by year-to-year fluctuations in consumption.

Based on the assumption of subsistence intake and income data from NBS, the World Bank (1997) and Yao (2000) conclude that poverty declined sharply during 1978-1985 but the incidence of poverty hardly changed and became sensitive as to how incomes were estimated in the following decade. Riskin (1994), Gustafsson and Li (1998), Riskin and Li (2001), Gusstafsson and Wei (2000) use rural household income survey data from the China Household Income Project carried out by a Sino-US team of social scientists in 1988 and 1995 and confirm the above-mentioned trend of change. However, different authors have come to very different conclusions. The World Bank (1997) says ‘most of China's remaining absolute poverty is now concentrated in a number of resource-poor rural areas, primarily in the northern, northwestern, and southwestern provinces. In contrast, Riskin (1994) says ‘a new, individualized kind of poverty may be developing within the core regions of agricultural China’. He continues ‘government anti-poverty efforts are regionally defined. If the findings presented are accurate, most rural poor reside outside officially designated poor regions and anti-poverty measures do not reach most of them’. Riskin’s view is shared by some more recent studies with more

comprehensive data (Ravallion and Jalan, 1999; Khan and Riskin, 2001; Stiglitz, 2002; Yao, Zhang and Hanmer, 2004).

Rozelle, Park, Benziger, and Ren (1998) employed county-level data to examine the sources and the effectiveness of targeted poverty investments in 43 poor counties of Shaanxi Province during the years 1986-91. According to their results, targeted investment funds allocated directly to households for agricultural activity has a significant and positive effect on growth, while investments in township and village enterprises or county state-owned enterprises do not have a discernible effect on growth. Investments in agricultural infrastructure do not positively affect growth rates in agricultural output, suggesting that other types of basic investments (e.g. roads and education) should receive higher priority. Much research is about effect of anti-poverty program of China too, such as Zhu and Jiang (1995) study the effects of food-for-work program, and Park and Wang (2001) employed the efficiency of three anti-poverty program.

In addition, Chen and Ravallion (2002) analyzed the income distribution and poverty reduction after Chin's accession into the WTO. It is concluded in this paper that most of the urban poor would gain from China's entering the WTO, but the rural poor may have to face sharp decrease of living quality. Rozelle, Zhang and Huang (2000) studied the reasons of rural poverty rate decreasing. They analyzed some data from Sichuan and Shannxi econometrically and found that most of the changes of rural poverty rate could be explained by economic growth. Tian, Wang and Ke (2003) analyzed the role of agriculture in poverty alleviation. They concluded that as the main income source and employment route of the rural poor, agriculture sector plays important role in poverty reduction in rural China, and the role of agricultural growth on urban poverty reduction is indirect and effective. Yue (2005) adopted the data set of Poverty Monitoring Survey (PMS) to calculate transient poverty and chronic poverty in rural poor, and estimate the causes of transient poverty.

Available studies on poverty in China provide useful insights for this proposed research, but the most of them are based on given poverty line, and only few studies have attempted to derive poverty lines using raw data. Chen and Ravallion (1996) derived provincial poverty lines for 4

southern provinces, but on unit prices. Khan (1999) derived rural poverty line based on a survey conducted in 1995, but his calculated poverty line is not relevant and comparable with the current official poverty line, and he only estimates one single poverty line for the whole country. Both Khan (1999) and Yao(2004) derived rural poverty line are based on he international poverty line adjusted by actual purchasing power of $1/day in rural China.

Martin Ravallion (1994) put forward a method to set poverty lines in developing country setting, using the data that are typically available from a household survey. The poverty line be regarded as two components: a food poverty, giving the allowance for 'basic foods', and an allowance for 'basic non-food goods'. But in China, few researches derived the actual rural poverty line by Martin's method.

The above review on existing literature reveals some significant knowledge gaps for understanding rural poverty in China. The main gaps are identified below:

1) Most of the researches are based on World Bank or Official poverty lines, though the official pan-country poverty line may be far too low.
2) No up-to-day poverty lines that can closely relate to the current living standards and prices.
3) No regional-specific poverty lines based on regional prices.
4) Few studies on China to decompose poverty into income change and distribution change.
5) Few studies on China to compare poverty distributions based on poverty dominance theory

The rural household survey data conducted by NBS at the provincial level will provide useful information to enable us to answer these questions. This research project is so designed that it will be able to close the knowledge gaps mentioned above.

3. Methodologies

3.1 Data sources and software

This research uses the rural household surveys in Hubei province and Inner Mongolia. Hubei is a middle income province whose average per capita net income in 2003 (2566 Yuan) is close to the level of China (2622Yuan), while Inner Mongolia is a low one (2268 Yuan). Due to the difficulty to obtain data, we only can utilize the data of Inner Mongolia for the 2002 and of Hubei province for 1997, 2002 and 2003. The data are processed with STATA and DAD software.

In order to get deep insight into the poverty variation over time for different regions, Hubei is also divided into the developed and less undeveloped regions by the economic geography. According to the administrative regionalism, Hubei is divided into twelve cities and one self-governing state. In the rural household survey, the developed (red region in Figure 1) covers Wuhan, Xiaogan, Jingmen, Jingzhou and Yichang, while the less developed (multicolour region in Figure 1) covers Huangshi, Huanggang, Xiangfan, Xianning,Yunyang and Enshi.

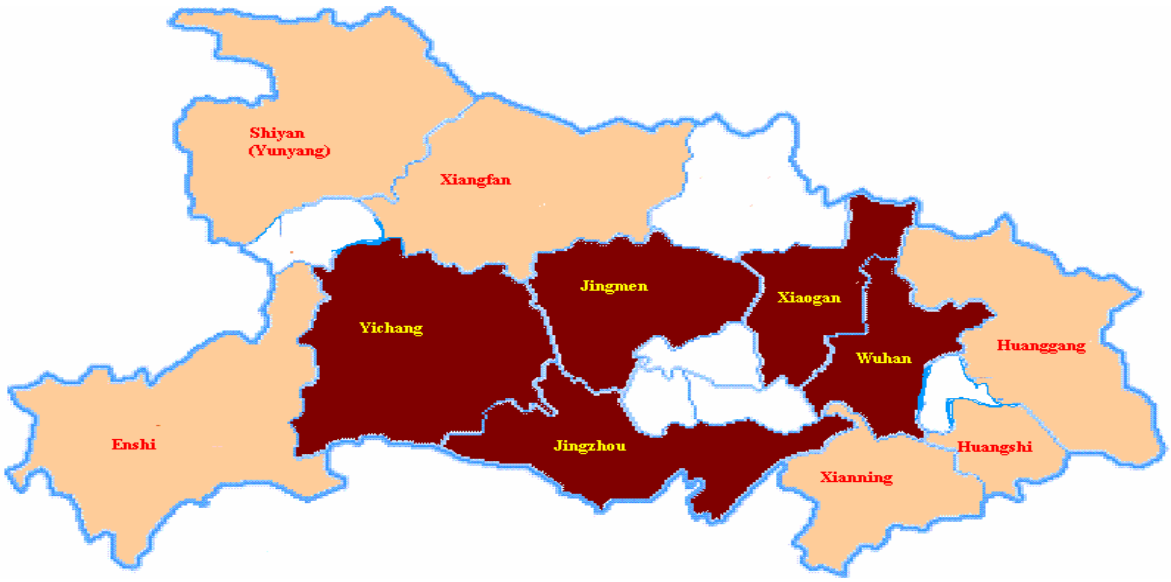

Figure 1 The map of Hubei province and region division

3.2Parametric and nonparametric analysis

3.2.1 Deriving the rural poverty line

The first step is to derive the food poverty line, which is defined as the cost to secure a minimum calorie intake for one adult per day. According to the international standards, an intake of 2,100 calories per day per person will be used. All the sample households will be ranked according to their mean net incomes and divided into two groups. The low-income group will be selected to derive the structure of their food consumption. This is because the consumption pattern of the low-income group should be close to what the poor might choose to follow (Deaton, 1997). The main food items will be treated as the actual food bundle for the low-income group. For each of the food items, their respective calorie equivalent can be found from the National Nutritional Institute. Once the food bundle is converted into calorie equivalents, it is possible to derive the equivalent physical bundle of food that can produce 2100 calorie. From the price information, the value of this food bundle will be calculated as food poverty line, denoted by Z_F.

The second step is to set basic non-food consumption. The definition of non-food spending can be implemented with available data. Assuming that food spending increases with total spending, with a slope less than unity, and decreasing as total spending increases, see figure 2, being a regression line, and it gives the expected value of food spending at any given value of total spending. Z_F is the food poverty line. Amongst those households who can afford to reach their nutritional requirement, and the lowest level of non-food spending is given by the distance NF, all of which displaces basic food spending. And Z_L can be obtained by Z_F combining with NF, and it is named as low poverty line (Ravallion, 1994). On the other side, we have an alternative approach to find some households whose non-food spending just reach the food poverty line, namely, they just can afford to the basic food goods, and not need to sacrifice some food to obtain non-food. To those households, the non-food spending is N_1F_1 in figure 2, and Z_F together with N_1F_1 is Z_U, named as high poverty line.

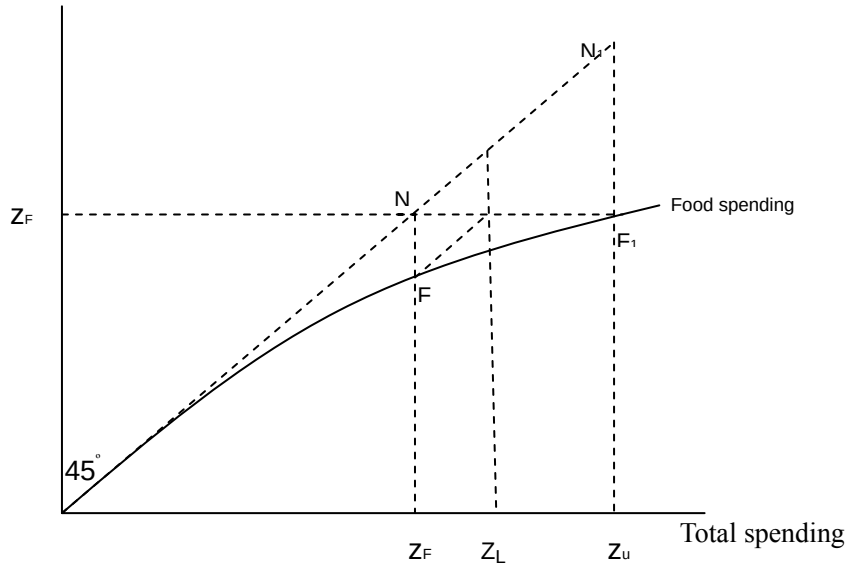

Figure2 Spending curve in a household

To derive the poverty line, one can follow Ravallion's (1994) approach to run the following regression:

$$s_i = \alpha + \beta \ln(\frac{X_i}{Z_F}) + \gamma \ln(n_i) \qquad (1)$$

Where subscript *i* denotes household, *S* is the share of food expenditure in total expenditure, *X* is total expenditure per capita, *n* is the number of household members. Once the parameters in equation (1) are estimated, the lower and higher poverty lines can be evaluated by the following formulae (see Ravallion, 1994, for a detailed explanation of lower and higher poverty lines).

The lower line (denoted by Z_L) is: $Z_L = Z_F(2 - \alpha - \gamma \ln(n))$

The higher line (denoted by Z_U) is: $Z_U = Z_F(1+\beta)/(\alpha + \gamma \ln(n) + \beta)$

In both cases, it is necessary to specify the household size in order to determine the "basic non-food expenditure" per person. Just as the food poverty line is set with reference to the calorie requirement for an average person, the "basic non-food expenditure" is determined with reference to an average family size.

3.2.2 Identify the main determinants of poverty

At the household level, the probability of a household falling into poverty can be estimated in a logit model, which estimates the odds of a household falling into poverty as a function of a set of

household level variables (*Hi*) such as family size and structure, per capita land and capital, education indicators, business types, and a set of village feature variables (*Ci*) such as terrain, irrigation rate, distance to the nearest town, nationality etc. The logistic model can be presented in equation (2): *Ln (p/1-p) =F (Ci, Hi)*, Where p is the probability that a household falling into poverty.

3.2.3 Growth-redistribution decomposition of poverty variation

It is assumed that two counteractive forces mainly determine poverty at the aggregate regional level: change in mean income and change in distribution. If distribution is held unchanged, a rise in mean income will quickly lead to a reduction in poverty. If rising income is accompanied with rising inequality, poverty reduction will be slow, as it has been the case in China. The interactive effects of rising income and inequality on poverty reduction can be illustrated in Figure3.

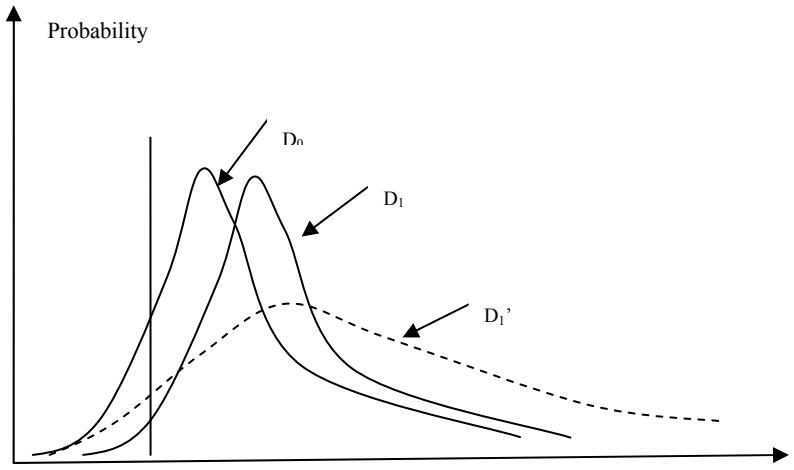

Figure3 The interface of poverty, income growth and inequality

Initially, the distribution is denoted by D_0. If this distribution remains unchanged as mean income rises, the distribution curve shifts to the right and is denoted by D_1. The incidence of poverty is reduced from the area on the left-hand side of the poverty line underneath D_0, to the area on the left-hand side of the poverty line underneath D_1. However, if the distribution curve changes from D_0 to D_1', rather than to D_1, the new poverty incidence will be the area on the left-hand-side of the poverty line underneath D_1'.

Income growth tends to have a pull effect but the worsening of income distribution a push effect on poverty. In rural China, although per capita incomes have risen but income inequality has also increased. The changes of poverty over time, across regions and between different sup-groups can be explained by two main components: income growth and redistribution. The decomposition method discussed by Duclos and Araar (2003) can be used for this purpose. The easiest decomposition approach is to use the normalized FGT (Foster, Greer and Thorbecke, 1984) indices $\overline{P}(z;\alpha)=\int_0^1(\frac{g(p;z)}{z})^{\alpha}dp$, where z is poverty line ，$\alpha\geq 0$ is an ethical parameter, p is the proportion of population and $g(z,p)$ is the poverty gap. Datt and Ravallion (1992) uses the initial distribution A as a reference 'anchor point' for the assessment of the impact of mean-income and distribution on poverty. The change in poverty between two distributions A and B can be expressed as the sum of a growth (change in mean income) effect and of a distribution (change in inequality) effect, plus a residual term. An alternative way uses the posterior distribution B as the reference distribution for assessing the growth and redistribution effects.

Clearly, an appropriate way between these two alternative decomposition methodologies is to measure the growth effect as the average of the two growth effects, and likewise to measure the redistribution effect as the average of the two redistribution effects. The advantage of this is that the error term can be eliminated, as the error terms of each of the two alternative decompositions sum to zero. This method is in fact what would be given by the use of the Shapley value to perform growth-redistribution decomposition. The decomposition can be shown in equation (3) , where μ is population mean income, z and α are defined above (Duclos and Araar, 2005).

$$\begin{aligned}&\overline{p}_B(z;\alpha)-\overline{p}_A(z;\alpha)\\&=\frac{1}{2}\underbrace{\left((\overline{p}_A(\frac{z\mu_A}{\mu_B};\alpha)-\overline{p}_A(z;\alpha))+(\overline{p}_B(z;\alpha)-\overline{p}_B(\frac{z\mu_B}{\mu_A};\alpha))\right)}_{\text{Shaplay growth effect}}\\&+\frac{1}{2}\underbrace{\left((\overline{p}_B(\frac{z\mu_B}{\mu_A};\alpha)-\overline{p}_A(z;\alpha))+(\overline{p}_B(z;\alpha)-\overline{p}_A(\frac{z\mu_A}{\mu_B};\alpha))\right)}_{\text{Shapley redistribution effect}}\end{aligned}\qquad(3)$$

3.2.4 Calculation and decomposition of the Gini index

This is to derive the inequality index so that inter-regional inequality and group inequality can be identified. It is useful to understand the causes of poverty. The Gini coefficient (G) can be decomposed into three components: inter-group, intra-group and overlapped. The decomposition can follow the four-step approach proposed by Yao (1999).

Step 1: Calculating the Gini coefficient according to equation (4)

$$G = 1 - \sum_{i=1}^{n} p_i (2Q_i - w_i) \qquad (4)$$

$$Q_i = \sum_{k=1}^{i} w_i, \text{cumulative income share up to i.}$$

Where G denote the Gini coefficient for the population where each household is ranked by per capita income (m_i, i = 1, 2... n) in an ascending order. p_i and w_i are respectively the population and income share of the *i*th household. n is the number of households.

Step 2: If the sample is divided into S groups, the inter-group component, denoted by G_B can be derived from equation (5).

$$G_B = 1 - \sum_{I=1}^{S} p_I (2Q_I - w_I) \qquad (5)$$

$$Q_I = \sum_{K=1}^{I} w_K, \quad \text{cumulative income share up to I}$$

Where p_I and w_I denote respectively the population and income shares of the *I*th group (I = 1, 2, ..., S) in the population. The explanation for equation (5) is akin to that for equation (4). The only difference is the definitions of p_I and w_I. To derive G_B, all the elements in equation (5) must be sorted in an ascending order of class mean incomes m_I, such that $m_1 \leq m_2 \leq ... \leq m_S$.

Step 3: The intra-group component, denoted by G_A, can be derived from equation (6).

$$G_A = \sum_{I=1}^{S} w_I p_I G_I \qquad (6)$$

As defined above, w_I and p_I are respectively the income and population shares of class I in the

total population. G_I is the Gini coefficient for the *I*th sub-population. There are S Gini coefficients for S classes. The equation for G_I looks identical to equation (4) except that the calculation is now focused on a particular sub-population.

Step 4: The overlapped component G_O can be calculated based on equation (7).

$$G_O = G - G_A - G_B \qquad (7)$$

3.2.5 Poverty dominance analysis

Following Duclos and Araar (2003), we will also attempt to conduct analysis on poverty dominance. This is particularly useful if we want to examine whether poverty increases over a particular time period, or whether the poverty situation in one region is worse than in another. Poverty dominance analysis is an application of stochastic dominance to distributions of households' income. Stochastic dominance has much application in economics; however, it is also useful in income distribution and poverty analysis.

Comparison of two poverty distributions, denoted by A and B can be expressed below:

$$\Delta P(Z) = P_A(Z) - P_B(Z) = \int_0^1 [\pi(Q_A(p); Z) - \pi(Q_B(p); Z)]dp = \int_0^z \pi(y; Z)\Delta f(y)dy \quad (9)$$

where P(z) denotes poverty indexes, *Q(p)* the contribution of individuals to overall poverty, *z* an artificially defined poverty line, *p* population distribution, *y* per capital income (or consumption), $\pi(Q(p), z)$ population poverty density function, $\pi(y; z)$ income poverty density function, $\Delta f(y)$ the difference in the densities of income (Duclos and Araar, 2003, p118). To check whether the above difference in poverty indices is positive will involve the use of stochastic dominance curves $D^s(z)$, for orders of dominance $s = 1, 2, 3....$ $D^1(z)$ is simply the proportion of individuals underneath the poverty line z. The higher order curves are iteratively defined as

$$D^S(Z) = \int_0^s D^{S-1}(y)dy \qquad (10)$$

For the popular FGT poverty indices, it becomes $D^s(Z) = \frac{1}{(s-1)!}P(z; \alpha = s-1)$. Hence, the dominance curve of order 1 is simply the headcount index of poverty for different poverty lines

The s^{th} order poverty dominance test can be carried out on the following general formulation:

$$P_A(Z) - P_B(Z) \geq 0 \text{ for all } P(Z) \in \prod^S (Z^+) \text{ iff } D_A^S(y) \geq D_B^S(y) \text{ for all } y \in [0, z^+] \quad (11)$$

An important character of poverty ordering is s-order stochastic dominance implies (s+1)-order stochastic, but not vice versa. And in principle it is possible to examine higher orders of dominance comparison but in practice it is rare to go beyond third order. To compare the poverty of two income distributions, we can use first-order poverty dominance $(FGT,\ \alpha=0)$ firstly, in this case the cumulative density function (CDF) is referred to as Poverty Incidence Curves (PIC), see Figure4.

If the first-order poverty dominance curves of the two distributions have crossing(s), see figure 5, we should use the second-order poverty dominance $(FGT,\ \alpha=1)$, and in this case the cumulative density function (CDF) is referred to as Poverty Deficit Curves (PDC). In figure6, A in vertical coordinate denotes the area of $0ZG_1$ in figure4, namely it is the area under poverty incidence curve.

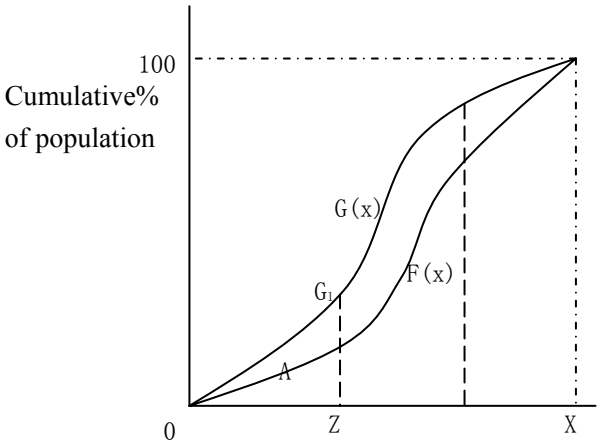

Figure4 First-order Poverty Dominance

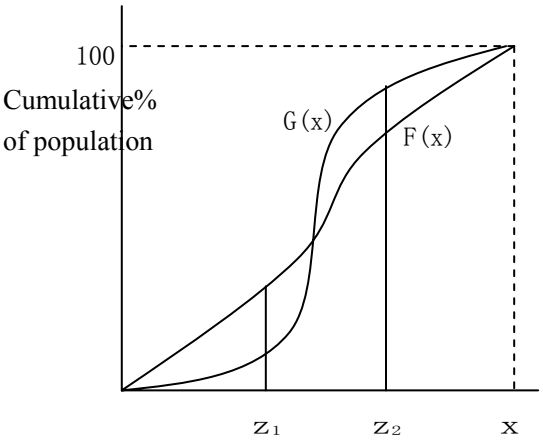

Figure 5 Crossing of PIC

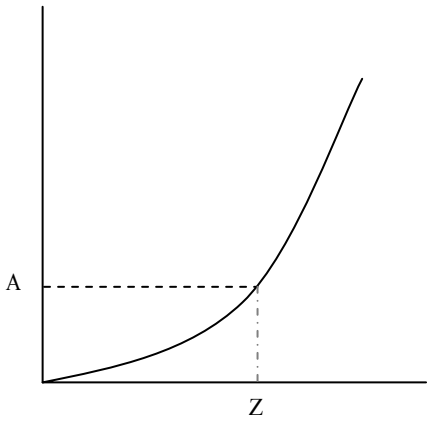

Figure6 Poverty Deficit Curve

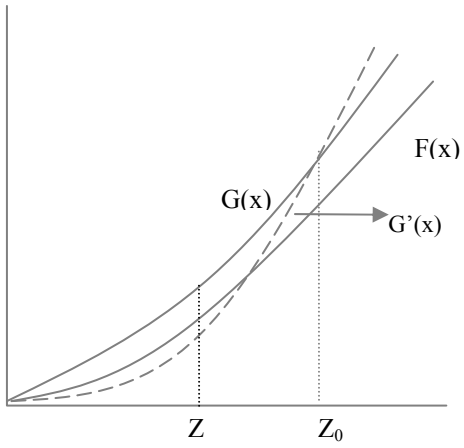

Figure7 Second-order Poverty Dominance

As the principle above, if the second-order poverty dominance curves of the two distributions have crossing(s), we proceed to the third-order poverty dominance $(FGT,\ \alpha=2)$, and the CDF is referred to as Poverty Severity Curves. See figure 7.

As discussed above, if any given order of dominance does not hold a unanimous conclusion, we should use an alternative approach is to investigate if dominance holds over a restricted range of poverty line Z. It was Atkinson (1987) who first emphasised that in poverty analysis there is often a lower as well as upper limit for the poverty line and it may turn out that the distributions do not cross between these limits, so that first-order dominance may hold for this range of income, if not for all values of z up to Z_{max}. This approach leads to another definition of stochastic dominance known as "poverty-mixed dominance". This definition is a combination of first and second-order dominance. In detail, the distribution of A displays second-order dominance over distribution B in the poverty line range of $(0, Z_{\min})$, and the first-order dominance of distribution A over that of distribution B in the poverty line range of $\left[Z_{\min}, Z_{\max}\right]$, and the distribution A have poverty-mixed dominance over distribution B.

The poverty dominance analysis can be proceeding by steps: after adjusting a proper range of poverty line $\left[Z_{\min}, Z_{\max}\right]$, we will examine whether first or second-order, third-order dominance exists over the entire range of expenditure values from zero to the upper bound estimate of the poverty line z_{max}. We also examine if first-order dominance exists between a lower bound

estimate of the poverty line z_{min}, and an upper bound estimate z_{max}, and then examine whether second-order dominance exists between zero and the lower bound estimate of the poverty line z_{min} in order to determine if "poverty-mixed dominance" occurs.

4. Rural Poverty in Hubei and Inner Mongolia

4.1 Rural Poverty Measurement

4.1.1 Deriving the rural poverty line

Ravallion's (1994) method is used here to derive the rural poverty lines of Hubei province and Inner Mongolia. In the rural household survey data of Hubei, the index setting of 2003 is more detailed than that of in 1997, especially on food purchase and consumption. So in this paper, we derive the poverty line of 2003, and then adjust it through CPI of Hubei to attain the poverty line of 1997 and 2002.

1) Food poverty line

All households in the data are ranked according to average per capita net incomes, and the poorest 30% are selected as the sample to derive poverty line, since the consumption pattern of the low-income group should be close to what the poor might choose to follow.

The second step is to calculate energy intake equivalent for each of the 30% low-income households. Then, the low-income group is further divided into three subgroups by the ranges of energy intake equivalent. The first subgroup is those households with energy intake less than 2050 (calorie per day per person), the second subgroup is those with energy intake no less than 2050 but no more than 2150, and the third subgroup is those with energy intake more than 2150.Since the second subgroup is most close to the 2100 calorie standard, it is used here to derive the food poverty line. The distribution of the 30% low-income households (H) and population (P) with respect to three energy intake ranges is given in Table 2.

Table2 Primary Energy Intake for the 30% Rural Households with the Lowest Per Capita Net Income

Year	Region	Number of Sample Households	30% Rural Households with the Lowest Per Capita Net Income							
			Sub Total		<2050		〔2050，2150〕		>2150	
			H	P	H	P	H	P	H	P
2002	Inner Mongolia	1986	596	2501	238	1094	26	107	332	1300
2003	Hubei Province	3300	990	4419	296	1457	40	186	654	2776
	Developed	1890	419	1869	133	642	17	79	269	1148
	Less Developed	1410	571	2550	163	815	23	107	385	1628

Note: H: number of households, P: number of population

Source: without special notes, the authors calculate all the tables in this paper.

The third step is to make the average consumption for each food item within the second subgroup (with 2050 to 2150 Calorie intake) as the standard food bundle. The food bundle is composed of corn, bean and leguminous product, vegetable, lipid, meat and birds, milk and its product, egg and its product, aquatic product, sugar, wine and drink, and flavouring etc. Though the flavouring cannot be transformed to energy, it is included in the food bundle, as a necessary in the household. The standard food bundles for Hubei Province (as well as it sub regions) and Inner Mongolia are shown in Table 3 and Table 4 respectively. The respective energy intake equivalents are given in Appendix Table1 and Appendix Table2.

The fourth step is to derive the food poverty line (Z_F) by valuing the food items in the standard combination through average local prices (unit value) for each food item. The derived food poverty lines are 617 Yuan/year for Hubei Province (2003) and 500 Yuan/year for Inner Mongolia (2002), as shown in Table 3 and Table 4 respectively.

Table 3 Standard Food Combination for Rural Households with (2050~2150)'s Calorie Intake in Hubei, 2003 unit: kg, Yuan/kg, Yuan

Food Items	Hubei Province (2003)			Developed Region (2003)			Less Developed Region (2003)		
	Quantity	Unit Value	Value	Quantity	Unit Value	Value	Quantity	Unit Value	Value
Wheat	0.0402	1.2094	0.0487	0.0250	1.3928	0.0348	0.0515	1.1521	0.0593
Rice	0.3521	1.0650	0.3750	0.4420	1.2882	0.5694	0.2857	0.8067	0.2304
Maize	0.0228	1.2628	0.0287	0.0087	1.1823	0.0103	0.0332	1.2781	0.0424
Other corn	0.0033	1.6492	0.0054	0.0008	1.2875	0.0010	0.0051	1.9034	0.0097
Potato	0.0122	3.9490	0.0483	0.0110	2.8859	0.0318	0.0131	6.3862	0.0839
Soybean	0.0031	3.3459	0.0103	0.0022	3.6401	0.0081	0.0037	2.8792	0.0106
Other bean	0.0013	2.4615	0.0031	0.0011	2.7157	0.0029	0.0014	2.2104	0.0032
Vegetable oil	0.0116	6.5389	0.0758	0.0181	6.4404	0.1164	0.0078	6.6535	0.0521
Tallow	0.0008	7.1583	0.0055	0.0005	8.6427	0.0040	0.0010	7.0079	0.0071
Greenery	0.1065	1.2437	0.1325	0.0819	1.3783	0.1129	0.1247	1.1043	0.1377
Cushaw ect	0.0460	1.2161	0.0559	0.0228	1.2460	0.0284	0.0631	1.1491	0.0725
Rootstock	0.0710	1.3536	0.0961	0.0807	1.4794	0.1194	0.0639	1.1917	0.0761
Nightshade	0.0338	1.5053	0.0509	0.0278	1.5763	0.0438	0.0382	1.4564	0.0557
Garlic& shallot	0.0110	1.6362	0.0180	0.0080	1.8927	0.0152	0.0132	1.3673	0.0180
Kidney bean	0.0197	1.8358	0.0361	0.0118	1.7197	0.0203	0.0255	2.2167	0.0565
Water plant	0.0007	1.9374	0.0013	0.0008	1.9317	0.0015	0.0005	1.9540	0.0011
Mushroom	0.0009	3.6016	0.0031	0.0005	3.0112	0.0015	0.0011	4.3636	0.0050
Other vegetable	0.0130	1.6750	0.0218	0.0379	1.6803	0.0637	0.0048	1.6689	0.0081
Pork	0.0456	9.5152	0.4335	0.0300	9.7185	0.2913	0.0519	9.3450	0.4855
Beef	0.0013	13.0747	0.0171	0.0002	12.6451	0.0029	0.0026	14.0475	0.0369
Mutton	1.47E-05	11.2892	0.0002	0.0000	11.2017	0.0013	2.56E-05	11.5179	0.0003
Poultry	0.0034	8.7874	0.0301	0.0039	8.9542	0.0350	0.0031	8.6083	0.0263
Meat product	0.0004	6.5907	0.0027	0.0005	6.6909	0.0032	0.0004	6.3466	0.0023
Egg product	0.0076	5.9577	0.0454	0.0081	5.8093	0.0470	0.0073	6.0562	0.0440
Milk product	0.0002	3.2778	0.0005	0.0000	5.0000	1.10E-05	0.0003	2.9333	0.0008
Fishery	0.0119	4.1463	0.0492	0.0174	3.9987	0.0696	0.0078	4.4216	0.0344
Shrimp etc	0.0001	6.3035	0.0009	0.0003	4.4055	0.0015	0.0000	7.0704	0.0001
Alga	0.0003	3.5289	0.0011	0.0003	3.1199	0.0009	0.0003	3.8923	0.0012
Other aquatic	0.0002		0.0013	0.0004		0.0016	1.79E-05		0.0010
Sugar	0.0019	3.5272	0.0067	0.0013	3.5096	0.0046	0.0023	3.5360	0.0082
Distilled spirit	0.0066	4.3353	0.0287	0.0048	4.6454	0.0224	0.0079	4.1474	0.0329
Beer	0.0073	2.0676	0.0150	0.0055	2.0331	0.0113	0.0085	2.0840	0.0178
Bean product	0.0033		0.0067	0.0043		0.0073	0.0026		0.0063
Flavorings			0.0345			0.0351			0.0341
Food poverty line (Z_F)			**617**			**627**			**606**

Table 4 Standard Food Combination for Rural Households with (2050~2150)'s Calorie intake in Inner Mongolia, 2002, unit: kg, Yuan/kg, Yuan

Food Items	Inner Mongolia (2002)		
	Quantity	Unit Value	Value
Corn	0.5009	1.2000	0.6011
Vegetable oil	0.0082	5.6637	0.0466
Tallow	0.0043	5.8549	0.0250
Bean and Bean Products	0.0030	2.3965	0.0073
Vegetable	0.1630	0.6181	0.1008
Pork	0.0339	8.4000	0.2850
Beef	0.0003	11.0000	0.0031
Mutton	0.0091	11.2404	0.1022
Poultry	0.0023	9.0262	0.0206
Meat product	0.0002	9.9166	0.0020
Egg product	0.0057	4.5275	0.0259
Milk product	0.0036	5.7927	0.0209
Fishery	0.0021	4.6119	0.0098
Shrimp etc	0.0001	3.9868	0.0002
Alga	0.0001	2.2414	0.0002
Other aquatic	0.0000	3.6134	0.0001
Sugar	0.0043	3.0109	0.0128
Candy	0.0006	5.9036	0.0035
Distilled spirit and wine	0.0140	4.1960	0.0588
Beer	0.0061	2.4674	0.0152
Flavorings			0.0283
Food poverty Line (Z_F)			**500**

2) Non-food poverty line estimates

In order to get the non-food poverty line parameters α, β, γ, a regression is made according to equation (1), and the results are listed in table 5.

Table5 The parameters of non-food poverty line

	Hubei Province (2003)						Inner Mongolia (2002)	
	Hubei		Developed region		Less developed region			
	Value	T-stat	Value	T-stat	Value	T-stat	Value	T-stat
α	0.6470	23.60***	0.5875	14.75***	0.6782	16.79***	0.8688	27.49***
β	-0.0924	-11.68***	-0.0963	-8.65***	-0.0907	-7.43***	-0.1886	-16.07***
γ	-0.0583	-3.08***	-0.0395	-0.07	-0.0819	-3.02***	0.0621	3.01***
F	89.74		39.92		41.99		132.31	
R^2	0.1539		0.1240		0.1667		0.3086	

Note: *** statistically significant at 1% ** statistically significant at 5%

3) Rural Poverty Lines

Based on the derived food poverty line and non-food poverty parameters, the lower and higher rural poverty lines for Hubei Province (2003) and Inner Mongolia (2002) are got by Ravallion's method (1994). The results are listed in Table 6. The lower line incorporates a minimal allowance for non-food goods (being the typical non-food spending of those who can just afford the food requirement), and the higher poverty line gives a more generous allowance (being the typical non-food spending of those who just attain the food requirement).

Using CPI derives the poverty lines of Hubei Province in 1997, while those of World Bank are adjusted by purchasing power parity. The poverty line of World Bank is US1$ one day one person. In China, if we convert the poverty line of World Bank into RMB by nominal exchange rates, the standard would be more than 3000 Yuan/year. It is higher than average net income of China; the poverty rate is so high that is not feasible. Because poverty estimates would change with the nominal exchange rates, it is better to use purchasing power parity. Based on the dollar value of 1995 and GNP adjusted by purchasing power parity，we make the ratio of the two indices of 1997 and 2003 to be purchasing power parity of one dollar to RMB. The results are 4.2994 in 1997, 4.2893 in 2002 and 4.2424 in 2003. Converting the poverty line of World Bank from US$ into RMB, we get 1569Yuan/year in 1997, 1566Yuan/year in 2002 and 1548Yuan/year in 2003.

Table 6 Rural Poverty lines in Hubei and Inner Mongolia Yuan/year

Region and poverty line		1997		2002		2003	
		Z_L	Z_U	Z_L	Z_U	Z_L	Z_U
Hubei Province	Hubei	898	1210	877	1183	889	1198
	Developed region	932	1323	911	1293	922	1310
	Less developed region	885	1201	865	1173	876	1189
Inner Mongolia				519	524		
Chinese official poverty line		640		627		637	
Poverty line of World Bank		1569		1566		1548	

Source: The authors calculate rural poverty lines of Hubei province, while other poverty lines come from China Rural Poverty Monitoring Report.

4.1.2 Poverty lines comparison

The derived rural poverty lines of Hubei Province are much higher than the Chinese official lines, while those of Inner Mongolia are relatively lower (as shown in Table 6). The most closely to the World Bank poverty line is that of the developed region in Hubei. For example, in 2002, the derived poverty lines for Hubei are 877 Yuan/year (lower lines) and 1183Yuan/year (higher lines), 39% and 88% respectively higher than the official line (627 Yuan/year) which is close to the food poverty line for the developed region, while the derived poverty lines for Inner Mongolia are 519 Yuan/year (lower lines) and 524Yuan/year (higher lines), 17% lower than the official line .In regard to the fact that most of the anti-poverty policy in China was based on the poverty monitoring through official lines, there might exist a risk that over estimates the poverty in Inner Mongolia and under estimates the poverty in Hubei Province. It is also interesting to find that even for a middle-income province such as Hubei; the derived poverty lines are not consistent with the official lines.

Adopting the same method proposed by Martin Ravallion (1994), the official rural poverty line for 1985 was derived in 1986.It was based on the expenditure of about 6.7million households and determined as 206 Yuan per person per year. Hereafter, the poverty lines were adjusted year by year through CPI. Several factors may account for the difference between official lines and the derived in our case study. The most basic difference comes from the food consumption structure and food prices. Referring back to Table 3 and Table 4, one can find that in order to get relatively the same basic 2050~2150 Calorie's energy intake, rural residents in Hubei Province have to spend more money than those in Inner Mongolia. This is a combined outcome of difference in foods consumption structure and difference in food prices. Not all the food items in rural Inner Mongolia keep lower prices than those in Hubei Province; it is also true for the comparison between the less developed region and the developed region in Hubei. This implies that the poverty lines derived from pan-country level food bundle could not fully reflect the regional poverty situation. In addition, because the structure of food bundle and food prices also change over time, just adjusting rural poverty lines by country level CPI without taking fully consideration of changes in the structure of food consumption and changes in food prices with

respect to different regions may lead to wrong poverty estimates. Another factor also needs to be considered here when we discuss the food price dispersion spatially. Due to China is just undergoing on the road towards market economy and lack of sufficient transportation infrastructure in rural areas, not all the regional markets is well co-integrated. The price changes in one region may not keep the same step as that of the average change at the whole country level. Therefore, it is not appropriate to apply a single poverty line that is derived by using the country level food prices to monitor poverty dynamics for all the regions. It is especially important when we discuss about the absolute poverty.

4.1.3 FGT comparison at different poverty lines

FGT indices are commonly used as poverty indicators. When $\alpha = 0$, FGT denotes the poverty headcount, and is simply the proportion of a population that is in poverty. When $\alpha = 1$, FGT index represents the depth of poverty. When $\alpha = 2$, FGT index represents the severity of poverty. In this section, the normalized FGT is used to do the comparison at different poverty lines. The results are listed in Table7and Table8.

Firstly, the rural poverty of Inner Mongolia is severe. Though the derived poverty line is lower, the poverty incidence is higher than that in Hubei in 2002. Based on the lower poverty lines, the poverty incidence is 5.02% in Hubei and 7.17% in Inner Mongolia; the poverty gap is 0.0128 in Hubei and 0.0446 in Inner Mongolia; the squared-poverty gap is 0.005 in Hubei and 0.1039 in Inner Mongolia. Based on the Chinese official poverty line or poverty line of World Bank, the difference of FGT index between the two provinces is distinct further.

Secondly, rural poverty of Hubei province has unanimous variable orientation under different poverty lines. All the rural poverty level, poverty degree and poverty depth reduced during 1997 to 2003, and rural poverty in Hubei province were alleviated in this period.

Thirdly, all the FGT indices calculated under Chinese official poverty lines are lower than those under other poverty lines for Hubei Province. The Chinese official poverty line has

underestimated the rural poverty in Hubei province. According to the official standard, the poverty incidence are only 2.40%(in1997) and 2.04% (in 2003), but the rural poverty incidence are 7.78% and 5.07% under lower poverty line and are 17.99% and 11.6% under higher poverty line respectively. The rural poverty line of Chinese government underestimates the poverty level of this area. In contrast, in comparison with the FGT indices calculated under the derived poverty lines for Inner Mongolia, the official line has over estimated rural poverty.

Fourthly, all the poverty indices of the developed region are lower than those of the less developed region, so the poverty in the less developed region is more severe. For example in 1997, the poverty incidence is 3.45% in the developed region under lower poverty line, but being 12.41% in the less developed region.

Fifthly, in comparison with other poverty lines based FGT changing rate from 1997 to 2003 for Hubei Province, the official poverty line based changing rates show no significant difference except poverty headcount and severity of poverty. The decreasing rate of poverty headcount is 15%, much lower than the estimates under other poverty lines; and the decreasing rate of poverty severity is 45.835, much higher than the estimates under other poverty lines.

Table 7 FGT indices under different poverty lines

		Lower Poverty Line			Higher Poverty Line			Chinese Official Poverty Line			World Bank Poverty Line		
		$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$
1997	Hubei	0.0778	0.0175	0.0066	0.1799	0.0455	0.0177	0.0240	0.0054	0.0024	0.3294	0.0935	0.0386
	Developed Region	0.0345	0.0080	0.0036	0.1133	0.0259	0.0100	0.0073	0.0029	0.0019	0.1968	0.0461	0.0174
	Less developed Region	0.1241	0.0275	0.0098	0.2809	0.0728	0.0280	0.0424	0.0081	0.0029	0.4747	0.1454	0.0618
2002	Hubei	0.0502	0.0128	0.0050	0.1258	0.0309	0.0124	0.0226	0.0038	0.0018	0.2631	0.0690	0.0283
	Developed Region	0.0264	0.0065	0.0025	0.0877	0.0205	0.0078	0.0105	0.0016	0.0009	0.1722	0.0378	0.0141
	Less developed Region	0.0803	0.0208	0.0081	0.1902	0.0496	0.0202	0.0378	0.0067	0.0030	0.3689	0.1066	0.0455
2003	Hubei	0.0507	0.0120	0.0044	0.1160	0.0297	0.0117	0.0204	0.0035	0.0013	0.2238	0.0614	0.0252
	Developed Region	0.0254	0.0053	0.0021	0.0958	0.0198	0.0070	0.0068	0.0017	0.0008	0.1529	0.0360	0.0129
	Less developed Region	0.0845	0.0203	0.0072	0.1756	0.0485	0.0196	0.0375	0.0059	0.0019	0.3132	0.0936	0.0407
2002	Inner Mongolia	0.0717	0.0446	0.1039	0.0720	0.0468	0.1028	0.0937	0.0528	0.0868	0.4521	0.1822	0.1143

Table8 FGT changing rate from 1997 to 2003 for Hubei province, %

	Lower Poverty Line			Higher Poverty Line			Chinese Official Poverty Line			World Bank Poverty Line		
	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=0$	$\alpha=1$	$\alpha=2$
Hubei	-34.83	-31.43	-33.33	-35.52	-34.73	-33.90	-15.00	-35.19	-45.83	-32.06	-34.33	-34.72
Developed Region	-26.38	-33.75	-41.67	-15.45	-23.55	-30.00	-6.85	-41.38	-57.89	-22.31	-21.91	-25.86
Less developed Region	-31.91	-26.18	-26.53	-37.49	-33.38	-30.00	-11.56	-27.16	-34.48	-34.02	-35.63	-34.14

4.2 Main determinants of rural poverty

In this section, we estimate the determinants of rural poverty by Logit Model in order to answer why some households are poor but others are wealthy in the same period, and want to know what the determinants to be at different poverty lines? In Hubei province, data of 2002 and 2003 are used since the data of 1997 is not accordant with that of 2002 and 2003 at some statistical items, and the sample number of this model is 6600. In Inner Mongolia, we use the data of 2002, and the sample number is 1986. Dependent variable is poverty incidence, being 1 when the household is poor, and 0 if not. All the explanatory variables and the respective explanation are listed in Appendix Table 3. The explanatory variables consist of three groups. The first is about the village characteristics such as old area, nationality, and terrain, distance to nearest town and irrigation rate. The second is about the demographic and non-demographic features of rural households such as per capita arable land, per capita physical assets, family size, and ratio of old men, trained ratio, education, dependency ratio, and management type. The third is alms per household that reflects the impact of anti-poverty program.

The Logit Model estimation results for Hubei Province and Inner Mongolia are given in Table 9 and Table 10 respectively. By the comparison of the models under different poverty lines, it is interesting to find that most variables show significant impacts on rural poverty. Locating at a mountainous or minority area, lack of better irrigation conditions, with big family size, few physical capital assets, low per capita land, or make a living only on agriculture would make a rural household easy to fall into poverty. With the increase of poverty standard from lower poverty line to higher poverty line (such as World Bank poverty line), the number of statistically significant variables increases.

A rural household whether having students in elementary or junior school or not, show no significant impacts on poverty, but those having students in senior high school or above would statistically uneasy to fall into poverty. This implies that making the poor getting more access to higher-level education should be fully taken into consideration in anti-poverty program.

Table 9 Parameter estimates of the poverty determinants for Hubei Province, 2002 and 2003

	Lower Poverty Line	Higher Poverty Line	Chinese Official Poverty Line	World Bank Poverty Line
C	－1.2632 （-1.1038）	-0.5257 (-0.6843)	-2.6326 （-1.4768）	0.9963* (1.8153)
Dummy of old revolutionary area	0.2531 （1.1862）	0.1950 (1.3479)	-0.1515 （-0.4300）	0.2040* (1.9367)
Dummy of minority area	0.8490*** （2.7468）	0.9796*** （4.4332）	0.5873 （1.2494）	0.9012*** (4.9918)
Dummy of plain area	0.2268 （0.9529）	0.2889** （1.9593）	-0.4957 （-1.2125）	0.2445** (2.5071)
Dummy of mountainous area	0.9978*** （3.8665）	1.0464*** （6.2122）	1.3411*** （3.5448）	0.6568*** (5.2636)
Log (irrigation rate of village)	-0.1779** （-2.1161）	-0.1529*** （-2.7288）	-0.2983** （-2.2244）	-0.1215*** (-3.1148)
Dummy of below 5 kilometers	-0.0723 （-0.3625）	-0.0954 （-0.7484）	-0.0423 （-0.1381）	-0.1290 (-1.4659)
Dummy of above 20 kilometers	0.2607 （0.7799）	-0.0578 （-0.2289）	-0.6874 （-1.2352）	0.2973 (1.4907)
LOG (family size)	2.5125*** （6.8355）	2.4721*** （10.0061）	2.3012*** （4.1083）	2.2177*** (12.6649)
LOG (per capita physical stock)	-0.3215** （-3.6489）	-0.2423*** （-4.2117）	-0.3002** （-2.1823）	-0.2056*** (-5.0813)
LOG (per capita arable land)	-0.7232*** （-4.8022）	-0.7519*** （-7.2095）	-0.5883*** （-2.5960）	-0.7924*** (-10.2891)
Dummy of farming	0.8968*** （4.1380）	0.7579*** （5.1604）	1.4389*** （4.4512）	0.5704*** (5.3469)
Dummy of non-farming& farming	-1.1253*** （-3.8709）	-1.2220*** （-6.6414）	-1.0290** （-2.0578）	-1.1642*** (-9.6104)
Dummy of non-farming	0.0598 （0.0538）	-0.4708 （-0.5697）	-1.8450* （-1.6028）	-1.6981** (-2.0934)
Education duration	-0.0735* （-1.7499）	-0.0812*** （-2.9278）	-0.0737 （-1.1219）	-0.0737*** (-3.8319)
Ratio of the old	1.2710** （2.4275）	1.1499*** （3.1335）	1.0322 （1.3252）	1.5501*** (6.0305)
Ratio of children younger than 6	0.8515 （0.8514）	2.0385*** （3.1828）	0.5348 （0.3561）	1.1883** (2.4708)
Ratio of trained labor	-0.9085 （-1.3412）	-0.7784* （-1.7965）	-1.1168 （-1.0323）	-0.5729** (-1.9601)
Dummy of having student of junior high of elementary school	-0.1873 （-0.9404）	-0.0877 （－0.6727）	-0.4295 （-1.3755）	0.1412* (1.5532)
Dummy of having student of senior high school or above	-0.2556 （-0.2705）	-0.3434** （-2.2487）	-0.1345 （-0.3803）	-0.2372** (-2.2656)
Alms per household	-0.0004 （-0.1952）	-0.0021 （-0.6541）		-0.0007 (-0.7938)
Sample Number	6600	6600	6600	6600
Log Likelihood	-527.31	-1057.50	-251.81	-1888.53
McFadden R^2	0.1862	0.1928	0.1837	0.1704

Note: Z statistics in parentheses. ***:1%significance，**: 5%significance，*:10% significance

Table 10 Parameter estimates of the poverty determinants for Inner Mongolia, 2002

	Lower Poverty Line	Higher Poverty Line	Chinese Official Poverty Line	World Bank Poverty Line
C	-4.1666*** (-7.0223)	-4.1719*** (-7.0481)	-4.4627*** (-6.9463)	-0.9756*** (-3.1269)
Dummy of old revolutionary area	1.1104*** (4.5424)	1.1269*** (4.6410)	1.2615*** (4.8247)	0.4547*** (2.8138)
Dummy of plain area	1.3102*** (4.6276)	1.3238*** (4.6739)	1.3719*** (4.4718)	1.1074*** (8.3694)
Dummy of mountainous area	0.9768*** (2.6199)	1.0441*** (2.8291)	0.6977* (1.6593)	1.0003*** (4.9990)
Distance to the nearest town	-0.0038 (-0.3125)	-0.0047 (-0.3897)	-0.0004 (-0.0349)	0.0008 (0.1254)
Dummy of minority area	-0.0928 (-0.3808)	-0.0526 (-0.3897)	-0.1989 (-0.7459)	-0.2011 (-1.3912)
Irrigation rate of village	-0.6077*** (-1.7936)	-0.5976* (-1.7672)	-0.6499* (-1.7740)	-1.0360*** (-5.9551)
Family size	0.2567*** (3.0871)	0.2472*** (2.9811)	0.2422*** (2.6815)	0.4649*** (8.8441)
Per capita physical stock	-1.69E-06 (-0.2205)	-1.62E-06 (-0.2114)	-5.14E-06 (-0.6701)	-2.57E-05*** (-5.0025)
Per capita arable land	-0.0166*** (-3.1869)	-0.0164*** (-3.1600)	-0.0168*** (-2.9942)	-0.0184*** (-6.7432)
Dummy of farming	0.5741*** (2.7453)	0.5826*** (2.7893)	0.6452*** (2.7922)	0.1784* (1.6207)
Dummy of non-farming	-0.4713 (-1.0326)	-0.4725 (-1.0347)	-0.3752 (-0.7516)	-0.4885** (-2.5325)
Education duration	-0.0314* (-0.7660)	-0.0298 (-0.7294)	-0.0346 (-0.7843)	-0.1017*** (-4.5651)
Ratio of non-labor in a household	0.5945 (1.1458)	0.6242 (1.2102)	0.9374* (1.6999)	0.4899* (1.5856)
Dummy of having student of junior high of elementary school	-0.1709 (-0.7747)	-0.1863 (-0.8475)	-0.2285 (-0.9693)	0.0100 (0.0801)
Dummy of having student of senior high school or above	-0.4598* (-1.7322)	-0.4729* (-1.7823)	-0.5462** (-1.8795)	-0.2783** (-2.0488)
Alms per household	0.0018 (0.3493)	0.0017 (0.3369)	-0.0052 (-0.3690)	0.0025 (0.8231)
Sample Number	1986	1986	1986	1986
Log Likelihood	-493.27	-495.88	-395.3698	-1174.229
McFadden R^2	0.0808	0.0826	0.0882	0.1360

Note: Z statistics in parentheses. ***:1%significance，**: 5%significance，*:10% significance

The alms received by a household show no significant impact on poverty. This implies that the current poverty program does not target well on the poor. Table 11gives us more information about who had received the alms provided by government, and the share of the alms to the poor .For example in 2002, In Hubei, there are 25 households which get alms in the total 3300 investigated samples, including 6 households according to poverty line of World Bank, but only 1 household belongs to poor according to higher poverty line, lower poverty line, and no household get alms according to Chinese official poverty line. In Inner Mongolia, there are 14 households in the 1986 investigated samples to get some alms in 2002, including 9 households by poverty line of World Bank, 3 households for each by Chinese official poverty line, high poverty line, and low poverty line.

Table 11 Number and share of household received alms in the investigated sample

Region	Year	Number of households received alms					Share of alms to poor household %			
		N_T	N_H	N_L	N_C	N_W	S_H	S_L	S_C	S_W
Hubei	1997	10	2	1	1	2	12.93	10.28	10.28	12.93
	2002	25	1	1	0	6	5.96	5.96	0	18.40
	2003	52	8	4	2	12	6.22	2.94	0.67	7.37
Inner Mongolia	2002	14	3	3	3	9	7.85	7.85	7.85	58.25

Note: N_T denotes the total number of households received alms in the investigated sample, and N_H, N_L, N_C and N_W denote the number of households received alms according to high poverty line, low poverty line of Hubei province, Chinese official poverty line and poverty line of World Bank in the investigated sample; S_H, S_L, S_c and S_w denote the share of alms to poor households according to different poverty lines in that to all the investigated samples.

One may think that alms distribution should be accordant with Chinese official poverty line at least, but in Hubei, no poor household get the alms according to this standard. The percent of alms distributed into the poor is very small, only being 7.85% in Inner Mongolia in 2002. It reveals that most of the alms provided by government leaks to the non-poor households and the current poverty program should be reformed.

It is very important to find that several variables such as education duration, ratio of the old, ratio of children, ratio of trained labor, and dummy of having student of senior high school or above appear to have no impact on poverty formation under the Chinese official poverty line (Table 9). However, these variables do show significant impacts under the derived poverty lines and the World Bank poverty line, especially with the increase of poverty standard through the lower line to the higher line and then to the World Bank line. If these poverty lines are acceptable, the anti-poverty policy based on the official poverty lines may lead to biased treatment on education and training.

4.3. Growth and redistribution decomposition

4.3.1 FGT decomposition

The poverty changes can be decomposed into growth and redistribution components. Shapley's method was used to study the growth and redistribution effect in Hubei province over 1997-2003. The year of 1997 is regarded as the reference period, since the precondition of Shapley decomposition approach is the two periods having the same poverty lines, so the poverty line, which is used in the decomposition, is that of 1997 (marked as z_97). By the ratio of the poverty lines of these two years, the deflated net incomes of 2003 can be got as dy_03=y_03*(z_97/z_03). Performing the Shapley decomposition at the poverty line of 1997 (z_97) is denoted as (y_97, dy_03, z_97).

In order to reveal the impact of growth and redistribution effects on poverty headcount, poverty degree and poverty depth, three FGT indices (as $\alpha = 0,\ 1, 2$) are decomposed. As noted in the above context, the FGT index of Hubei province and regions became smaller, during the period from 1997 to 2003, so the total effect is negative. In order to make the effects comparable, the total effects are normalized as 100. The decomposition results are shown in Table12.

Table 12 Growth-redistribution decomposition of poverty variation from 1997 to 2003 in Hubei

Poverty Lines		$\alpha = 0$	$\alpha = 1$	$\alpha = 2$
Lower Line	Total Effects	-0.0270	-0.0056	-0.0022
	Growth Effects	-0.0376	-0.0099	-0.0038
	Redistribution Effects	0.0106	0.0043	0.0016
Higher Line	Total Effects	-0.0639	-0.0158	-0.0060
	Growth Effects	-0.0812	-0.0230	-0.0095
	Redistribution Effects	0.0173	0.0072	0.0035
Official Line	Total Effects	-0.0036	-0.0019	-0.0011
	Growth Effects	-0.0128	-0.0034	-0.0012
	Redistribution Effects	0.0092	0.0015	0.0001
World Bank Line	Total Effects	-0.1057	-0.0320	-0.0134
	Growth Effects	-0.1405	-0.0438	-0.0193
	Redistribution Effects	0.0348	0.0118	0.0059

For all the three FGT indexes in Hubei province, income growth devoted much to the alleviation of poverty, while the redistribution or inequality effects counteracted the growth effects and aid on

the poverty formation. The poverty incidence decomposition results reveal that about one third of the growth effects had been counteracted by the redistribution effects. This implies that future anti-poverty program should pay much attention on how to solve the inequality problem in China.

It is also interesting to find that the poverty depth ($\alpha = 2$) decomposition results for the developed region of Hubei Province under both lower poverty line and Chinese official poverty line appear to have same tendency for growth effects and redistribution effects (Table 13). This implies that among the households with income lower than the low poverty line or Chinese official poverty line, the redistribution or inequality status is becoming better and better from 1997 to 2003 in this developed region.

Table 13 Growth-redistribution decomposition of poverty variation from 1997 to 2003 in developed and less developed regions of Hubei.

Poverty Lines		Developed Region			Less developed Region		
		$\alpha = 0$	$\alpha = 1$	$\alpha = 2$	$\alpha = 0$	$\alpha = 1$	$\alpha = 2$
Lower Line	Total Effects	-0.0090	-0.0028	-0.00144	-0.0396	-0.0072	-0.0026
	Growth Effects	-0.0213	-0.0045	-0.00147	-0.0585	-0.0164	-0.0066
	Redistribution Effects	0.0123	0.0017	-0.00003	0.0189	0.0092	0.0040
Higher Line	Total Effects	-0.0175	-0.0062	-0.0030	-0.1053	-0.0244	-0.0085
	Growth Effects	-0.0617	-0.0154	-0.0056	-0.1108	-0.0352	-0.0154
	Redistribution Effects	0.0442	0.0092	0.0026	0.0055	0.0108	0.0069
Official Line	Total Effects	-0.0004	-0.0012	-0.0011	-0.0049	-0.0022	-0.0010
	Growth Effects	-0.0031	-0.0009	-0.0004	-0.0248	-0.0065	-0.0021
	Redistribution Effects	0.0027	-0.0003	-0.0007	0.0199	0.0043	0.0011
World Bank Line	Total Effects	-0.0439	-0.0100	-0.0046	-0.1615	-0.0519	-0.0211
	Growth Effects	-0.1097	-0.0269	-0.0102	-0.1691	-0.0618	-0.0294
	Redistribution Effects	0.0658	0.0169	0.0056	0.0076	0.0099	0.0083

4.3.2 Gini coefficients Decomposition

The above growth-redistribution decomposition results reveal that the inequality of income redistribution can deepen the poverty degree in Hubei province. So, it is better to get deep insights into the trend and causes of inequality. Gini coefficient is an index to scale the distribution of household's incomes of a country or an area. In this paper, Gini coefficient is used to evaluate the trend of inequality of income and the causes of inequality by districts and income sources.

In the rural household survey data of Hubei province, the average family size are 4.20 (1997), 4.07 (2002) and 4.06 (2003), show a decreasing tendency. Per capita net income (CPI deflated)

increased 19.40% from 1997 to 2003. Sorting all the households in the survey in ascending order by per capita net income (being nominal) and adopting Yao's approach, the Gini coefficients are derived as 0.2673 in 1997, 0.2915 in 2002 and 0.2975 in 2003. The inequality deepened gradually.

The results of Gini coefficients decomposition by developed region and less developed regions are given in Table 17. It reveals that the intra-group component (G_A) in total inequality is the main factor of income inequality in Hubei province, and shows more effect than inter-group component (G_B) and overlapped component (G_O). The increasing share of inter-region inequality (G_B) and overlapped component (G_O) implies that how to lessen the inequality between developed and less developed regions should also be fully considered in policy making..

Table14 Decomposition results of the Gini coefficient by regions

	Decomposition Gini				Percent			
	G	G_A	G_B	G_O	G	G_A	G_B	G_O
1997	0.2673	0.1363	0.0744	0.0562	100	51.07	27.88	21.06
2002	0.2915	0.1474	0.064	0.0802	100	50.57	21.96	27.51
2003	0.2975	0.1461	0.0662	0.0851	100	49.11	22.25	28.61

4.4．Poverty dominance

Over the years, the literature of poverty measurement has evolved into two closely connected but distinct branches: the construction of summary poverty measures and partial poverty orderings (Zheng, 2000). Potentially different results could be obtained by the choice of a different poverty line/measure, so few conclusions can be drawn if poverty trends differ substantially when different poverty measures are applied or the position of the poverty line is changed. To supply the gap, poverty orderings is a useful branch to obtain unanimous agreement among some measures on poverty comparisons. In this section, poverty dominance analysis is used to do the poverty comparison between regions and over time.

4.4.1 Poverty dominance over time

As shown in Figure 8 for Hubei Province, at any poverty lines, the first-order poverty dominance curve in 1997 are higher than that in 2003.This reveals that rural poverty has been lessened in the period from 1997 to 2003. It is also true for the developed region in Hubei Province (Figure9).

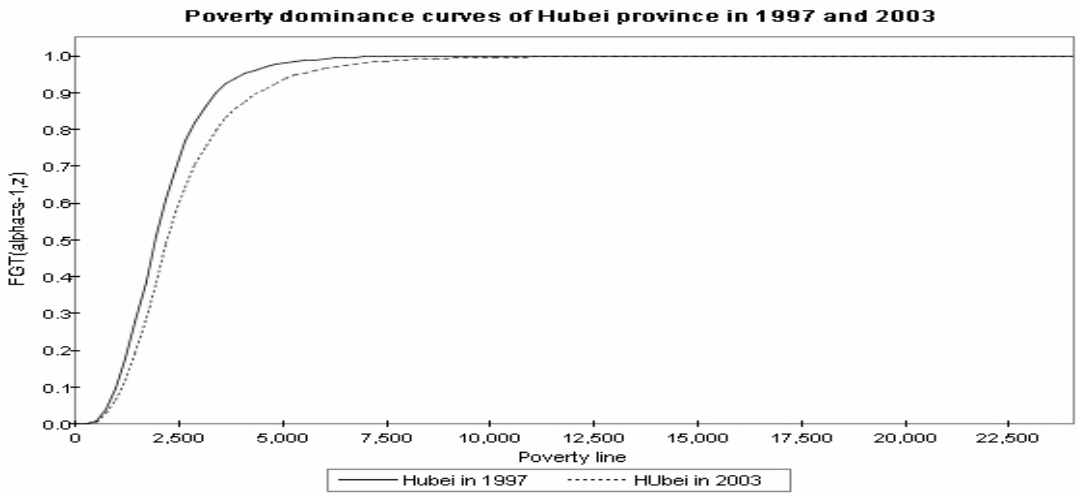

Figure8 First-order poverty dominance curves in 1997 and 2003

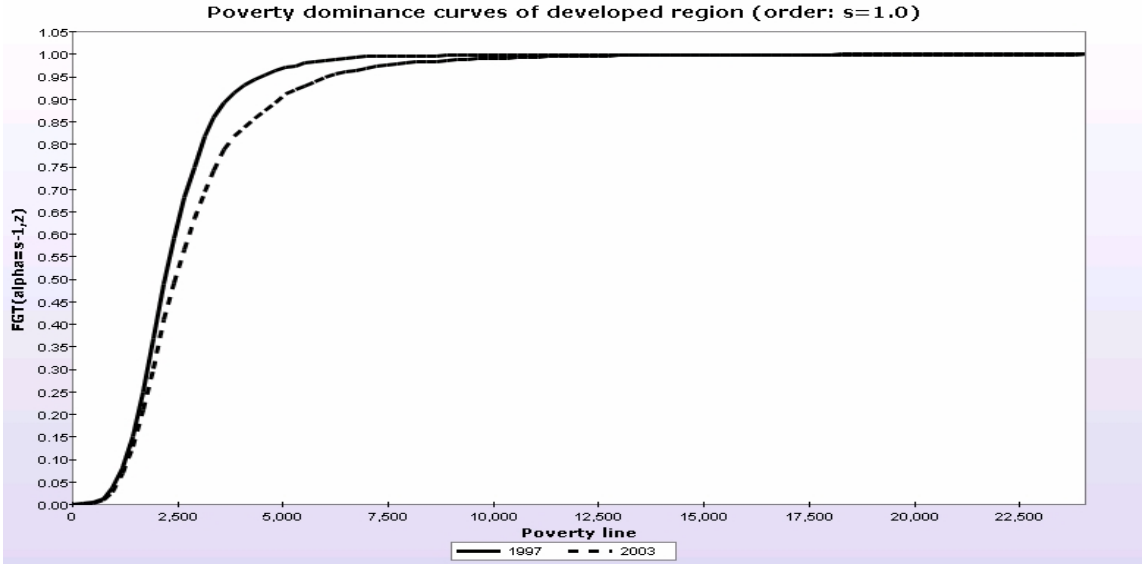

Figure9 First-order poverty dominance curves in 1997 and 2003, Developed Region.

In contrast, the first-order dominance is not hold for the less developed region in Hubei Province. As shown in Figure10~12, the first-order dominance curves intersect at 111.39, 343.75, 345.75 and 8499.13(Yuan/year), the second-order dominance curves intersect at171.25 (Yuan/year), and the third-order dominance curve intersect at 220.57 (Yuan/year). The above evidence implies that we cannot robustly give any definite words about whether rural poverty in less developed region has been lessened in the period from 1997 to 2003. However, to certain extent, it reminds us that the poverty situation of the rural households with per capita net income lower than 500 Yuan/year remains unchanged and they did not gain much from the economic growth during the period from 1997 to 2003.

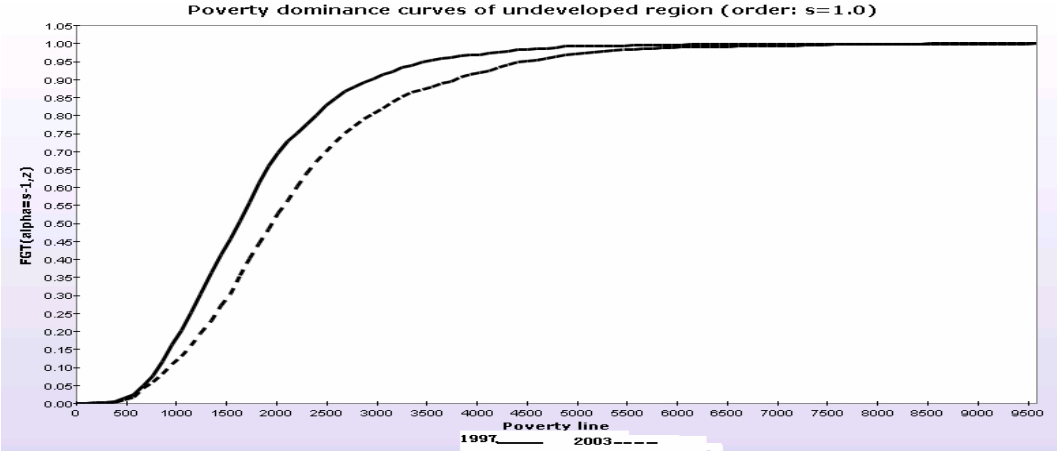

Figure10 First-order poverty dominance curves in 1997 and 2003, less developed region

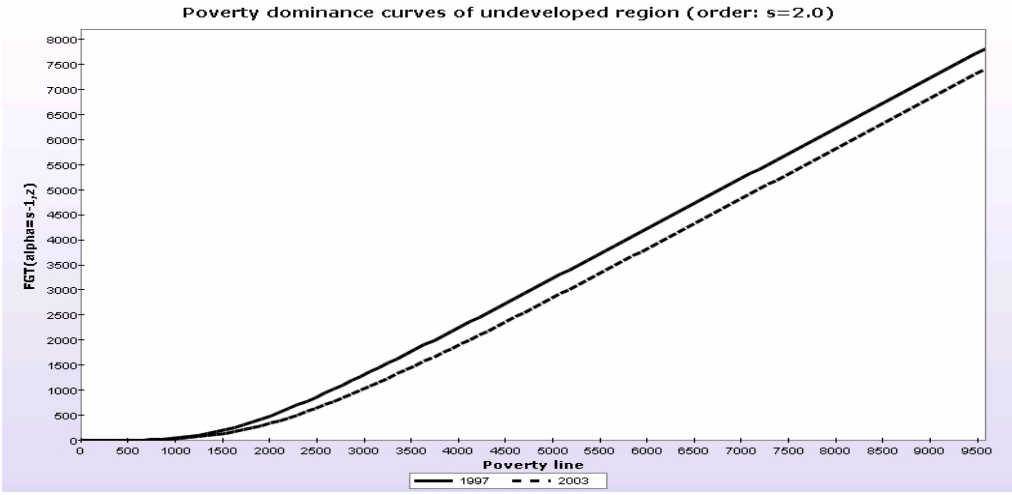

Figure11 Second-order poverty dominance curves in 1997 and 2003, less developed region

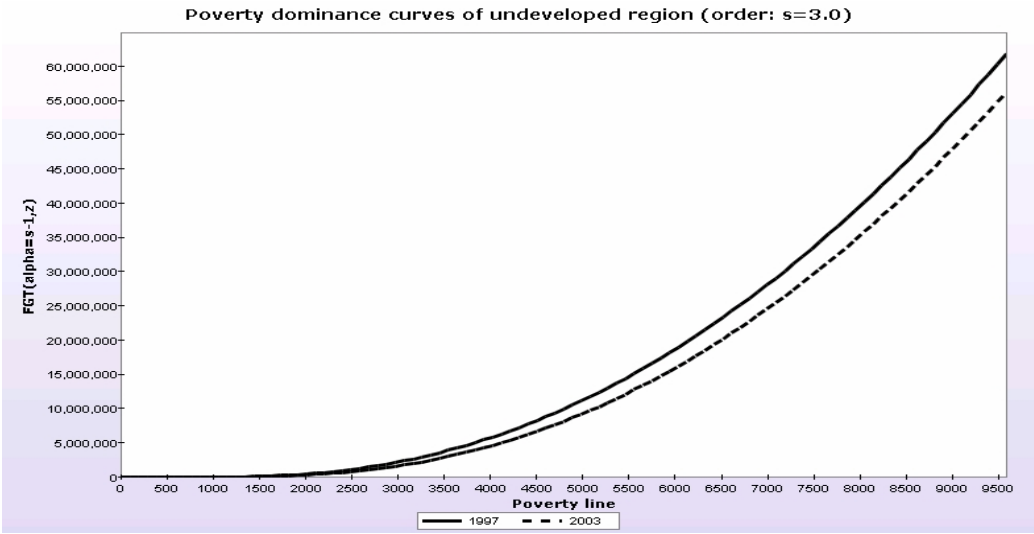

Figure12 Third-order poverty dominance curves in 1997 and 2003, less developed region

4.4.2 Poverty dominance between different regions

The results of poverty dominance analysis for Hubei and Inner Mongolia are shown in Figure 13 and Figure 14. The first-order dominance curves intersect at 4781.93, 8799.57, 9263.34 and 9444.23(Yuan/year), but the second-order dominance curves do not intersect at all. This implies that income distribution of Hubei Province second-order dominates that of Inner Mongolia in 2002 and the rural poverty of Inner Mongolia is more severe than that of Hubei, the same findings as the above context.

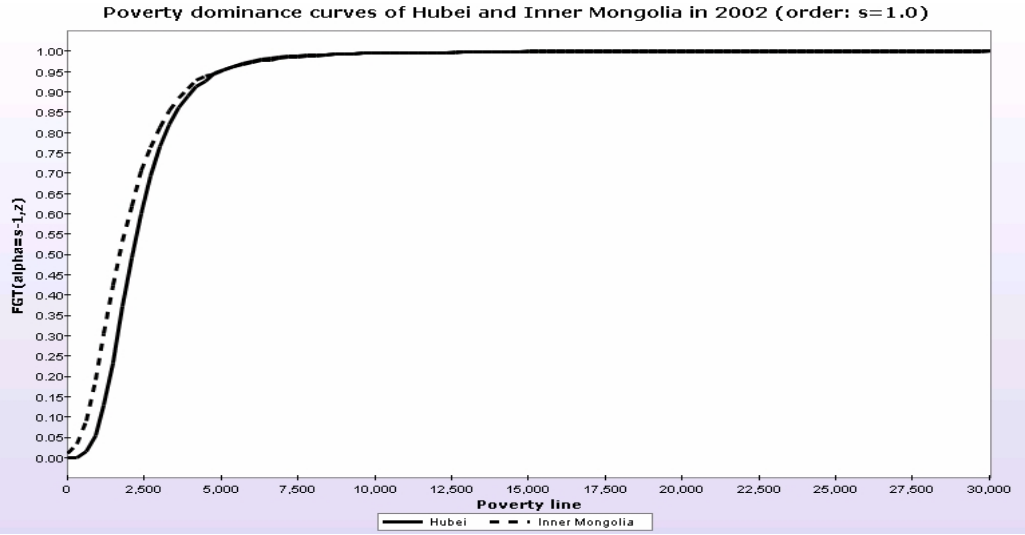

Figure13 First-order poverty dominance curves of Hubei and Inner Mongolia, 2002

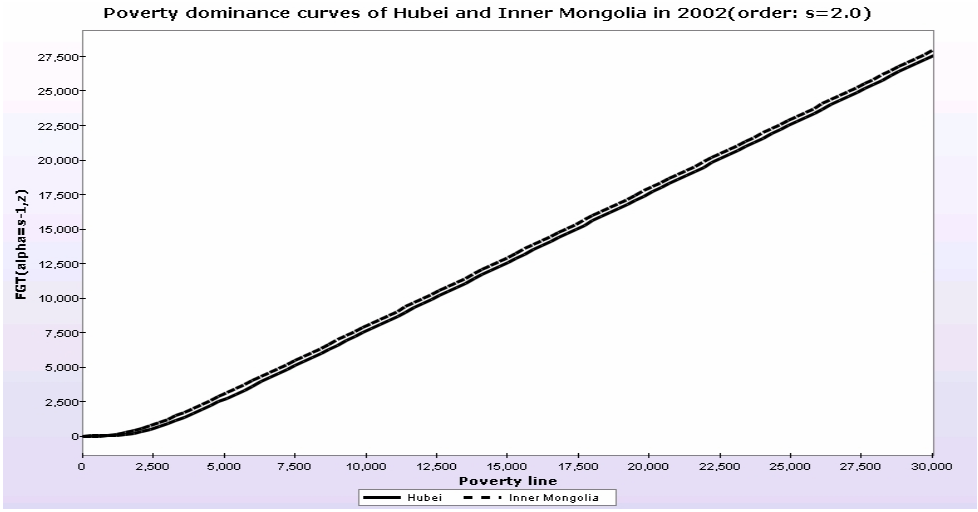

Figure14 Second-order poverty dominance curves of Hubei and Inner Mongolia, 2002

Table 15 gives us more information on the poverty difference over time and between regions. The poverty difference is calculated at the poverty line 1000Yuan/year (it is the default of DAD). One can draw the same conclusions as the above context.

Table 15 Poverty difference

	Poverty difference	Standard deviation
The same region at different period		
Hubei between 1997 and 2003	0.0372	0.0077
Developed region between 1997 and 2003	0.0095	0.0071
Undeveloped region between 1997 and 2003	0.0613	0.0140
Different regions in the same period		
Inner Mongolia and Hubei in 2002	0.1555	0.0122

In summary, poverty dominance analysis helps us understand the poverty situation without restrictions in setting poverty line. Our case study reveals that rural poverty in Inner Mongolia is more severe than that in Hubei, and the poverty in Hubei has been lessened in the period of 1997 to 2003.

5. Conclusion and discussions

The most basic issue of poverty study is the measurement of poverty. Our case study measured the rural poverty in Hubei province for 1997, 2002 and 2003 and the rural poverty Inner Mongolia for 2002, using the data set of NBS rural household survey. The poverty lines we derived by Ravallion's method differ from the Chinese official poverty lines. The official pan-country poverty line underestimates rural poverty in Hubei Province and overestimates rural poverty in Inner Mongolia.

Based on the derived poverty lines, poverty determinants are estimated by Logit model. It reveals that most variables show significant impacts on rural poverty under different poverty lines. Locating at a mountainous area, lack of better irrigation conditions, with big family size, few fixed assets, low per capita land, or make a living only on agriculture would make a rural household easy to fall into poverty. A rural household whether having students in elementary or junior school or not, show no significant impacts on poverty, but those households having students in senior high school or above would statistically uneasy to fall into poverty. This implies that making the poor getting more access to higher-level education should be fully taken into consideration in anti-poverty program. It is also found that the alms received by a household show no significant impact on poverty. This implies that the current poverty program does not target well on the poor.

Another important finding is that several variables such as education duration, ratio of trained labor, ratio of the old and children appear to have no impact on poverty formation under the Chinese official poverty line but do show significant impacts under the derived poverty lines and the World Bank poverty line. This implies that the anti-poverty policy based on the official poverty lines may lead to biased treatment on education and training.

The growth-redistribution decomposition reveals that for all the three FGT indexes in Hubei province, income growth devoted much to the alleviation of poverty, while the redistribution or inequality effects counteracted the growth effects and aid on the poverty formation. The poverty incidence decomposition results reveal that about one third of the growth effects had been counteracted by the redistribution effects. This implies that future anti-poverty program should pay much attention on how to solve the inequality problem in China.

Without the needs for setting poverty lines, poverty dominance analysis also helps us better understand the poverty situation. Our case study reveals that rural poverty in Inner Mongolia is more severe than that in Hubei, and the poverty in Hubei has been lessened in the period of 1997 to 2003, the same findings as those drawn from deriving poverty lines.

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Appendix Table1:

Standard Food Combination and the Energy Intake Equivalents for Rural Households with (2050~2150)'s Calorie Intake in Hubei Province, unit: Calorie/Kg, Kg, and Calorie

Food Items	Coefficients (Calorie/kg)	Hubei Province (2003)		Developed Region (2003)		Less Developed Region (2003)	
		Quantity (Kg)	Equivalents (Calorie)	Quantity (Kg)	Equivalents (Calorie)	Quantity (Kg)	Equivalents (Calorie)
Wheat	3620.70	0.0402	145.6936	0.0250	90.4076	0.0515	186.5122
Rice	2756.16	0.3521	970.3539	0.4420	1218.2839	0.2857	787.3027
Maize	3901.44	0.0228	88.7866	0.0087	33.8256	0.0332	129.3654
Other corn	2030.00	0.0033	6.6381	0.0008	1.5840	0.0051	10.3696
Potato	958.04	0.0122	11.7197	0.0110	10.5489	0.0131	12.5842
Soybean	5983.62	0.0031	18.3325	0.0022	13.3845	0.0037	21.9856
Other bean	3327.54	0.0013	4.2446	0.0011	3.5312	0.0014	4.7713
Vegetable oil	17081.00	0.0116	208.0868	0.0181	308.7434	0.0078	133.7702
Tallow	17961.00	0.0008	13.9026	0.0005	8.2533	0.0010	18.0737
Greenery	279.40	0.1065	19.6044	0.0819	22.8907	0.1247	34.8472
Cushaw ect	184.00	0.0460	15.1776	0.0228	4.1870	0.0631	11.6110
Rootstock	330.19	0.0710	17.5635	0.0807	26.6448	0.0639	21.0838
Nightshade	247.35	0.0338	18.6653	0.0278	6.8668	0.0382	9.4560
Garlic& shallot	552.50	0.0110	18.3481	0.0080	4.4415	0.0132	7.2728
Kidney bean	1670.00	0.0197	7.6225	0.0118	19.7493	0.0255	42.5678
Water plant	387.20	0.0007	1.3139	0.0008	0.3088	0.0005	0.2122
Mushroom	2009.00	0.0009	0.2241	0.0005	1.0207	0.0011	2.2891
Other vegetable	257.20	0.0130	132.6670	0.0379	9.7497	0.0048	1.2424
Pork	7027.20	0.0456	312.9859	0.0300	210.6186	0.0519	562.9857
Beef	5321.28	0.0013	9.8087	0.0002	1.1995	0.0026	13.9657
Mutton	6109.32	1.47E-05	0.0495	0.0000	0.0000	2.56E-05	0.1564
Poultry	3360.72	0.0034	8.9769	0.0039	13.1468	0.0031	10.2831
Meat product	2623.50	0.0004	1.0874	0.0005	1.2419	0.0004	0.9337
Egg product	2679.60	0.0076	23.8404	0.0081	21.6849	0.0073	19.4684
Milk product	3130.00	0.0002	0.2434	0.0000	0.0000	0.0003	0.8655
Fishery	1530.24	0.0119	15.6124	0.0174	26.6459	0.0078	11.9151
Shrimp etc	1314.72	0.0001	0.0815	0.0003	0.4559	0.0000	0.0000
Alga	553.15	0.0003	0.2162	0.0003	0.1640	0.0003	0.1678
Other aquatic	719.44	0.0002	0.6831	0.0004	0.2745	1.79E-05	0.0129
Sugar	3964.00	0.0019	6.2534	0.0013	5.2514	0.0023	9.1805
Distilled spirit	3300.00	0.0066	2.6803	0.0048	15.9421	0.0079	26.1938
Beer	405.00	0.0073	5.3708	0.0055	2.2431	0.0085	3.4605
Bean product	1497.60	0.0033	4.9589	0.0043	6.4869	0.0026	3.8308
Daily Energy Intake			2091.7938		2089.7773		2098.7371

Appendix Table2:

Standard Food Combination and the Energy Intake Equivalents for Rural Households with (2050~2150)'s Calorie Intake in Inner Mongolia, 2002, unit: Calorie/Kg, Kg, and Calorie

Food Items	Coefficients (Calorie/kg)	Inner Mongolia (2002)	
		Quantity (Kg)	Equivalents (Calorie)
Wheat	3620.70	0.2108	763.1700
Rice	2756.16	0.0534	147.2822
Maize	3901.44	0.0383	149.3446
Other corn	2030.00	0.0447	42.8058
Potato	958.04	0.1476	299.6531
Soybean	5983.62	0.0056	33.5530
Other bean	3327.54	0.0005	1.7040
Vegetable oil	17081.00	0.0082	140.3918
Tallow	17961.00	0.0043	76.8016
Cushaw ect	184.00	0.0040	0.7444
Rootstock	330.19	0.0292	9.6466
Nightshade	247.35	0.0276	6.8274
Cabbage	208.10	0.0692	14.4026
Greenery	279.40	0.0116	3.2408
Other fresh vegetables	257.20	0.0210	5.3936
Dried Vegetables	2684.10	0.0003	0.8247
Vegetable Products	2634.50	0.0001	0.2024
Pork	7027.20	0.0339	238.4084
Beef	5321.28	0.0003	1.4988
Mutton	6109.32	0.0091	55.5322
Poultry	3360.72	0.0023	7.6585
Meat product	2623.50	0.0002	0.5374
Egg product	2679.60	0.0057	15.3002
Milk product	3130.00	0.0036	11.3002
Fishery	1530.24	0.0021	3.2521
Shrimp etc	1314.72	0.0001	0.0673
Alga	553.15	0.0001	0.0425
Other aquatic	719.44	0.0000	0.0184
Sugar	3964.00	0.0043	16.8486
Distilled spirit	3300.00	0.0139	45.8814
Beer	405.00	0.0112	4.5524
Wine	739.00	0.0003	0.2081
Drinks	330.00	0.0101	3.3461
Candy	4006.80	0.0006	5.0271
Bean product	1497.60	0.0030	4.5632
Daily Energy Intake			**2110.0314**

Appendix Table3: Explanatory variables, way of creating, and their expected signs

Name of Variables	Expected Sign	Way of creating variables and explanation
Dummy of old revolutionary area	?	It is 1 if the village locates at an old revolutionary area and 0 otherwise.
Dummy of minority area	?	It is 1 if the village locates at a minority area and 0 otherwise.
Dummy of plain area	_	It is 1 if the village locates at a plain area and 0 otherwise.
Dummy of mountainous area	+	It is 1 if the village locates at a mountainous area and 0 otherwise.
Log (irrigation rate of village)	_	The ratio of irrigation area to the total arable land in the village (%).
Dummy of below 5 kilometers	–	It is 1 if the distance from the village to the nearest town is no more than 5 Km and 0 otherwise.
Dummy of above 20 kilometers	+	It is 1 if the distance from the village to the nearest town is more than 20 Km and 0 otherwise.
LOG (family size)	+	Family size that represents the number of household and has always been considered as a cause of poverty. Its estimates should be positive.
LOG (per capita physical stock)	_	Physical capital stock of the household.(Yuan)
LOG (per capita arable land)	_	Cultivated land per capita of household. (Mu.) 1 Mu=1/16 Ha.
Dummy of farming	+	It is 1 if the household only does farming and 0 otherwise.
Dummy of farming & non-farming	?	It is 1 if farming is the main income source for the household that also does non-farming business and 0 otherwise.
Dummy of non-farming& farming	–	It is 1 if non-farming business is the main income source for the household that also does farming and 0 otherwise.
Dummy of non-farming	–	It is 1 if the household only does non-farming business and 0 otherwise.
Education duration	–	Education years of the member who got the highest level of education in the family.
Ratio of the old	+	The ratio of the number of the old more than 60 year's old to the size of the family. (%)
Ratio of children younger than 6	+	The ratio of the number of children younger than 6 year's old to the size of the family. (%)
Ratio of trained labor	–	The ratio of the number of trained labors to the total number of labors in the household. (%)
Ratio of non-labor in a household	+	The ratio of the non-labor to the size of the family. A family with less labor should be easy to fall into poverty, sign of this variable should be positive.(%)
Dummy of having student of junior high of elementary school	?	It is 1 if the household having student of junior high of elementary school and 0 otherwise.
Dummy of having student of senior high school or above	?	It is 1 if the household having student of senior high school or above and 0 otherwise.
Alms per household	?	The Alms received by a household. (Yuan)