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Poverty and vulnerability in rural China: Effects of taxation

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This paper studies the impact of taxation on poverty and ex ante vulnerability of households in rural China based on national household survey data in 1988, 1995 and 2002. It has been confirmed that (i) poverty and vulnerability have reduced significantly with a great deal of geographical disparity; (ii) education, land, and access to infrastructure and irrigation facilities are the key factors to reduce vulnerability, and (iii) the highly regressive tax system increased farmers' poverty and vulnerability. The abolishment of rural tax since 2006 would thus have a significant negative impact on both poverty and vulnerability of rural households.

Keywords: poverty; vulnerability; taxation; rural China

JEL Classifications: C23; C61; I31; I32

Introduction

The Chinese economy has been growing at around 10% per annum since the reforms began in 1978. However, inequality has risen across the regions and during most of the period – for example, the urban–rural income gap in China is now amongst the biggest in the world and this would be even bigger once the differences in the standard of living (e.g. in terms of health or education), welfare benefits and infrastructure between the two groups were taken into account (e.g. Ravallion and Chen 2007; Sicular et al. 2007; Wan and Zhang 2006).

The increasing inequality in China implies that not everyone has enjoyed the fruits of the reform and growth evenly. This is closely associated with the persistence of poverty for a certain proportion of the population. According to the official poverty line set by the government, poverty has dramatically reduced from around 20% in 1979 to 3% in 2006. However, Chen and Ravallion (2008) showed that based on the new international $1.25 a day poverty line, the poverty rate for China is substantially higher than past estimates, with about 15% of the population living in consumption poverty in 2005.

Much research has been done on poverty and inequality within China, but there are only a handful of works on vulnerability. However, the measure of vulnerability is a very important indicator of development as the welfare of a household depends not only on its present income or consumption, but also on the risks it faces.

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Among these works, Zhang and Wan (2006) explore whether diversification and education affect vulnerability in rural China, and find that diversification into non-agriculture activities exerts little effect on vulnerability, and that education is an important determinant of vulnerability in rural China. Until recently, China had long taken a 'growth' oriented anti-poverty policy. That is, the policy that prioritises growth promotion over redistribution, but this does not appear to have been entirely successful in achieving its goal. On the other hand, using the China Health and Nutrition Survey (CHNS) in the period 1989–2004, Zhang and Wan (2008) compare the predicted vulnerability, defined as the probability of a household falling into poverty and actually observed poverty. They find that setting the thresholds at 50% improves the power of vulnerability as a prediction of future poverty, which provides more solid supports for Chaudhuri's ex ante measure of vulnerability as predicted poverty (Chaudhuri, Jalan, and Suryahadi 2002; Chaudhuri, 2003).

One of the main reasons for the rural–urban disparity as well as the overall inequality is the highly regressive Chinese tax system, where the rural poor had to pay a disproportionally high share of income tax in the form of agricultural tax (Wang and Piesse 2009). Although the incomes of rural households were much lower than those of their urban counterparts, rural households were taxed much more heavily than their urban counterparts (Tao and Liu 2005). This highly regressive tax system put a heavy burden on those at the bottom of the income distribution and made them extremely vulnerable, which would justify our study of the impact of this tax system on vulnerability. Building upon Wang and Piesse (2009), the present study examines the regional pattern of vulnerability, the evolution of vulnerability and the impacts of taxation on poverty and vulnerability in rural China. With regard to the methodology, the present study applies Chaudhuri's ex ante measure of vulnerability to the nationally representative household survey data in 1988, 1995 and 2002 in order to identify household incomes, the burden of taxation and their impacts on rural residents' welfare status in terms of vulnerability and expected poverty in rural China.

The contribution of this paper to the literature of poverty in China is threefold. To begin, this is the first study to analyse the impact of rural taxation on people's welfare in term of vulnerability. Second, we show that a small tax burden can be 'the last straw on the camel's back', which can make people in the lower income end extremely vulnerable, although it may have a relative small impact on poverty. Thirdly, it provides rationales for the abolishment of the agriculture tax as well as the associated fees and charges in 2006 as it shows the significant negative impact of these taxes on rural people's welfare.

The rest of the paper is organised as follows. The next section briefly reviews the literature on taxation in China. Then the paper summarises the data to be followed by the discussion of econometric models and specifications. The empirical results are presented in the subsequent section. The final section concludes with a discussion of the implications of the policy on taxes where the importance of tax reform is emphasised as a policy to encourage a more equitable distribution of income and to greatly reduce poverty and vulnerability of rural households.

China's rural tax system and tax reform

There were two major direct taxes related to urban and rural households in China: income tax and agricultural tax.[1] There is a universal requirement to pay income tax when incomes are above a certain benchmark, which is a progressive regime by law. Rural residents who hold rural *Hukou* had to pay agriculture tax up to 2006. The *Hukou* system of residency permits dates back to ancient China.

The income tax legislation in China was passed in 1980, with the tax threshold set at 800 yuan a month, 20 times higher than the average monthly wage at that time, of 40 yuan. This rate did not change until 2006, when the benchmark income for taxation was increased to 1600 yuan. Because of the high tax threshold, the vast majority of rural residents would not be liable for this tax in principle. However, rural residents were required to pay agricultural tax simply because they lived in a rural area and they were considered to be involved in agricultural production, although in many cases this was not true.

The agricultural tax adopts the flat rates, which were differentiated at regional level and constant irrespective of income levels for all households in each region. According to the Agriculture Tax Regulations, the national average rate was 15.5% of the value of the yield in a normal year and this was fixed for several decades after it was introduced in the 1950s. However, the actual tax burden on farmers was heavier than suggested by the state agricultural tax statistics during the pre-reform period in which the Chinese Government was able to tax agriculture implicitly through the price scissors, i.e. increasing the prices of agricultural inputs and depressing the prices of agricultural outputs (Lin and Liu 2007). Besides the formal taxes explicitly set by laws and regulations, the rural population needed to pay to local governments and village community organizations various fees and administrative charges, which were difficult to distinguish from the formal taxes as they were collected together. Overall, there existed hundreds of different kinds of fees and charges imposed on farmers by various levels of government and organisations without explicit government regulations or legislation.

It was claimed that these charges had to be paid to the village for social welfare, infrastructure and management and to the township for education, family planning, paramilitary support, infrastructure and irrigation, but in reality most of those services were never received or the work was not carried out, although the payment was made (Knight and Song 1999). Peasants felt besieged by the unpredictable and arbitrary imposition of levies that were more numerous than 'hairs on an ox' (Bernstein and Lu 2000). It has been shown that although state agricultural taxes constituted only a relatively small part of the formal state taxes, the amount of rural fees and charges was almost twice as large as that of the agricultural taxes (Tao and Liu 2005).

Since the mid-1990s until 2004, the rural tax burden remained heavy simply due to the need to support the functions of local government (Lu and Wiemer 2005). To make things worse, the over-staffed local administrations extracted resources from farmers for their own salary and sought rents at the expense of peasant income.

While the informal fees and charges varied from time to time and region to region because of their illicit nature, they were most relevant to inland agriculture-based areas in the second half of the 1990s. In most cases, these fees and charges were uniformly applied to all the households regardless of income levels or affordability of the households. Therefore, the increasingly regressive nature of rural taxes and the heavier burdens on poor farmers were at the heart of the rural taxation issue in China (Lin and Liu 2007).

In order to relieve farmers' financial burdens, central government introduced the fees-for-tax plan in early 2000, which required farmers to pay only the agricultural tax, the special agricultural product tax[2] and a few additional taxes. However, with the hundreds of items of fees and charges being forbidden by the central government, local authorities were able to create more fees and charges with other names.

According to the *China statistic yearbook*, the income from agricultural taxes made up 39% of the total national financial revenue in 1950. This proportion declined to 4.6% in 1995 and to 3.7% in 2000. At the national level, the share of agricultural taxes to total tax was decreasing in those periods. However, the share of agriculture tax to value added in agriculture was increasing, which means that the tax burden in rural areas was becoming heavier. The agricultural tax, despite its small share in the total government revenue, implies large financial burdens for farmers whose income growth remained low. Official figures (*China statistic yearbook*) suggest that farmers' per capita income grew around 4% per year for a decade after 1996, far below the income growth of urban residents or of GDP growth. The insignificant share of agricultural tax in total government revenue made it easier for the central government to carry out further tax reforms with the aim to narrow the increasing urban–rural gap.[3]

A new set of tax reforms have been implemented since 2004, including cancellation of the tax on special agricultural products except of tobacco. The agricultural tax was exempted in most provinces in 2005 and waived across the country in 2006. Since the agricultural tax was being abolished, the fees and administrative charges, which were imposed by local authorities, that had been levied with this tax lost their legitimacy and became forbidden. Although there remain some small fees introduced by some local governments, rural residents' burden has been greatly reduced by these tax reforms.

Data

The data used in this study are three cross-sectional national household surveys, the Chinese Household Income Project (CHIP) for 1988, 1995 and 2002. The data in all three surveys were drawn from a large-scale sample selected by the National Bureau of Statistics (NBS) from the annual household survey (approximately 65,000 rural households and 35,000 urban households) using a multistage, stratified probability sampling method, which is designed in such a way that households are randomly sampled in each province. The large sample size would make our study of vulnerability unique in the literature. The original CHIP 1988 dataset has 51,352 rural residents. The original CHIP 1995 dataset has 34,739 rural residents. The CHIP 2002 dataset has 37,968 rural residents.

All three rounds of the survey cover more than half of the Chinese provinces, with representative provinces from different regions, although the distribution is not absolutely even. This allows us to study regional disparity in China. The dynamic change of poverty and vulnerability can be assessed by the use of repeated cross-sectional data sets in three years, 1988, 1995 and 2002 spread over this 14-year period. The construction of household panel data is not feasible.

The CHIP data sets are considered the best publicly available data source on household income and expenditures and their geographical coverage is unique as it covers provinces in the eastern, central, and western regions of China (Riskin et al. 2001). They still remain the only source of household-level data on income and other individual and household characteristics in China. They also provide the only comprehensive database of household income that would overcome the limitations of the published income data in China based on official definitions and census data. Detailed analyses of the CHIP surveys are published in Griffin and Zhao (1993) and Riskin et al. (2001), and Gustafsson et al. (2008).

In this paper, a rural household refers to a group of members of the household that have rural *Hukou*. That is, have registered with the police as rural residents and are living and sharing economic resources as a unit. Household income is based on cash payments and a broad range of additional components, such as, payments in kind valued at market prices, agricultural output produced for self-consumption valued also at market prices, the value of food and other direct subsidies, and the imputed value of housing services. Total disposable household income refers to the sum of income from various activities by members of rural households, includes wages and salaries, net business income, income from property and income from transfers provided by members of the household, but excludes income from selling properties and funds that are borrowed. Income per person is calculated by the total household income per year divided by the number of household members.

We define tax in two parts: the agricultural tax by the state and the fees and charges by the local governments. The surveys collected the data on these two components and we use them as they are, without making any changes. The agricultural taxes cover taxes on primary, secondary and tertiary sector activities paid to state and local government, and miscellaneous fees paid to the state and collectives. Fees and charges include various items, including surcharges, fees retained by villages and townships, ad hoc fees, and various apportions and contributions to fund-raising, which are paid by households, in cash and in kind, with respect to their production and operations. Since the amounts of the fees and charges were determined arbitrarily and inconsistently by each local authority, changing from one local authority to another and from time to time, the households could never predict how much they would have to pay in fees and charges next year. This is one of the underlying factors, that the fees and charges would increase vulnerability. The present study analyses the effects of taxes and fees on household poverty and vulnerability in rural areas.

Methodology

It is not straightforward to analyse the effects of tax and fees on household poverty or vulnerability as they are either direct or indirect. While direct effects are the increase of poverty or vulnerability due to the decrease in disposal income after tax, indirect effects are associated with (i) market distortion or disincentive effects arising in the flat tax system where a household has to pay more or less the same amount of agricultural tax or fees regardless of the income levels; (ii) the change in central or local government fiscal system, which would affect the public expenditure in infrastructure, health or education and the resulting changes in multiplier or second round effects; (iii) the political economy effect, which could be influenced by the share of tax in various sectors in the economy (e.g. the share of government's tax income from either urban or rural areas; from either agricultural, manufacturing, or service sectors); and (iv) the increase of vulnerability as a result of the change in the expectation of future disposal income (e.g. due to the announcement of an increase in agricultural taxes and fees).[4,5]

Capturing a part of these indirect effects would necessitate the comparison of actual poverty or vulnerability with its counterfactuals, but it is not easy to estimate the latter as the relevant data are not easily available.[6] The present study thus focuses only on the direct effects as well as the last component of the indirect effects (or (iv)) by simply comparing the impact of tax on the welfare of rural household in terms of poverty incidence and vulnerability through the change of household disposal income before and after tax. The effects of tax on poverty and on vulnerability are not necessarily the same because the latter is associated with the household members' perception of future welfare. If the abolition of tax reduces future uncertainty of household income, the reduction of vulnerability after tax may be larger than that of poverty. For poverty, we report the impact of tax on rural poverty in terms of the change in the head count ratio. For vulnerability, the ex ante measure of vulnerability, or Vulnerability as 'Expected Poverty' (VEP) is used (Chaudhuri et al. 2002; Chaudhuri 2003, Suryahadi and Sumarto 2003). We derive VEP measures for poverty based on household income before and after tax.

Vulnerability as expected poverty (VEP)[7]

In this subsection, we provide a brief summary of the estimation procedure of estimating vulnerability to poverty. First, using recorded level household data, the FGT measure of headcount poverty (Foster et al. 1984) is calculated. Second, we estimate household's expected consumption and its variance of the error term using the Feasible Generalized Least Square (FGLS) estimation procedure. Household's vulnerability to poverty is then derived as the conditional probability of the household falling into poverty in the next period.

The main aim of a forward looking vulnerability to poverty estimation is to have an estimate of household's mean and variance of consumption expenditures over time. Ideally, this requires panel data collected over a sufficiently long period. However, as noted by Jalan and Ravallion (2001), most of the available standard data sources are based on a cross-sectional household survey and cannot be used for this purpose. In this study, we use the VEP measure developed for large cross-section data. Vulnerability is defined as expected poverty, or the probability that a household's consumption will lie below the predetermined poverty line in the near future.

For a given household h, the vulnerability is defined as the probability of its consumption being below poverty line at time $t+1$:

$$V_{ht} = \Pr\big(\ln c_{h,t+1} < \ln \underline{c}\big)$$

where V_{ht} is vulnerability of household h at time t, $c_{h,t+1}$ denote the consumption of household h at time $t+1$ and $\underline{c}$ stands for the poverty line of household consumption.

Assuming that for household h the consumption function is specified as

$$\ln c_h = X_h\beta + \varepsilon_h \tag{1}$$

where c_h stands for per capita consumption expenditure for household h, X_h represents a vector of observable household and other determinants, β is a vector of parameters, and ε_h is a mean-zero disturbance term that captures household's idiosyncratic shocks. Consumption expenditures, c_h, is assumed to be log-normally distributed and as such the disturbance term, ε_h, will be distributed normally.

The vulnerability of household, h with characteristics X_h can now be calculated using the coefficient estimates of equation (1) in the following manner:

$$\hat{V}_h = \hat{\Pr}(\ln c_h < \ln \underline{c} - |X_h) = \Phi\left(\frac{\ln \underline{c} - X_h\hat{\beta}}{\hat{\sigma}}\right) \tag{2}$$

where $\hat{V}_h$ denotes vulnerability to poverty, that is the probability that the per capita consumption level (c_h) will be lower than the poverty line ($\underline{c}$) conditional on household characteristics X_h. Meanwhile, $\Phi(\cdot)$ denotes the cumulative density of the standard normal distribution and $\hat{\sigma}$ is the standard error of Equation (1).

Households' future consumption is further assumed to depend upon uncertainty about some idiosyncratic and community characteristics. To have consistent estimates of parameters, it is necessary to allow heteroscedasticity, that is, variances of the disturbance term to vary. This can take the following functional form:

$$\sigma^2_{e,h} = X_h\theta \tag{3}$$

A three-step Feasible Generalised Least Squares (FGLS) procedure can be used to estimate the parameter θ. Equation (1) is first estimated using an ordinary least squares (OLS) procedure. Then, the estimated residuals from the Equation (1) are used to estimate the following equation, again by OLS:

$$\hat{e}^2_{OLS,h} = X_h\theta + \eta_h \tag{4}$$

The estimate from above is then used to transform equation (4) into the following:

$$\frac{\hat{e}^2_{OLS,h}}{X_h\hat{\theta}_{OLS}} = \left(\frac{X_h}{X_h\hat{\theta}_{OLS}}\right)\theta + \frac{\eta_h}{X_h\hat{\theta}_{OLS}} \tag{5}$$

This transformed equation is estimated using OLS to obtain an asymptotically efficient FGLS estimate, $\hat{\theta}_{FGLS}$. $X_h\hat{\theta}_{FGLS}$ is a consistent estimate of $\sigma^2_{e,h}$, which is the variance of the idiosyncratic component of household consumption.

This is then used to transform equation (1) into:

$$\frac{\ln c_h}{\sqrt{X_h\hat{\theta}_{FGLS}}} = \left(\frac{X_h}{\sqrt{X_h\hat{\theta}_{FGLS}}}\right)\beta + \frac{e_h}{\sqrt{X_h\theta^{\grave{U}}_{FGLS}}} \tag{6}$$

OLS estimation of Equation (6) yields a consistent and asymptotically efficient estimate of β. The standard error of the estimated coefficient, $\hat{\beta}_{FGLS}$, can be obtained by dividing the reported standard error by the standard error of the regression. Finally, the estimates of β and θ obtained through this FGLS method can be used to estimate the vulnerability to poverty of household h through the following generalisation of Equation (2):

$$\hat{V}_h = \Phi\left(\frac{\ln \underline{c} - X_h\hat{\beta}}{\sqrt{X_h\hat{\theta}}}\right) \tag{7}$$

Clearly, estimation of vulnerability to poverty depends on the following elements: the distributional assumption of the normality of log consumption, the choice of poverty line $\underline{c}$, the expected level of log consumption and the expected variability of log consumption. The higher the level of expected consumption and expected consumption variability the lower the vulnerability.

As noted earlier, a merit of this vulnerability measure is that it can be estimated with cross-section data. However, the measure correctly reflects a households' vulnerability only if the distribution of consumption across households, given the household characteristics at time t, represents time-series variation of household consumption. Hence, this measure requires a large sample in which some households experience good times and others suffer from some kind of negative shocks. In addition, the measure is unlikely to reflect large unexpected shocks, if we use the cross-section data for a normal year.

Any operationally useful assessment of households' vulnerability status depends essentially on two important factors: first, the choice of a vulnerability threshold, that is, a minimum level of vulnerability above which all households are defined to be vulnerable; and second, specifying the time horizon over which households' vulnerability is to be assessed. There is, however, a certain degree of arbitrariness involved in making such decisions.

In the actual estimation of vulnerability, we will use log per capita household income instead of log per capita consumption, $\ln c_h$ because (i) we are interested in the effects of tax on income; (ii) CHIP data are more suitable for analysing income poverty than consumption poverty as they provide much more detailed and reliable data of household income; and (iii) the literature of poverty studies on China has mainly focused on income poverty, not consumption poverty. X_h, the determinants of log per capita household income used in our study include (i) the characteristics of household head, such as, the age of household head and its square, whether the head is married, the educational attainment of household head; (ii) household composition, such as the share of female members in the total household members and dependency burden; (iii) whether the household belongs to the ethnic majority or minority; (iv) the size of the household's farm land and the share of the farm land irrigated and its squares; (v) a vector of regional dummy variables; and (vi) infrastructure (whether the household belongs to the village with power supply or not). We will first carry out the regressions for all the households in rural areas covered by the surveys to derive the VEP headcounts of rural China. While it is not easy to overcome the limitations of the VEP measure associated with the use of cross-sectional data, we will then repeat the same form of regressions at regional level to capture the difference in coefficient estimates across different regions, as a robustness check for the results of VEP headcounts.

Results

This section discusses the results based on three rounds of CHIP data sets in 1988, 1995, and 2002. While rural poverty declined in the period 1988–2002, it should be noted that poverty rates calculated based on income 'after tax' is much higher than 'before tax'.

Table 1 indicates that the tax system in China has been regressive over the years, although by 2002 it was getting less regressive. The average tax rate of the bottom 10% decile was 7.61 times larger than the top 10% decile in 1988, 10.53 in 1995 and 6.36 in 2002. It should be noted that since 2004 the tax on special agricultural products has been cancelled except for tobacco and that the agricultural tax was not levied in most provinces in 2005 and was waived across the country in 2006.[8]

Table 2 compares the poverty headcount ratios before and after tax in 1988, 1995, and 2002. Two cases are considered. The first case, or Case (A), is the case 'After tax' where we use the disposal income after subtracting all the agricultural taxes, fees and administrative charges, including land contract fees.[9] The second case, or Case (B), is 'Before tax' where we use the income before subtracting the agricultural taxes, fees and administrative charges. We apply two different poverty lines following Khan (2008). The lower poverty line is set at 367 Yuan in 1988, 810 Yuan in 1995, and 876 Yuan in 2002. The upper poverty lines are 525 in 1988, 1157 in 1995 and 1252 in 2002.

Table 1. Average tax rate by household income decile.

Income decile	1988	1995	2002
1 (Bottom 10%)	13.7	13.7	8.9
2	7.3	7.3	5.6
3	5.6	5.6	4.7
4	4.7	5.9	4.1
5	4.2	5.8	3.6
6	4.2	4.9	3.4
7	3.5	4.7	3.1
8	3.2	4	2.7
9	2.9	2.8	2.1
10	1.8	1.3	1.4

Table 2. Poverty headcount ratios in rural China.

	1988			1995			2002		
	Case (A) After tax	Case (B) Before tax	*(A) – (B) difference*	Case (A) After tax	Case (B) Before tax	*(A) – (B) difference*	Case (A) After tax	Case (B) Before tax	*(A) – (B) difference*
Lower poverty line	15.1%	12.7%	*2.4%*	12.3%	10.2%	*2.1%*	7.0%	5.9%	*1.1%*
Upper poverty line	32.2%	29.1%	*3.1%*	28.1%	24.1%	*4.0%*	16.9%	15.1%	*1.8%*

Rural poverty line: Lower: 367 in 1988, 810 in 1995 and 876 in 2002.
Upper: 525 in 1988, 1157 in 1995 and 1252 in 2002.
Poverty lines for 1988 were estimated by deflating poverty lines of 2002 in Khan(2008) using rural CPI.

For both cases, before and after tax, poverty declined dramatically between 1988 and 2002. In the first case of 'After tax' (Case (A)), poverty based on the lower poverty line declined moderately from 12.7% in 1988 to 12.3% in 1995 and then was further reduced to 7.0% in 2002. Poverty based on the higher poverty line shows the similar trend from 32.2% in 1988, 28.1% in 1995 to 16.9% in 2002. The second case of 'Before tax' (Case (B)) showed the similar trends. Poverty based on the lower poverty line declined from 12.7% in 1988 to 10.2% in 1995 and to 5.9% in 2002. Poverty based on the higher poverty line changed from 29.1% in 1988, 24.1% in 1995, and to 15.1% in 2002. The difference between Case (A) and Case (B) shows the direct effect of tax on poverty. It is noted that the tax effect on poverty reduced over time. For example, for the lower poverty line, the difference of the two cases reduced from 2.4% in 1988, to 2.1% in 1995, and to 1.1% in 2002. This was due to the agricultural tax reform being partially implemented in 2002.

Table 3 provides the results of VEP – Vulnerability as Expected Poverty – for all households in rural areas covered by the surveys.[10] We estimate equations (1) and (4) for the variance of the error term based on log per capita household income. The definitions of the explanatory variables are listed in Appendix A. A brief summary of the results is given below. It is noted that regression results are based on the cases where a dependent variable is 'per capita income after tax', but that similar results are obtained if 'per capita income before tax' is regressed.

Most of the econometric results in Table 3 are intuitive – showing more or less the same coefficient estimates for 1988, 1995 and 2002 with a few exceptions. Below, we mainly focus on the results for the log per capita income function. Household head's age is negative and significant (and its square is positive and not significant) only in 2002, which implies that the household with an older household head tends to have a lower income with a nonlinear effect. A dummy variable on whether the household head is married is negative and significant at the 10% level only in 1988 and not significant in 1995 or 2002. This implies that the marital status of the head is not related that much to per capita household income. The share of female members in the household as well as the dependency burden (or the share of household members under 15 years old or above 65 years old in the household) is negative and significant for all three years. The share of numbers of members of the communist party is positive and significant for all three rounds. This does not necessarily mean that members of the communist party get special treatment as it could be as a result of ex ante superior personal abilities that are not controlled in our estimation. A dummy variable on whether the household belongs to an ethnic majority is positive and significant, which implies that the ethnic minority group, on average, enjoys much less per capita household income. Also significant are a set of dummy variables on whether the household head has completed various levels of education, namely, elementary school, lower middle school, upper middle school, technical school and college or education. The results suggest that education is generally an important determinant of log income. However, the higher level of education becomes more important as a determinant of log per capita income in later years. For example, 'elementary school dummy' is positive and significant only in 1988, 'lower middle school dummy' is positive and significant only in 1988 and 1995, and 'higher education dummy' is positive and significant only in 1995 and 2002.

Table 3. Estimation results of log per capita income and the variance of error term (for Equation (1) and Equation (4)).

	1988		1995		2002	
	log (per capita Income)	Variance	log (per capita Income)	Variance	log (per capita Income)	Variance
Headage	0.001	−0.013	−0.007	**−0.028**	**−0.02**	0.003
	(0.46)	(0.94)	(1.56)	**(1.69)****	**(4.17)******	−0.14
Headage2	−0.00001	0.0001	0.0001	**0.0003**	**0.0002**	0.00003
	(0.39)	(0.91)	(1.04)	**(1.85)****	**(3.35)******	(0.14)
Married	**−0.035**	**−0.161**	0.002	0.06	0.012	−0.129
	(1.65)**	**(1.97)*****	(0.05)	(0.41)	(0.38)	(1.08)
Femaleshare	**−0.169**	−0.094	**−0.139**	**−0.427**	**−0.111**	0.186
	(4.96)****	(0.65)	**(3.05)******	**(2.52)*****	**(2.74)******	(1.16)
Depburden	**−0.486**	0.035	**−0.519**	**−0.372**	**−0.604**	−0.027
	(16.87)****	(0.29)	**(14.35)******	**(2.57)*****	**(17.73)******	(0.20)
Ratio_Party	**0.7**	0.285	**0.682**	−0.077	**0.578**	0.156
	(11.29)****	(1.10)	**(9.78)******	(0.32)	**(11.65)******	(0.85)
Majority	**0.056**	**−0.235**	**0.052**	−0.147	0.029	0.035
	(2.48)***	**(2.41)*****	**(1.81)****	(1.31)	(1.32)	(0.41)
Elementary_Head	**0.111**	−0.002	0.014	−0.02	−0.01	−0.183
	(6.60)****	(0.03)	(0.45)	(0.17)	(0.23)	(1.28)
Lowermiddle_Head	**0.134**	−0.108	**0.086**	0.018	0.058	−0.156
	(7.09)****	(1.25)	**(2.75)******	(0.14)	(1.40)	(1.08)
Uppermiddle_Head	**0.155**	−0.003	**0.163**	−0.02	**0.122**	−0.238
	(6.34)****	(0.03)	**(4.44)******	(0.14)	**(2.83)******	(1.53)
Technical_Head	**0.183**	0.168	0.086	**0.384**	**0.233**	−0.088
	(3.44)****	(0.86)	(1.25)	**(1.76)****	**(3.63)******	(0.43)
Higher_Head	0.146	−0.089	**0.336**	0.014	**0.306**	−0.146
	(1.26)	(0.18)	**(3.51)******	(0.04)	**(3.96)******	(0.54)
Land_farm	−0.0002	**0.001**	−0.0004	−0.004	−0.0001	−0.007
	(0.70)	**(2.48)*****	(0.27)	(0.85)	(0.05)	(1.48)
Ratio_Irrigated	**0.108**	−0.4	−0.05	0.052	0.025	−0.213

	(1.93)*	(1.59)	(0.60)	(0.17)	(0.30)	(0.71)
Ratio_Irrigated2	**0.124**	0.18	**0.217**	−0.138	0.036	0.02
	(2.21)**	(0.71)	**(2.56)****	(0.44)	(0.44)	(0.07)
NorthEast	**−0.18**	**0.8**	**0.282**	0.138	0.036	0.156
	(6.27)***	**(7.63)*****	**(8.93)*****	(1.15)	(0.88)	(1.39)
NorthCoast	−0.024	**0.47**	**0.15**	**0.554**	**0.099**	**0.283**
	(1.25)	**(5.77)*****	**(6.02)*****	**(6.10)*****	**(4.00)*****	**(3.19)*****
EastCoast	**0.322**	**0.942**	**0.76**	**0.563**	**0.659**	**0.37**
	(14.10)***	**(10.66)*****	**(27.69)*****	**(5.31)*****	**(24.07)*****	**(3.90)*****
SouthCoast	**0.31**	**0.566**	**0.885**	**0.464**	**0.625**	0.006
	(12.70)***	**(5.70)*****	**(25.44)*****	**(3.73)*****	**(21.50)*****	(0.05)
MYRiver	**−0.272**	**0.382**	**−0.111**	0.114	**−0.151**	0.115
	(14.94)***	**(4.66)*****	**(4.98)*****	(1.23)	**(6.81)*****	(1.34)
SouthWest	**−0.03**	**0.255**	**−0.05**	**−0.145**	**−0.097**	**−0.3**
	(1.70)*	**(3.04)*****	**(2.25)****	**(1.65)***	**(5.02)*****	**(3.58)*****
NorthWest	**−0.219**	**0.255**	**−0.321**	0.183	**−0.058**	**0.229**
	(8.70)***	**(2.16)****	**(8.39)*****	(1.17)	**(1.76)***	**(2.15)****
Hilly	−0.02	**−0.15**	**−0.151**	**0.233**	**−0.056**	−0.084
	(1.48)	**(2.54)****	**(8.63)*****	**(3.49)*****	**(3.47)*****	(1.33)
Mountainous	**−0.077**	**−0.143**	**−0.308**	0.124	**−0.33**	**0.231**
	(4.74)***	**(2.02)****	**(14.49)*****	(1.54)	**(17.63)*****	**(3.37)*****
Electricity	**0.179**	**0.15**	**0.173**	**0.516**	**0.334**	0.467
	(11.26)***	**(2.08)****	**(3.82)*****	**(2.30)****	**(3.69)*****	(0.95)
Constant	6.34	−2.396	7.47	−2.309	8.038	−2.976
	(81.41)	(7.13)	(63.16)	(4.86)	(52.20)	(4.32)
Observations	9365	9365	7785	7785	9139	9139
R-squared	0.24	0.02	0.32	0.02	0.26	0.01
Joint Significance	$F(25, 9339)$ = 122.43	$F(25, 9339)$ = 9.41	$F(25, 7759)$ = 159.50	$F(25, 7759)$ = 4.95	$F(25, 9113)$ = 132.65	$F(25, 9113)$ = 5.16
Prob > *F*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: 1. Robust *t* statistics in parentheses *significant at 10%; **significant at 5%; ***significant at 1%.
2. *R* squared is based on the Equations (1) and (4).

3

While the size of the household's farm land is not significant, the share of irrigated land in the total farm land and its square are positive and significant in 1988. A set of regional dummies is highly significant to reflect the regional disparity of per capita log household income. For example, a dummy variable for East Coast or South Coast is positive and significant. That is, those living in rural areas in coastal regions tend to have higher income than those in the rest. Negative and significant coefficient estimates are found for the dummy variables on 'Middle Yellow River Region', 'South West', 'North West', 'Hilly Area' and 'Mountain Area'. A dummy variable to capture the infrastructure, whether the household belongs to the village with power supply, is positive and significant for all three years.

Table 4 shows that the share of the households with a high degree of vulnerability declined dramatically over the years for both cases, Case (A) after tax and Case (B) before tax. Here, households are classified into three groups according to the vulnerability estimate. The first group of households is 'the high vulnerable' with $\hat{V}_{ht} \geq 0.5$, the second is 'the low vulnerable' $0.25 \leq \hat{V}_{ht} < 0.5$, and 'the non-vulnerable' with $\hat{V}_{ht} \leq 0.25$. The upper panel shows the headcounts of vulnerability based on regressions for all households in the survey data. The results in the lower panel are based on separate regressions at regional level. While the share of the first and the second groups declined over the years, that of the third group increased in both upper and lower panels. That is, as poverty reduced over the years, so did vulnerability. Table 4 also suggests that the agricultural tax and fees increased vulnerability. Together with Table 1, Table 4 implies that the current policy to abolish the agricultural tax and fees would reduce both poverty and vulnerability.

The first three columns of Table 5 show the results of a probit model for static poverty based on the upper poverty line (where the dependent variable is whether the household is poor or not), whilst the last three columns of Table 5 report the results of OLS for the (estimated) vulnerability or VEP measure based on Case (A), 'Income after tax'. With a few exceptions, the signs of coefficient estimates in Table 5 are opposite to those in Table 3, where log per capita household income is estimated. The results of the probit model for static poverty in the first three columns of Table 5 are similar to those of OLS for vulnerability estimates in the last three columns of Table 5. To save space, we focus only on the differences of the results for static poverty and vulnerability.

First, in 1995, the characteristics of the household head (that is, age and its square and his or her marital status) are significant for vulnerability, but not for poverty. Second, the size of farm land is positive and significant for vulnerability in 1988, 1995, and 2002, but not for poverty. This suggests that after controlling for household characteristics, smaller farmers or the landless may not necessarily be poorer, bur more vulnerable than larger farmers. The share of the farmland irrigated is negative and significant for poverty only in 1988, but negative and significant for vulnerability in all three years. This implies the more pronounced role of irrigation to reduce vulnerability of farming households. Third, the results of regional dummies show the generally similar pattern for poverty and vulnerability. That is, households in East and South Coast regions are less poor as well as less vulnerable, while those living in 'Middle Yellow River Region' or 'Mountain Areas' are poorer and more vulnerable. In 2002, however, there are a few variables to show the different coefficient estimates from those in previous years, particularly for vulnerability.

Table 4. Headcount of vulnerability as expected poverty (VEP) for rural China.

		1988			1995			2002		
		Case (A) After tax	Case (B) Before tax	(A) – (B) *difference*	Case (A) After tax	Case (B) Before tax	(A) – (B) *difference*	Case (A) After tax	Case (B) Before tax	(A) – (B) *Difference*
Headcount of VEP (Based on the regressions for all the survey households in rural China)	$\hat{V}_i \geq 0.5$ High vulnerable	23.5%	17.4%	6.1%	16.4%	13.1%	3.3%	2.6%	2.0%	0.6%
	$0.25 \leq \hat{V}_i < 0.5$ Low vulnerable	8.6%	7.7%	0.9%	6.3%	4.8%	1.5%	2.9%	2.3%	0.6%
	$\hat{V}_i < 0.25$ Non vulnerable	67.9%	74.9%	−7.0%	77.3%	82.1%	−4.8%	94.5%	95.7%	−1.2%
Headcount of VEP (Based on the separate regressions for each region)	$\hat{V}_i \geq 0.5$ High vulnerable	24.9%	21.3%	3.6%	18.3%	14.3%	4.0%	5.4%	4.2%	1.3%
	$0.25 \leq \hat{V}_i < 0.5$ Low vulnerable	17.9%	17.4%	0.5%	14.5%	12.6%	1.9%	8.7%	8.0%	0.7%
	$\hat{V}_i < 0.25$ Non vulnerable	57.2%	61.3%	−4.1%	67.2%	73.1%	−6.0%	85.9%	87.9%	−2.0%

Notes: 1. Rural upper poverty line: 525 in 1988, 1157 in 1995 and 1252 in 2002.
2. Poverty lines for 1988 were estimated by deflating poverty lines of 2002 in Khan (2008) using rural CPI.

Table 5. Determinants of poverty and vulnerability.

	Determinants of Poverty (Probit Model) (Based on Upper Poverty Lines)			Determinants of Vulnerability or VEP (OLS) (Based on Upper Poverty Lines) (Based on Income after Tax)		
	1988	1995	2002	1988	1995	2002
	Coef. (*z* value)	Coef. (*z* value)	Coef. (*z* value)	Coef. (*t* value)	Coef. (*t* value)	Coef. (*t* value)
Headage	0.003	0.001	**0.007**	–0.001	**0.008**	**0.004**
	(1.14)	(0.33)	**(2.42)****	(1.25)	**(6.46)*****	**(4.39)*****
Headage2	–0.00004	–0.0000008	**–0.0001**	0.00001	**–0.0001**	**–0.00003**
	(1.19)	(0.24)	**(1.97)****	(1.31)	**(5.44)*****	**(3.06)*****
Married	0.025	–0.003	–0.016	**0.02**	**–0.016**	**–0.014**
	(1.44)	(0.10)	(0.89)	**(3.71)*****	**(1.81)***	**(2.08)****
Femaleshare	**0.086**	0.043	**0.068**	**0.154**	**0.081**	**0.02**
	(2.83)***	(1.30)	**(2.93)*****	**(15.45)*****	**(7.32)*****	**(2.74)*****
Depburden	**0.319**	**0.253**	**0.204**	**0.48**	**0.391**	**0.198**
	(12.09)***	**(9.15)*****	**(10.49)*****	**(51.45)*****	**(36.71)*****	**(21.86)*****
Ratio_Party	**–0.442**	**–0.423**	**–0.183**	**–0.379**	**–0.176**	**–0.054**
	(7.02)***	**(7.20)*****	**(5.67)*****	**(14.41)*****	**(8.86)*****	**(9.18)*****
Majority	**–0.072**	**–0.047**	–0.003	**–0.098**	**–0.096**	**–0.019**
	(3.47)***	**(2.21)****	(0.31)	**(13.73)*****	**(10.44)*****	**(3.68)*****
Elementary_Head	**–0.082**	–0.01	0.03	**–0.12**	**–0.034**	**–0.047**
	(5.31)***	(0.44)	(1.33)	**(22.21)*****	**(4.50)*****	**(4.48)*****
Lowermiddle_Head	**–0.101**	**–0.056**	0	**–0.151**	**–0.098**	**–0.074**
	(5.99)***	**(2.34)****	(0.02)	**(24.85)*****	**(12.59)*****	**(7.22)*****
Uppermiddle_Head	**–0.092**	**–0.094**	–0.024	**–0.164**	**–0.141**	**–0.082**
	(4.42)***	**(3.68)*****	(1.06)	**(21.97)*****	**(16.00)*****	**(7.90)*****
Technical_Head	**–0.14**	–0.04	**–0.071**	**–0.183**	**–0.063**	**–0.086**
	(3.29)***	(0.86)	**(2.45)****	**(14.13)*****	**(4.86)*****	**(7.68)*****
Higher_Head	**–0.13**	**–0.146**	**–0.119**	0.003	**–0.118**	**–0.073**
	(1.90)*	**(2.18)****	**(3.41)*****	(0.16)	**(4.49)*****	**(6.08)*****

Land_farm	0.0001	−0.001	−0.001	**0.0002**	**0.001**	**0.001**
	(0.69)	(0.62)	(0.95)	**(8.45)*****	**(3.90)*****	**(4.91)*****
Ratio_Irrigated	**−0.119**	0.05	−0.025	−0.363	**−0.209**	**−0.063**
	(2.26)**	(0.84)	(0.55)	(21.10)***	**(10.28)*****	**(4.50)*****
Ratio_Irrigated2	−0.055	**−0.165**	−0.006	**0.142**	**0.075**	**0.038**
	(1.02)	**(2.70)*****	(0.14)	**(8.38)*****	**(3.81)*****	**(2.85)*****
NorthEast	**0.199**	**−0.109**	0.009	**0.287**	**−0.153**	**−0.014**
	(8.65)***	**(5.13)*****	(0.48)	**(37.24)*****	**(21.22)*****	**(4.28)*****
NorthCoast	**0.082**	−0.003	0.015	**0.051**	**−0.01**	**0.014**
	(4.38)***	(0.20)	(1.06)	**(10.69)*****	**(1.92)***	**(6.16)*****
EastCoast	**−0.054**	**−0.213**	**−0.109**	0.008	**−0.034**	**−0.009**
	(2.55)**	**(10.53)*****	**(8.19)*****	(1.20)	**(4.98)*****	**(3.30)*****
SouthCoast	**−0.13**	**−0.215**	**−0.136**	**−0.062**	**−0.185**	**−0.04**
	(5.83)***	**(9.96)*****	**(8.25)*****	**(8.93)*****	**(18.44)*****	**(10.50)*****
MYRiver	**0.28**	**0.09**	**0.078**	**0.453**	**0.105**	**0.03**
	(15.38)***	**(5.11)*****	**(5.55)*****	**(71.28)*****	**(17.16)*****	**(8.49)*****
SouthWest	**0.084**	**0.079**	**0.035**	**0.046**	**0.104**	**0.048**
	(4.67)***	**(4.74)*****	**(2.85)*****	**(9.08)*****	**(16.15)*****	**(12.71)*****
NorthWest	**0.266**	**0.311**	**0.078**	**0.347**	**0.425**	**−0.018**
	(9.85)***	**(9.30)*****	**(4.40)*****	**(40.74)*****	**(45.38)*****	**(3.56)*****
Hilly	−0.011	**0.108**	0.011	**0.031**	**0.075**	**−0.004**
	(0.90)	**(8.04)*****	(1.07)	**(7.68)*****	**(19.11)*****	**(1.97)****
Mountainous	**0.045**	**0.189**	**0.189**	**0.139**	**0.355**	**0.121**
	(2.97)***	**(11.30)*****	**(15.69)*****	**(27.40)*****	**(50.22)*****	**(29.91)*****
Electricity	**−0.15**	**−0.168**	**−0.182**	**−0.262**	**−0.242**	**−0.451**
	(9.55)***	**(3.95)*****	**(2.08)****	**(42.98)*****	**(21.51)*****	**(25.84)*****
				0.416	0.194	0.386
				(18.23)	(6.06)	(12.80)
Observations	9365	7785	9139	9365	7785	9139
Pseudo R^2	0.15	0.17	0.14	0.79	0.76	0.44
Wald chi^2 (26)	1477.27	1225.52	887.19	$F(25, 9339) = 1406.44$	$F(25, 7759) = 1153.15$	$F(25, 9113) = 126.39$
Prob > chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Robust z statistics or t statistics in parentheses.
*significant at 10%; **significant at 5%; ***significant at 1%.

For example, it is noted with regard to the vulnerability estimate in 2002 that 'North Coast' is positive and significant (while it is positive and non-significant for poverty in the same year), 'North West' is negative and significant (while it is positive and significant for poverty), and 'Hilly Area' is negative and significant (while it is positive and non-significant for poverty). The better infrastructure (in terms of electricity supply) tends to reduce both poverty and vulnerability. The results in Table 5 suggest that while poverty is closely associated with vulnerability, the latter is a distinct concept from the former because there are factors only associated with vulnerability, not poverty and vice versa.

Table 6 summarises the regional distribution of poverty and vulnerability based on the upper poverty line in China and based on the regressions at regional level in rural areas. Three conclusions can be drawn here. First, there is a considerable regional disparity in both poverty and vulnerability in China. While both poverty and vulnerability are close to zero in some regions or provinces (e.g. Beijing, Jiangsu, Guangdong), they are still high, for example in Guizhou, Yunnan, Shaanxi or Gansu. Second, in most of the regions, both poverty and vulnerability declined over the years. In general, vulnerability declined at a faster pace from 1988 to 1995 and then slowed. Third, not only do poverty and vulnerability move in the same direction, we also observe a one-to-one correspondence in most cases.

One possible explanation as to why VEP is high or low in the province with a similar level of poverty is as follows. The agricultural tax might not be a great burden

Table 6. The regional distribution of poverty and vulnerability based on upper poverty line (%).

	Poverty Head Count Ratio			Vulnerability (VEP)		
	1988	1995	2002	1988	1995	2002
Beijing	8.6	1.0	1.7	27.4	7.0	5.6
Hebei	28.1	21.7	18.4	22.5	6.7	15.0
Shanxi	48.2	48.3	18.5	51.8	23.5	6.7
Liaoning*	25.0	21.7	17.1	41.6	18.4	12.2
Jilin	36.5	17.4	11.9	37.2	13.4	9.1
Jiangsu	24.1	3.4	1.6	5.6	1.6	0.9
Zhejiang	4.4	4.8	6.6	2.9	4.0	2.0
Anhui	33.2	27.6	18.0	77.6	26.2	15.8
Jiangxi	23.5	27.1	11.6	28.4	30.4	9.1
Shandong	26.4	18.9	9.3	24.3	8.1	3.4
Henan	49.8	19.9	13.6	56.0	30.2	9.4
Hubei*	18.4	23.9	11.8	2.1	25.4	9.4
Hunan	11.4	37.9	18.2	15.8	63.0	14.0
Guangdong	4.8	6.1	2.1	42.4	2.8	1.5
Guangxi	37.8	–	23.3	37.4	–	18.3
Sichuan	30.6	43.0	11.0	26.2	38.9	10.1
Guizhou	56.1	59.2	48.2	60.5	59.7	46.5
Yunnan	44.3	45.0	38.8	45.2	41.1	43.2
Shaanxi	58.0	56.9	39.8	86.7	52.0	38.2
Gansu	67.5	68.0	40.4	63.5	66.7	11.2

Note: *The vulnerability estimates are not robust and we have replaced them by those based on regressions for total sample for Liaoning and Hubei.

for farmers in many eastern regions where non-agricultural activities generated a majority of income, whilst the tax was likely to be a great burden for those who lived in the western region where few non-agricultural work opportunities were available. For many people, the after-tax income was at, or just above, the subsistence level, which means that they had little capacity in resisting risk and were very vulnerable, although they were not in poverty.

On the regional disparity, the regional difference in tax and informal fees was likely to be one of the important factors. For example, households in poor western regions might have paid more tax than those in the relatively rich coastal regions. Local governments in rural agricultural regions had to resort to informal fees collected directly from individual households, while coastal regions shifted to the non-agricultural taxes involving less tax collection cost during the period.

Conclusion and policy implications

At the high levels of development that are being achieved in China, one of the major objectives built into the nation's social benefit system has been regarded as reducing income inequality. In order to target the poor effectively, it is essential to identify those who were in poverty or were vulnerable and to understand why they were poor or vulnerable. Drawing upon three comparable national representative household surveys for China in 1988, 1995 and 2002, this paper studies the impact of taxation on poverty and vulnerability of households in rural China. We have found the following: (1) poverty and vulnerability have been reduced significantly in China during the reform period from 1988 to 2002; (2) geographical disparity of poverty and vulnerability is substantial across the period and is increasing; (3) both poverty and vulnerability are associated with household characteristics, such as household head's educational attainment, in which region a household lives, and the infrastructure, such as the access to electricity power supply; (4) however, there are a few factors associated with vulnerability but not poverty, such as, farm land size and the share of the farm land irrigated. That is, landholding or access to irrigation is a key to reducing vulnerability; and (5) the heavy rural tax and its highly regressive nature increased rural poverty and vulnerability levels.

The econometric results that have identified the statistically significant determinants of vulnerability and those of poverty provide some policy implications. For example, larger farm land area and the higher share of irrigated farm land area are both associated with lower vulnerability, but not necessarily with poverty. Better infrastructure in terms of more electricity supply tends to reduce both poverty and vulnerability. Given the difficulty of carrying out land redistributions in rural areas in the short-run, providing rural infrastructure and allowing more access to irrigation for poor farmers would be particularly important in reducing vulnerability. It is conjectured in this context that designing and implementing social safety net policies, such as Rural Public Works, which can provide rural infrastructure and wage employment at the same time, would be a good measure for helping the vulnerable (e.g. Morduch 1994; Scandizzo et al. 2009). If tax revenues are spent in a way that enhances output or increases public infrastructure investment in rural areas, the negative effects of tax may be offset by indirect benefit from the improved infrastructure. There is a strong case for building better rural infrastructure and guaranteeing equal access to infrastructure in rural areas of China.

When the new leadership of Hu Jintao and Wen Jiabao came to power in 2002, the focus was finally shifted to people's livelihood. A fundamental rural tax reform was initialized and the agricultural tax was finally abolished in 2006. It is thus conjectured that since the abolishment of the rural agriculture tax in 2006, the welfare of rural households has been improved and inequality has been reduced in China. This will have to be confirmed by future studies when more recent national household data are available.

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Notes

1. Residents also pay the indirect taxes through their consumption of goods and services. But this paper focuses on direct tax only.
2. The special agricultural product is one of the major items in rural areas including fruits, flowers and mushrooms as well as aquatic products. The tax was imposed in 2000 at an average tax rate of 8% of total value of the special agricultural product.
3. It is argued that the system of taxation has significantly contributed to inequality between the urban and rural over the past two decades (Tao and Liu 2005; Wang and Piesse 2009).
4. It would be ideal to model the endogenous response of households to taxes, fees and charges, for example, by estimating log per capita income or consumption by predicted or lagged taxes and local administrative charges. However, this is not feasible because (i) we do not have panel data by which the lagged response of the household is estimated and (ii) taxes, fees and charges are arbitrarily determined by government and local authorities and they cannot be predicted in nature. Caution is thus required in interpreting the results of the effects of taxes on vulnerability in the present study.
5. The 'income effect' of taxes is supposed to increase economic efficiency under the assumption of competitive markets where individuals, facing heavier taxation, are induced to choose to work harder or longer hours to keep their living standard (Salanié 2003). However, in developing countries with high levels of surplus labour, the utility of leisure is typically very low. When incomes of many rural household are at, or merely above, subsistence level, and far below a comfortable lifestyle, people would have already worked to the point that the marginal product of labour becomes extremely low. The substitution effect of work and leisure is almost non-existent under these circumstances and thus the 'income effect' of taxes is likely to be negligible in rural China.
6. See Imai (2007) for the example of analysing the effects of government policy on poverty in India using the counter-factual approach based on village-level social accounting matrices.

7. This subsection is based on Azam and Imai (2009) and Gaiha and Imai (2009). See also Hoddinott and Quisumbing (2003a, b) who provide a comprehensive review of recent approaches and a 'toolkit' to quantify vulnerability of households and data requirements. 2
8. While the focus of the present paper is on the impact of tax on poverty in a non-welfarist context, Table 1 could be interpreted in light of the optimal taxation literature, which takes account of both income and leisure in the social welfare function (e.g. Mirrlees 1971; Atkinson and Stiglitz 1980; Kanbur et al. 1994). According to this theoretical literature, (i) the optimal taxation implies positive marginal rates of tax for all, including the poor, and (ii) marginal tax rates decline with productive capacity or income. Table 1 suggests declining marginal tax rate and seems in line with the theoretical literature as well as the quantitative simulations by Kanbur et al. (1994). However, whether China's tax system has been optimal is an empirical question that should be examined empirically by the household survey data. We thank Armand Barrientos for pointing this out.
9. It is noted that in rural China land is collectively owned and contracted to households. The land contract fees are charged regardless of the cultivation status.
10. Table 3 presents the regression results for all rural areas. Some caution is required to interpret the results because of the generally low values of R^2 (0.24–0.32) for log per capita income. We have repeated the regressions at regional levels and found R^2 is generally low except North West (see Appendix B). Regression results at regional level are broadly similar to those for all rural areas. They can be provided on request.

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Appendix A. Definitions and descriptive statistics of variables

		1988					1995					2002				
Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Log (consumption)	Log of per capita household income	10162	6.501	0.629	0.405	9.962	7941	7.469	0.755	1.678	10.906	9175	7.751	0.699	0.405	10.864
Headage	Age of a household's head	10153	43.248	11.385	0	86	7941	44.056	10.551	0	95	9175	46.395	10.307	16	88
Married	Whether the household head has a spouse	10162	0.919	0.307	0	6	7941	0.965	0.185	0	1	9168	0.960	0.196	0	1
Femaleshare	Share of number of female in total household members	10162	0.484	0.165	0	1	7941	0.482	0.157	0	1	9175	0.474	0.152	0	1
Depburden	Share of household members under 15 years old or above 65 years old in total household members	10162	0.327	0.213	0	1	7941	0.286	0.218	0	1	9175	0.237	0.212	0	1
Ratio_Party	Share of numbers of the members of the communist party in total household members	10162	0.036	0.092	0	1	7941	0.043	0.108	0	1	9175	0.064	0.138	0	1
Majority	Whether the household belongs to ethnic majority or	9855	0.928	0.258	0	1	7796	0.931	0.254	0	1	9166	0.876	0.329	0	1

(*continued*)

Appendix A. Continued.

		1988					1995					2002				
Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
	not (majority = 1 / minority = 0)															
Elementary ~ d	Whether the education attainment of the household head was from elementary school or not	10162	0.412	0.492	0	1	7921	0.377	0.485	0	1	9175	0.308	0.462	0	1
Lowermiddl ~ d	Whether the education attainment of the household head was from lower middle school or not	10162	0.306	0.461	0	1	7921	0.418	0.493	0	1	9175	0.479	0.500	0	1
Uppermiddl ~ d	Whether the education attainment of the household head was from upper middle school or not	10162	0.101	0.301	0	1	7921	0.123	0.329	0	1	9175	0.152	0.359	0	1
Technical_ ~ d	Whether the education attainment of the household head was from technical school or not	10162	0.012	0.108	0	1	7921	0.016	0.124	0	1	9175	0.026	0.160	0	1
Higher_Head		10162	0.005	0.071	0	1	7921	0.005	0.073	0	1	9175	0.009	0.094	0	1

	Whether the education attainment of the household head was from college or university															
Land_farm	The size of the household's farm land	9750	11.915	37.131	0.1	970	7941	6.346	5.808	0	54.1	9175	6.083	7.149	0	180
Ratio_Irri ~ d	The ratio of irrigated land to the total farm land	10162	0.454	0.427	0	1	7941	0.516	0.432	0	1	9175	0.519	0.426	0	1
NorthEast	Whether the household is located in north east region	10162	0.087	0.282	0	1	7941	0.075	0.264	0	1	9175	0.101	0.301	0	1
NorthCoast	Whether the household is located in north coast region	10162	0.148	0.355	0	1	7941	0.163	0.369	0	1	9175	0.126	0.332	0	1
EastCoast	Whether the household is located in east coast region	10162	0.103	0.305	0	1	7941	0.113	0.316	0	1	9175	0.104	0.306	0	1
SouthCoast	Whether the household is located in south coast region	10162	0.081	0.273	0	1	7941	0.062	0.242	0	1	9175	0.058	0.233	0	1
MYRiver	Whether the household is located in middle yellow river region	10162	0.163	0.370	0	1	7941	0.163	0.369	0	1	9175	0.142	0.349	0	1
SouthWest	Whether the household is located in south west region	10162	0.178	0.383	0	1	7941	0.174	0.379	0	1	9175	0.192	0.394	0	1
NorthWest	Whether the household is located in north west region	10162	0.051	0.220	0	1	7941	0.038	0.191	0	1	9175	0.077	0.267	0	1

(*continued*)

Appendix A. Continued.

Variable	Description	1988					1995					2002				
		Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Hilly	Whether the household is located in hilly area	10162	0.304	0.460	0	1	7941	0.302	0.459	0	1	9155	0.308	0.462	0	1
Mountainous	Whether the household is located in mountain area	10162	0.200	0.400	0	1	7941	0.230	0.421	0	1	9155	0.218	0.413	0	1
Electricity	Whether the household belongs to the village with power supply or not.	10059	0.869	0.338	0	1	7941	0.984	0.126	0	1	9175	0.998	0.047	0	1

Notes: 1. The base group for the household head educational attainment is illiterate.
2. Provinces in China is divided into 8 regions as follows: Northeast region: Liaoning, Jilin, Heilongjiang; North coast region: Beijing, Tianjin, Hebei, Shandong; East coast region: Shanghai, Jiangsu, Zhejiang; South coast region: Fujian, Guangdong, Hainan; Middle Yellow River region, Shaanxi, Shanxi, Henan, Neimenggu; Middle Changjiang region: Hubei, Hunan, Jiangxi, Anhui; Southwest region, Yunnan, Guizhou, Sichuan, Chongqing, Guangxi; Northwest region, Gansu, Qinghai, Ningxia, Xizang, Xinjiang.
3. The base group for the regional variables is middle Changjiang (whether the household is located in middle Changjiang region).
4. There is only one common variable (Access to electricity) for village information throughout CHIP 1988, 1995 and 2002 although 1995 and 2002 have a few variables for the village.

Appendix B. *R* square of regional regressions for estimating VEP

	1988		1995		2002	
	Log (per capita income)	Variance	Log (per capita income)	Variance	Log (per capita income)	Variance
North East	0.16	0.03	0.09	0.03	0.19	0.04
North Coast	0.12	0.02	0.12	0.02	0.10	0.03
East Coast	0.19	0.06	0.27	0.03	0.16	0.07
South Coast	0.21	0.03	–	–	0.26	0.05
MY River	0.14	0.02	0.10	0.01	0.09	0.02
MC Jiang	0.15	0.01	0.23	0.03	0.13	0.02
South West	0.17	0.02	0.15	0.02	0.22	0.02
North West	0.53	0.06	0.75	0.10	0.35	0.03