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Poverty dynamics in rural Sichuan between 1991 and 1995

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Summary

Studies from several countries suggest that poverty is a dynamic phenomenon with households moving in and out of poverty all the time. This paper describes the dynamics of poverty in rural Sichuan using a unique panel data set of 3,311 households surveyed between 1991 and 1995. Poverty is found to be extremely dynamic with over 30 per cent of households falling below the lower consumption poverty line at some point in the five years. Most households who fall into poverty experience only one or two years of poverty, but poverty is persistent with the total time spent in poverty more likely to be endured as a single spell of poverty than multiple repeated spells. A new measure of vulnerability is constructed and compared with traditional poverty measures. Households are found to be highly vulnerable to falling into poverty even when their average incomes are some distance above the poverty line. The results hold implications for targeting and anti-poverty policy in China.

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1 Introduction

China is often hailed as one of the most successful examples of poverty reduction in history. The economic reforms initiated in 1978 led to a dramatic increase in the rate of economic growth. The average annual rate of growth of GDP was 10.2 per cent during the 1980s leading to a rapid decline in the proportion of the population below the official poverty line (Khan 1998). Although estimates vary, all sources show a huge decline in poverty between the late 1970s and the mid 1980s – for example, a World Bank study estimated that the proportion of the rural population in poverty declined from 33 per cent in 1978 to 11 per cent in 1984 (World Bank 1992). However, despite continued high growth rates in the second half of the 1980s, the decline in poverty slowed considerably in the second half of the 1980s and the early 1990s, even reversing in some places. The principal reason for the smaller impact of growth upon poverty in this period has been because the non-poor have benefited proportionately more from growth than the poor leading to a considerable increase in income inequality in China between the late 1980s and the mid 1990s (Gustafsson and Shi 1998; Ravallion and Chen 1999; Yang 1999; Yao 1999). This has sparked a debate about the policies necessary to ensure that future growth is successful in reducing poverty.

There are numerous anti-poverty policies open to governments. These include investments in infrastructure in poor areas, market reforms, measures to enhance social protection, education, locational subsidies and investments and so forth. Aggregate statistics on poverty and inequality provide useful information on the location of poverty, the characteristics of the poor and the relative contribution of different income sources to inequality. However, they are of less help in determining the appropriate balance between such policies. For this it is necessary to understand the reasons for the observed changes in poverty – in other words, to examine the dynamics of poverty and the causes of entry into and exit from poverty.

There is a popular perception that poverty in both developing and industrialised countries is a structural, long-term phenomenon. Yet evidence from longitudinal household surveys in industrialised countries such as Germany, the UK and the USA indicates that poverty is mostly a temporary phenomenon (Duncan, Gustafsson *et al.* 1993). Rather than the same people remaining below the poverty line year in and year out, a high percentage of households have been shown to move into poverty due to temporary shocks (such as illness or loss of employment) that are reversed just one or two years later. Similarly, many of the people who escape poverty only succeed in doing so for one or two years before a reversal in their circumstances forces them back below the poverty line. Viewed in this light the ‘poverty problem’ is one involving a large turnover of vulnerable people rather than a large hard-core of the chronically poor.

Work using longitudinal studies in developing countries seems to confirm the importance of a dynamic perspective on poverty. For example, work by ICRISAT in eight villages in southern India in the late 1970s and early 1980s found that around a quarter of poor households moved out of poverty from year to year (see Walker and Ryan 1990). More recently, Baulch and Hoddinott review work on panel data

sets from 10 different developing countries. They show that if households are split into those who are always poor, those who are sometimes poor and those who are never poor, the percentage of households which experience poverty for one or two time periods is almost always larger than the always poor (Baulch and Hoddinott 2000).

Static measures of poverty cannot, by definition, capture the welfare impact of movements in and out of poverty. Some authors have responded to this problem by developing measures of chronic and transient poverty and have shown that the determinants of transient poverty differ in important ways from the determinants of chronic poverty (Jalan and Ravallion 2000). However, evidence from participatory studies of poverty indicate the importance to poor people of reducing ‘vulnerability’ – that is the risk or probability of being in poverty – as well as reducing the extent of poverty (Narayan *et al.* 2000; World Bank 2000). We therefore adapt Pritchett *et al.* (2000) and attempt to construct a new inter-temporal measure of household vulnerability. Our measure takes explicit account of the fact that households differ both in their mean incomes and in the variability of those incomes. We compare our new measure of vulnerability with traditional poverty measures.

The nature of poverty dynamics has immediate relevance for the design of cost-effective poverty reduction strategies. Knowledge of the factors associated with movements in and out of poverty ought to allow anti-poverty policies to be targeted at particular vulnerable groups. If, for example, loss of employment or changes in family status (in particular child-birth, divorce and widowhood) typically precede movements into poverty – as has been found in many industrialised countries – then employment guarantee schemes combined with support for mothers and female headed households have a crucial role to play in anti-poverty initiatives. Furthermore, information concerning the length of time that different categories of households spend in poverty, and the frequency with which spells of poverty recur, is important in determining the nature of such interventions. Numerous short, recurring spells of poverty indicate that priority should be given to measures such as safety nets, credit and insurance schemes designed to support vulnerable households during hard-times. In contrast, extended spells of poverty point to policies (such as education, investment in infrastructure, land reform, or improved disability and old age pensions) that improve the assets and entitlements of the poor.²

This paper investigates these issues using a household panel study for rural Sichuan between 1991 and 1995. This data set is particularly useful because of the special effort made by the Chinese authorities to avoid non-sampling errors in its collection. Furthermore its coverage of 3,311 households makes it one of the largest panel datasets from the developing world and enables us to disaggregate changes in poverty by a range of locational and household characteristics. Finally, the data cover a period in which a major market liberalisation took place thereby opening up the possibility of exploring the impact of that liberalisation upon poverty.

The next section describes the sampling design and the content of the surveys, including details on the adjustments which have been made to the data to ensure that the income and consumption measures

² Although Devereux (2001) shows that measures to address chronic poverty can also reduce transitory poverty.

calculated conform to internationally recognised conventions. This section also discusses the construction of the panel data set, the measures taken to account for household composition and changes in prices over time, as well as the construction of the poverty lines. The following section presents the results including measures of poverty for each of the five years of the panel. Several indicators of the extent to which households move in and out of poverty are also presented along with an analysis of the income sources of the poor. The methodology used in calculating a new measure of household vulnerability is outlined and measures of vulnerability are presented and compared with alternative indicators of welfare. The final section summarises the key findings and draws some tentative policy conclusions from the results.

2 The data

The data which we use are from a five year panel of 3,311 households in rural Sichuan from 1991 to 1995. This data was collected by the Rural Household Survey (RHS) team of the State (now National) Bureau of Statistics. The administration of the RHS has been described in detail elsewhere (Chen and Ravallion 1996). However, it is worth highlighting some of the key features of the RHS since they impact strongly upon the quality and reliability of the data. Firstly the RHS is administered directly by the NBS through its provincial and local survey network. This ensures that the data collected are free from interference by local governments. Secondly, rather than employing a single interview approach, each selected household maintains a daily diary as well as two transaction books – one for cash transactions and one for goods. An assistant interviewer is supposed to visit each household every two weeks to check the books, assist the household in filling them in and transfer the information to the county level. The assistant interviewer is usually a cadre and is therefore familiar with the local area and has a secondary school qualification. A member of the county level team visits each household once a month. Data processing is done by the county level officials who then forward the data to the provincial level team who are responsible for data cleaning and reporting. Once this has been done, all the data (both raw and processed) is sent to the NBS in Beijing for analysis and the production of summary statistics. Partial data is sent to the NBS every quarter and the full accounting pages are submitted at the end of each year. The unusual rigor applied to the collection, checking and processing of the RHS data means that the RHS is less likely to suffer from a variety of non-sampling errors common to household surveys in many other countries.

2.1 Sample design

The sample design is based on a three-stage procedure: first clusters are selected at the county and then the village level and then households are selected within each village. In total, 55 counties were selected from around 206 in the province,³ within each county a small number of villages (typically 10) was chosen; finally 10 households were selected from each village. The selection of clusters and observations at each

³ The number of counties in the province varied between 1991 and 1995 due to administrative changes.

stage is implemented using the random start, symmetric and isometric sampling method: counties are ranked according to their average per capita income; a random starting position is then chosen and counties are selected in roughly evenly spaced intervals thereafter.⁴ The same procedure is followed to sample villages within each selected county and to select households from each village. If the household head died during the period of the survey, the household still stayed in the panel. However, if the whole household moved away, then it was replaced although we were informed that this is rare. Counties and villages are ranked using information on household net incomes and population from a once-off survey done at the county and village level in 1989.

Note that the sample design introduces both clustering and stratification into the survey. Unfortunately it has not been possible so far to take this into account in order to calculate population estimates from the sample because the NBS did not calculate any sampling weights and we do not have the necessary information from which to construct them. Consequently this paper reports sample estimates rather than population estimates and may suffer from the attendant biases.

2.2 Content of the survey

The questionnaire collects basic socio-economic information coded into 22 subjects, 1,401 items in all.

The survey includes data on:

- General information about the community and the rural area (e.g. geography, facilities and infrastructure, ethnic composition).
- General information about the household and its individual members (e.g. family size and type, age, education, ability to work, school enrolment, occupation).
- Fixed assets of production (the overall value of assets and the value and quantity of the main productive assets at year-end).
- Area and type of cultivated land.
- Construction and housing data (number of rooms, area and value of new buildings and total value at year-end).
- Ownership of durable goods.
- Itemised data on quantities of agricultural production.
- Quantity and value of main products sold.
- Grains stocks and flows: production, detailed uses (consumption, sale, seeds, forage, lent out etc.) and stocks at year-end.
- Detailed household's gross income in cash and in-kind (including wages, income from family business, transfers and assets income).

⁴ See National Bureau of Statistics (2000) for details of the sampling methodology.

- Total family expenditure in cash and in-kind (divided into expenditure for family business, productive assets, taxes and payments to the collective unit, itemised living expenditure and remittances given).
- Cash flows (income and expenditure in cash only, including credits, saving and deposits) and
- Value and quantity of main items purchased by the household (both consumption and durable goods).

The questionnaire was expanded slightly between 1992 and 1993 to provide a more detailed breakdown of some categories. However, the main categories of information collected remained the same in the two questionnaires so it is relatively straightforward to match variables between the two surveys.

2.3 Income and consumption data

The data set contains detailed information on both household income and consumption. Net income refers to the household's income in cash and in-kind after the deduction of all costs and taxes. It is obtained by subtracting the following items from gross income: family business expenditure, depreciation of fixed productive assets, business tax, payments to collective unit (including land rental and contributions for collective provision of infrastructure), the survey subsidy, and remittances to friends and relatives. Net income has four components: *wage or employment* income; *business profits*, which is the income from family businesses minus the expenditure on those business, depreciation of assets and business taxes; *transfer income*, which consists of net remittances received from friends and family members and other transfers and subsidies which includes pensions for those people who worked for state owned business, army pensions for the disabled or for the family of the deceased, benefits for the 'five category' households,⁵ special awards, compensation for the use of privately owned land, and income transferred from other sources e.g. scholarships in schools; and *assets income*, which includes interest, dividends, rent (including from housing and machinery but not imputed rent), 'special rights' fees including royalties, income from collective assets and capital gains.

Consumption expenditure refers to expenditure on food, clothing, housing, commodities, health, education and recreation, transportation and communication. Amendments were made to three categories of expenditure (own consumption of grain, durable goods, and housing) to ensure that the final aggregate measure of consumption expenditure conforms to international accounting conventions.

Grain consumption includes rice, wheat, potatoes, corn, sorghum and other grains except any beans that are not considered a staple, and is calculated on the base of pre-processed quantities, i.e. including the chaff. In-kind grain expenditure is valued at a mixed price based on list prices, negotiated prices and free

⁵ 'Five category' households (wu bao hu) are those who are: without neighbours; widows or widowers; one person households, or otherwise with 'no economic resources'. They can apply for five categories of support: food; clothing; fuel; education; and funeral expenses.

market prices. For consistency with cash expenditure and to reflect the increased marketisation of the economy, we follow the practice of Chen and Ravallion and re-value the own consumption of grain (Chen and Ravallion 1996). This revaluation can only be implemented for grains due to the lack of the relevant information for other goods. However, the problem of valuation for own-consumption is particularly severe for grains, since in-kind expenditure amounts to an average of 87 per cent of total household grain expenditure in our dataset.

The revaluation of the own-consumption of grain at market prices is complicated by the fact that the values reported for own-consumption were measured at unknown official prices. Consequently, both the market and the official prices had to be estimated. To estimate the market price of grains sold by each household, the value of grain sold in the market is divided by the quantity of grain sold. The median unit price received by households is used as an estimate of the market price of grain. To estimate the official price, all households that did not purchase grains from the market but that did consume are selected since their consumption will have been valued only at official prices. For each of these households, the value of grain consumed is divided by the total quantity consumed to arrive at an estimate of the official price. The median unit price faced by these households is taken as an estimate of the official price. Finally the quantity of home produced grain consumed by the household is obtained by subtracting cash grain expenditure from total grain expenditure and dividing by the estimated official price. These quantities are then re-valued at 90 per cent of the estimated market price; the figure of 90 per cent is used to account for the fact that the quality of grain for home use is lower than that of the grain sold on the market.

The NBS data on consumption expenditure include one-off expenditure on durables in the year in which the purchase was made. However, durable goods, by definition, last for a number of years. Thus the appropriate measure for the consumption of durable goods is the value of the services that the household receives from these goods. Ideally one should calculate the 'user-cost' or 'rental equivalent' of the durable good.⁶ However, this relies on the availability of information on the prices of the durable good in each year, the real interest rate in each year and the rate of depreciation. Unfortunately, this information is not available for the durable goods in our data. Consequently we approximate the rental value of the stock of durables in each year as 10 per cent of the value of the stock of durables at year-end. To determine the value of this stock, we calculated household unit prices for each durable and then valued the stock of durables owned by the household at the end of each year using the median prices for each durable in that year.

A similar problem is encountered in relation to housing expenditure since the NBS's expenditure data include all housing expenditure in the year in which the spending took place. Again best practice would impute the rental value of such expenditure using information about rents in the local area. However, in the absence of such rental data, five per cent of the value of the dwelling is included in total consumption on the assumption that housing investments have an average lifetime of 20 years.

⁶ See Deaton and Zaidi (1999) for an excellent exposition of best practice in the construction of consumption aggregates including durable goods.

Thus the final value of consumption expenditure used is obtained by subtracting the stated expenditure on own-consumption of grain, durables and housing from total living expenditure and adding the adjusted values described above.⁷

2.4 Panel construction

The survey from which the panel was constructed was an annual survey of 5,500 households undertaken by the NBS in Sichuan. Because the NBS surveys the same households in each year, rotating the entire sample only every 4–5 years depending on the province, it is possible to construct a panel data set. However, because the survey was not originally designed to be a panel, the household code is not necessarily kept the same between different years. In 1993 a variable was introduced into the survey to indicate whether the household had been surveyed in the previous year. This allowed the NBS to exclude households from the panel who responded that they had not been surveyed in the previous year. However, this variable was not available in 1992 making it more difficult to match households between 1991 and 1992. Furthermore, the potential changes to the household code made exclusive reliance on the matching variable unwise.

Consequently, the NBS tracked households by looking at characteristics such as the household head's age, educational level and so forth. The manner in which this was done is important since it determines the extent to which we can be sure that the households in the 'panel' actually constitute the same households in each year. The NBS took the following steps to match households between different years:

Starting with all households, households were deleted from the panel if:

- The household wasn't surveyed every year (i.e. the variables indicating county, village and household were not present for each year)
- The household in 1995 was not surveyed in 1994 (according to the matching variable)
- The variables Geography, Early liberated area, Boarding area, and Minority area do not have the same value between 1991 and 1995.

The resulting set of households still contained a measure of ambiguity. A scoring approach was therefore applied to the remaining households. A score of one was added to the household score when: the variable Family Type⁸ had the same value across all five years; Highest education level had the same value across all five years; the number of persons in the household had the same value across all five years; the difference between year-end deposits and year-beginning deposits between adjacent years lay within the

⁷ In addition, the variable representing household fuel expenditure was dropped from the consumption aggregate because it experiences implausibly wide swings between one year and the next. The reason for this is not clear – it could for example be due to communal purchasing of fuel attributed to individual households. We omit it in order not to distort movements in aggregate consumption; however fuel expenditure on average accounts for only 5.4 per cent of total consumption expenditure (and this percentage is exaggerated by a small number of the extraordinarily high values) so we do not believe that its omission will lead to serious biases.

⁸ The variable Family Type indicates the composition of the family e.g. whether the family consists of a single person, husband and wife, husband and wife with one child, husband and wife with two children, etc.

range [-200,200]; and the difference between year-end cash-in-hand and year-beginning cash-in-hand between adjacent years lay within the range [-200,200]. Households with a score of three or less were then dropped from the panel except if the age difference of the household head between each pair of years fell into the range [-1,2]. The resulting panel contained 3,311 households.

Although the above procedure is derived from the experience of the NBS with the data set, it is inevitably a somewhat ad hoc process. To assess whether the overall pattern of results obtained are robust to the choices made in constructing the panel, we reconstructed five different panels from the original individual year data sets using a variety of approaches to matching households between years.

Panel 1 used the matching variable as the only criterion for excluding households – households with the same county, village and household number were deleted from all years of the panel if in any year the household responded that they were not surveyed in the previous year. This led to the construction of a panel containing 4,599 households in each year; Panel 2 narrows Panel 1 by also eliminating households from the panel whenever variables describing locational characteristics – Geography, Early liberated area, Boarding area, and Minority area – changed over the five years. This created a panel with 3,962 households in each year; Panel 3 narrows Panel 2 further by incorporating the scoring system described above, yielding a panel with 3,354 households; Panel 4 widens the scoring criteria to include changes in the ages of the head of the household and their spouse without any change in the household size, and changes in the level of education of the household head and spouse when neither are students. A household is eliminated if they score five or less out of the nine criteria (the original five criteria plus the additional four). This led to a panel with 3,549 households; finally Panel 5 narrows the scoring criteria to include only the Family Type variable and the four new criteria introduced in Panel 4, with a threshold of three or less resulting in exclusion. This gave a panel with 3,024 households.

Clearly the use of different panels will lead to somewhat different results – for example poverty tends to increase as the panel becomes more restrictive which may indicate that the matching criteria are excluding better off households whose locational, demographic and educational characteristics may fluctuate more than those of poorer households. Our interest, however, is whether the overall pattern of results is robust to the manner of panel construction. Generally speaking this is the case. Therefore, for brevity we report below the results using the original panel constructed by the NBS and note in the text cases where the overall results are sensitive to manner of panel construction.

2.5 Accounting for household composition

Conventionally, estimates of household income and consumption expenditure are divided by household size to obtain per capita measures of consumption. However, there is now considerable evidence that the use of per capita measures may be misleading for two reasons: firstly children have lower consumption needs than adults – a per capita consumption measure therefore tends to underestimate household welfare because it regards the needs of a small child as the same as those of an adult; secondly households are subject to economies of scale due to the presence of common goods such as housing, cooking facilities, utilities etc. Again failure to account for such economies of scale will typically underestimate household

welfare since some goods and services may be consumed in equal measure by all members of the household whilst only appearing in the aggregate household consumption expenditure once. Estimates in the literature of the extent of household economies of scale vary considerably (Lanjouw and Ravallion 1995). Furthermore, the profession does not currently have an acceptable theory for how to handle differing needs and economies of scale (see Deaton 1997) for an exposition of the theory and debate over the identification of equivalence scales; Deaton and Muellbauer (1980) and Deaton and Muellbauer (1986) provide a detailed description of the theory). Despite this we feel that it is better to take some account of the impact of differing needs and economies of scale than to ignore the issue altogether. We therefore construct per adult equivalent measures of income and consumption based upon the World Health Organisation adult equivalence scale presented in Appendix 1. This scale is derived from detailed studies of the nutritional requirements of males and females of different ages in developing countries (West *et al.* 1988).

2.6 Accounting for changes in prices

The Consumer Price Index used to deflate nominal variables is taken from the published data in the *China Statistical Yearbook* for rural Sichuan. It is based on a basket of 382 commodities and services and compounds the year-on-year rates using 1991 as the base year.⁹ Published data for 1991 to 1993 used mixed prices, rather than market prices to value certain goods which may give an underestimate of the rate of increase of consumer prices (and therefore an overestimate of the improvement in real incomes and consumption). Unfortunately, we have no means of correcting this since we do not have any information on the market prices of the goods included in the basket.¹⁰ Published price indices for 1994 and 1995 appear to use free market prices and so we have used these values. The index used is shown in Table 2.1.

Table 2.1 Consumer Price Index for rural Sichuan

Year	CPI rural Sichuan
1991	1
1992	1.046
1993	1.221
1994	1.495
1995	1.769

⁹ Note that since the CPI is a year-on-year Paasche index, compounding in this way yields a mixed index rather than a true Paasche index for the whole period.

¹⁰ It is not advisable to use our dataset to correct for these since our panel data contains information on only 17 commodities.

2.7 Poverty line

The poverty line is composed of two elements, the food and non-food components:

$$Z = Z^F + Z^{NF}$$

The food poverty line is based on the basic nutrition requirement of individuals, using the composition of food consumption of those families around the poverty line. The non-food component has been estimated using the methodology presented in Ravallion and Bidani (1994).

The first step in calculating the food poverty line was to determine the actual food consumption and calorie in-take of the sub-set of families with net average per capita income between 400 and 500 yuan. The quantities of each element in the food basket were then scaled (keeping the weights attached to each component unaltered) until the basket supplied the basic nutrition requirement of 2,100 calories. The average prices of the various food items were determined based on sale prices for own-produced food – the main component – and purchase prices for the food that was bought. The food poverty line was then calculated from these quantities and prices – in 1994 it amounted to 452 yuan.

Households also have basic non-food needs such as housing, clothing, heating and transport costs. It is therefore necessary to add a non-food component to the food poverty line. The non-food component of the poverty line is determined using a food share regression of the form:

$$S_i = a + b * \log (X_i / Z^F) + \text{error term}$$

Where:

S_i = share of food expenditure in total expenditure

X_i = households' average net per capita income

Z^F = food poverty line

The parameters of this regression have been estimated using data from 5,500 families in Sichuan in 1994; the results obtained are: $a = 0.7065$ and $b = -0.0514$. Using these parameters a low and a high poverty line have been calculated: the low poverty line has a non-food component equal to the expenditure on non-food items of those households whose *total* expenditure is equal to the food poverty line – this can be regarded as a lower limit of essential non-food expenditure, since these households are choosing to spend on these items at the expense of meeting their nutritional needs; the high poverty line is based on the non-food expenditure of those whose *food* expenditure is equal to the food poverty line – that is, the typical non-food expenditure of those who just meet the nutritional standard. The lower poverty line for 1994 is 585 yuan per capita, while the upper line is 655 yuan per capita. These values were then deflated by the price index for 1994 (1.495) to obtain per capita poverty lines of 391 and 438 yuan in 1991 prices.

However, as mentioned above, to take into account the fact that food for own-consumption is valued at market prices despite its lower quality, own-consumption in the data set has been re-valued at 90 per cent of market prices. To be consistent with our previous adjustment, the poverty line was deflated

by 1.1. In this way we get a lower per capita poverty line of 356 (the higher poverty line is 398 yuan), which is close to the poverty line of 360 yuan suggested in Tong and Lin (1995). Also this adjustment reduces the ratio of the poverty line to mean per capita income from 64 to 58 per cent, which is closer to the 50 per cent ratio often used in calculating relative poverty lines including in (Khan 1998).

Note that these are per capita poverty lines. However, we are using per adult equivalent measures of income and consumption. Therefore, the per capita poverty lines were transformed into per adult equivalent values by multiplying by the average household size in 1991 (4.36) and dividing by the average number of adult equivalents in the same year (3.80). This yields per adult equivalent lower and upper poverty lines for 1991 of 409 and 457 yuan respectively.

3 Results

The next sub-section presents descriptive statistics for both income, consumption and a variety of demographic, educational, geographical and asset ownership characteristics. We show how these characteristics vary across years and by income quintile. The following sub-section calculates measures of poverty using both income and consumption, and explores the extent of transitory and permanent poverty, the number of years and the number of spells of poverty experienced by households and the movements in and out of poverty across the panel. A measure of vulnerability is derived in the subsequent sub-section and the relationship between vulnerability and measures of poverty is described.

3.1 Descriptive statistics

Table 3.1 presents descriptive statistics for the main demographic, educational and geographical variables in the survey. In addition it presents information on the households 'ability to work'¹¹ and ownership of key productive assets. An important demographic shift occurs in the sample between 1991 and 1995. Average household size decreases from 4.36 to 4.15 in the five year period, a 5 per cent reduction, while the number of adult equivalents is reduced by 4 per cent. The dependency ratio¹² drops from 56 to 49 per cent. This is explained by a halving of the household members under the age of five along with small increases in the proportion of household members in each of the other age groups. It is likely that this represents a life cycle effect associated with the panel rather than a more general demographic shift in Sichuan. Because the dataset tracks the same households over five years it prevents the inclusion of new households entering their reproductive years; however, households who had young children at the beginning of the panel are tracked and their children leave the youngest age group as the panel continues.

¹¹ There are actually three categories: full ability to work, half ability to work and no ability to work. This variable takes into account both the ability to work and the person's age. More precisely:

Full ability: Males aged 18-50 or Females aged 18-45

Half ability: Males aged 16-17 or 51-60; or Females aged 16-17 or 46-55; and are able to work

No ability: Under or over age and don't or can't work. But under/over age people that do work either full or part-time are classified as Full ability or Half ability accordingly.

¹² The ratio of the number of individuals in a household below the age of 16 and above the age of 64 divided by the number of members between these ages.

There are slightly fewer female members in households than male members and this proportion has declined slightly over the panel. However, the percentage of female-headed households stays roughly constant at 5.5 per cent.

The education variables show a marked gender gap with an average of around 15 per cent of males having no education compared with 30 per cent of females. Indeed males are better educated at every level of educational achievement although educational levels are not high with only 6 per cent of males and 2 per cent of females having higher education. The average level of education improves over the five years although this is again likely to be a life-cycle effect. Almost 90 per cent of household heads have some form of education, but for nearly half of household heads this consists only of primary education and only 0.5 per cent of household heads have either secondary or tertiary education.

In terms of the ability to work, the number of household heads with full ability to work declined from 85.1 to 83.7 per cent, while the percentage of those with part-ability to work increased from 10.8 to 12.4 per cent. Only around 0.5 per cent were classified as having no ability to work. However, labour force participation within households is increasing for both men and women, although again this may be partly explained by the decreasing dependency ratio. Participation in the labour market is roughly equivalent for males and females, but female household members are more likely to have 'half-ability' to work.

The survey questionnaire categorises the geography of each area into three types: flat, hilly and mountainous. Most households (60 per cent) live in hilly areas, but over a quarter live in mountainous areas. However, the minority of households living in flat areas used on average more than three times the cultivated land area used by those living in hilly areas, although there are marked differences in the areas used by different households in both flat and hilly areas as shown by the large average standard deviations for these variables. The average area of cultivated land used in flat areas increased steadily between 1991 and 1994, but then fell sharply in 1995. By contrast, the average area of cultivated hilly land remained roughly constant between 1991 and 1994 but increased by one third between 1994 and 1995.

The value of total fixed productive assets rose by almost 12 per cent in real terms between 1991 and 1994, but dropped by 5 per cent in the final year of the panel. The categories that represent the highest proportion out of total value were buildings (43 per cent in 1995) and draught/product animals (25 per cent). Average values conceal marked differences between households, which are evident if one looks at the standard deviations and the percentages of households owning individual assets of production. In 1995 only 40 per cent of households (down from 46.5 per cent in 1991) had at least one draught animal and barely more than one third owned one or more product animals. Each of the other productive assets enumerated in the survey are owned by less than 4 per cent of households suggesting that household farming activities are characterized by extremely low levels of investment.

Table 3.1 Descriptive statistics of explanatory variables

Variables	Mean					Av. std. dev.
	1991	1992	1993	1994	1995	
<i>Demographic variables</i>						
Household size	4.36	4.32	4.25	4.20	4.15	1.30
Adult equivalents	3.80	3.77	3.72	3.68	3.65	1.13
Dependency ratio	0.56	0.53	0.52	0.50	0.49	0.51
% of hh. Members under age 5	9.98	8.49	6.99	5.88	5.02	12.76
% of hh. Members aged 6–15	16.12	16.06	16.59	16.64	16.86	18.45
% of hh. Members aged 16–64	70.08	71.66	72.45	73.27	73.71	20.94
% of hh. Members over 65	3.82	3.79	3.97	4.21	4.41	10.21
% of females	49.24	49.17	48.99	48.72	48.74	16.66
% of female headed households	5.56	5.53	5.41	5.71	5.65	22.94
<i>Education variables</i>						
% of males with no education	17.82	17.33	15.07	14.18	14.01	25.75
% of females with no education	33.07	32.46	30.28	28.77	27.56	34.88
% of males with lower ed.	75.84	76.25	79.00	79.56	79.42	30.38
% of females with lower ed.	63.76	64.27	67.47	68.70	69.90	35.66
% of males with higher ed.	5.08	5.17	5.93	6.25	6.57	17.76
% of females with higher ed.	1.95	2.07	2.23	2.54	2.54	11.14
Hous. Head with no education (%)	11.54	11.45	10.81	10.84	10.78	31.39
Hous. Head with primary education (%)	47.45	47.33	48.32	47.75	47.78	49.95
Hous. Head with junior education (%)	34.07	34.40	35.03	35.31	35.64	47.67
Hous. Head with senior education (%)	5.19	5.10	5.35	5.62	5.44	22.48
Hous. Head with secondary education (%)	0.42	0.42	0.39	0.42	0.33	6.30
Hous. Head with tertiary education (%)	0.06	0.06	0.09	0.06	0.03	2.42
<i>Ability to work</i>						
% of Hous. head with full ability to work	85.14	83.63	84.51	84.11	83.75	36.45
% of Hous. head with half ability to work	10.78	11.54	11.60	12.17	12.41	32.14
% of Hous. head with no ability to work	0.36	0.48	0.54	0.45	0.60	0.49
% of males with full ability to work	60.51	61.02	64.26	65.08	65.39	29.22
% of males with half ability to work	8.50	8.88	8.29	8.56	8.83	20.89

Variables	Mean					Av. std. dev.
	1991	1992	1993	1994	1995	
<i>Ability to work (continued)</i>						
% of working age males with no ability to work	0.49	0.63	0.57	0.54	0.58	0.56
% of females with full ability to work	55.33	55.59	56.96	58.56	58.84	32.84
% of females with half ability to work	13.21	14.24	15.53	15.07	15.14	28.58
% of working age females with no ability to work	0.43	0.43	0.54	0.49	0.65	0.51
<i>Land and geography</i>						
Area of flat land used per adult equiv. (mu)	1.25	1.24	1.35	1.62	1.45	4.75
Area of hilly land used per adult equiv. (mu)	0.36	0.38	0.35	0.36	0.48	0.21
Area of fishponds land used per adult equiv. (mu)	0.007	0.007	0.006	0.006	0.009	0.08
% living in flat land	13.89	13.47	14.10	13.89	13.80	34.53
% living in hilly land	61.07	61.19	60.68	60.31	60.28	48.85
% living in mountainous land	25.04	25.34	25.22	25.79	25.91	43.57
<i>Value of assets of production in real terms per adult equivalent</i>						
Value of total fixed productive assets	302.42	308.25	329.39	338.10	320.55	469.16
Draught/product animals	66.30	65.65	67.65	75.85	82.31	171.60
Iron/wood agricultural tools	28.47	26.10	27.24	25.15	22.61	40.68
Agricultural machine	13.90	17.83	13.75	12.61	12.17	97.08
Industry machine	7.06	6.50	5.63	6.91	6.80	69.80
Transportation machine	12.69	18.46	21.18	35.03	29.79	272.79
House for production	125.16	124.39	165.55	146.18	137.00	194.74
Other productive assets	48.85	49.32	28.38	36.38	29.87	72.35
<i>Households owning main prod. assets (%)</i>						
Motor vehicle	0.15	0.18	0.24	0.33	0.30	4.86
Large/ middle size tractor	0.09	0.12	0.36	0.27	0.36	4.74
Small tractor	1.93	2.20	1.57	1.60	1.30	12.95
Threshing machine	2.02	2.36	2.45	2.60	2.96	15.51

Variables	Mean					Av. std. dev.
	1991	1992	1993	1994	1995	
<i>Households owning main prod. assets (%) (continued)</i>						
Large size cart	0.45	0.39	0.91	0.60	0.51	7.47
Man-driven cart	2.63	2.51	2.87	4.11	3.99	17.55
Pump with pipes	2.54	3.14	2.99	3.56	3.90	17.62
Pump	2.11	2.48	3.32	4.05	4.29	17.57
Powered boat	0.06	0.09	0.03	0.03	0.03	2.14
Draught animals	46.51	44.22	40.71	39.69	40.00	49.33
Products animal	30.75	33.43	33.19	34.97	34.79	47.15

Note: The average standard deviation for each variable refers to the average of the five cross-sectional standard deviations for each year. Educational and Ability to work percentages do not sum to 100% because of missing values. Land area is measured in mu; 15 mu = 1 hectare.

Table 3.2 gives an indication of how household characteristics vary by income. The table shows the inter-temporal mean of the main explanatory variables for each income quintile. Household size decreases monotonically with income, from an average of 4.78 for the poorest 20 per cent of households to 3.78 for the richest 20 per cent. The 38 per cent drop in the dependency ratio from 0.63 to 0.40 between the poorest and the richest quintile is even more marked, reflecting the fact that the percentage of household members in the prime 16–64 age group is 68 per cent for the lowest quintile but 77 per cent for the highest one. Conversely, the percentage of people within each household in all other age groups is much lower for households in the richest quintile than for the poorest households.

Education is also strongly correlated with income. The percentage of male members without education is 22 per cent for the poorest quintile but only 11 per cent for the richest. Again, a marked gender gap is evident. At every income level the proportion of females who are illiterate is around double that of males. Similarly the proportion of males with lower or higher education is larger than the proportion of females with such education. However, the gender gap for lower and higher education narrows as income rises; a male in the bottom quintile is 5.5 times more likely to have higher education than a female in the same quintile, whereas in the top quintile a male is twice as likely to have higher education. Interestingly, the ratio of female to male illiteracy does not narrow with income so that it is still the case that more than one in five females in the top quintile are illiterate.

Table 3.2 Cross-tabulation of inter-temporal mean of independent variables by income quintiles

	Income quintiles				
	1	2	3	4	5
Demographic variables					
household size	4.77	4.41	4.23	4.09	3.78
Dependency ratio	0.63	0.58	0.54	0.45	0.40
Education variables					
% male illiterate	21.62	17.26	15.18	13.24	11.25
% female illiterate	40.15	32.25	30.25	27.15	22.13
% males with lower education	74.86	77.43	79.04	79.43	79.08
% females with lower educ.	59.20	65.63	66.96	69.63	72.80
% males with higher education	3.52	4.70	5.16	6.54	9.18
% of females with higher educ.	0.64	1.52	2.17	2.40	4.58
Ability to work					
% male w/ full-time work ability	59.35	62.04	64.89	64.15	65.78
% female w/ full-time work ability	53.43	55.53	56.64	59.63	60.14
Land					
flat land per adult equiv. (mu)	1.29	1.38	1.32	1.31	1.61
hilly land per adult equiv. (mu)	0.55	0.46	0.40	0.34	0.18
fishpond per adult equiv. (mu)	0.001	0.002	0.007	0.012	0.013
Value of Assets					
value of assets per adult equiv.	239.03	262.94	302.07	353.62	441.18

Note: Land area is measured in mu; 15 mu = 1 hectare. Values are in 1991 Yuan.

Labour force participation also increases with income: 59 per cent of males and 53 per cent of females in the bottom quintile are working full time compared to 65 per cent and 60 per cent respectively in the top quintile. The area of owned cultivated land in flat areas is roughly constant for households in the bottom 80 per cent of the income distribution, but the top 20 per cent of income earners in flat areas have much higher endowments of land. Similarly, area of fishponds per adult equivalent is strongly positively correlated with income. However, the reverse is the case in hilly areas, with the mean hilly land owned per adult equivalent falling sharply as income rises. Unsurprisingly, the value of productive assets per adult equivalent is 84.5 per cent higher for households in the top quintile compared to those in the lowest one.

Finally, it is instructive to examine where households in different income quintiles live. Table 3.3 shows the number of households in each quintile living in flat, hilly and mountainous areas in 1995.

Table 3.3 Numbers of households by geography and income quintiles in 1995

	Income quintile in 1995					Total
	1	2	3	4	5	
Geography						
<i>Plain</i>	13	20	52	104	268	457
<i>Hill</i>	335	468	457	445	291	1996
<i>Mountain</i>	315	174	153	113	103	858
Total	663	662	662	662	662	3311

Households living in flat areas are much more likely to come from higher income groups, with 59 per cent of households in flat areas belonging to the top income quintile and only 3 per cent in the bottom quintile. The opposite is true for mountainous areas where 57 per cent of households belong to the bottom two quintiles of the income distribution and only 12 per cent to the top quintile. Mountain areas have by far the highest proportion of households in the bottom quintiles, but, because 60 per cent of the population live in hilly areas compared to 25 per cent in mountainous areas, roughly the same proportion of households from the bottom quintile live in hilly areas as in mountainous areas. Note, however, that only 2 per cent of households in the bottom quintile live in the plains.

3.2 Income and consumption

The main welfare indicators used in our analysis are consumption and income per adult equivalent. Table 3.4 presents mean consumption and income for each year of the panel along with the average standard deviation for each variable. The mean value of consumption is increasing throughout the five years of the survey, with modest percentage increases in 1992 and 1993 (0.5 per cent and 2 per cent respectively) and more marked increases in 1994 and 1995 (5.4 per cent and 6 per cent). Mean income, on the other hand, does not follow a simple pattern, with a rise of 3.2 per cent in 1992 followed by a drop of 6.5 per cent in 1993. In 1994 there was a substantial recovery of 12.4 per cent which was followed by a further rise of 3.6 per cent in 1995. Over the five years income increases by 12.3 per cent compared to 10 per cent in the case of consumption. Unsurprisingly, the cross-sectional distribution of income is broader than that of consumption, as evident from its larger average standard deviation over the period. This indicates that higher income households are likely to be saving, while poor households may be dis-saving. Mean income, however, is greater than consumption in all years denoting a positive average saving rate.

Table 3.4 also shows a breakdown of income by source. Profits from family business are the most important component of income, although their importance declines steadily from 83.1 per cent in 1991

to 78.5 per cent in 1995. Wages are the second most important source and their share increases from 13.5 per cent in 1991 to 17.5 per cent in 1995. Net remittances, transfers and subsidies and assets income never contribute more than 3.5 per cent of total income. The most volatile income source is assets income, in the sense that mean assets income experienced larger percentage rises and falls than other sources, but it never represents more than 2 per cent of total income. Net remittances and transfers have a slight counter-cyclical effect, in particular in relation to the 1993 income drop. However, the decline in income in 1993 can be largely attributed to a drop in profits, down by 7.1 per cent although wages also fell by 3.1 per cent.

Looking at the cross-sectional distribution of different income sources one sees that the most equally spread source of income is profits, with an average standard deviation substantially below the mean value in each year. Wages are much less evenly distributed than profits, with the average standard deviation between 35 per cent and 96 per cent larger than mean income depending on the year. However, wages are considerably more evenly spread across households than net remittances, transfers and subsidies and assets income, all of which have average standard deviations between 3 and 10 times the mean income from these sources.

Table 3.4 Mean consumption and income statistics by year

Variables in 1991 prices per adult equivalent	Mean (1991 Yuan)					Average standard deviation
	1991	1992	1993	1994	1995	
Consumption	623.2	626.0	638.5	672.9	713.1	282.1
Income	694.5	716.9	669.9	752.8	780.1	357.3
Wage	93.7	115.3	111.7	124.7	136.2	183.9
Profits	577.0	575.4	534.4	597.1	612.1	321.0
Net remittances	13.1	13.5	19.8	19.5	24.5	88.5
Transfers & subsidies	17.4	18.3	22.5	22.6	21.4	71.4
Assets income	6.2	7.6	3.5	14.2	13.6	34.6

Note: The average standard deviation for each variable refers to the average of the five cross-sectional standard deviations for each year.

To examine the relative importance of each source of income to different income groups, Table 3.5 presents the income shares of each source by income quintiles. The wage share in total income increases with income, from 12 per cent for the bottom quintile to 18 per cent for the top quintiles. Conversely the share of profits from family business in total income decreases from 83 per cent to 75 per cent between the bottom and top quintiles. The remaining income categories represent only a small proportion of total income. Net remittances are roughly constant at 2.2 per cent, while transfers are rather regressive ranging accounting for 1.4 per cent of the income of households in the poorest quintile but 3.7 per cent of the income of the richest households. Asset income is marginally more important for households in the bottom and top quintiles compared to those in the middle quintiles.

Table 3.5 Income shares by inter-temporal mean income quintiles

Intertemporal mean income quintiles	% income share of:				
	wages	profits	net remittances	transfers	asset income
1 (poorest)	11.9	82.8	2.2	1.4	1.6
2	14.1	80.1	2.5	2.3	1.0
3	14.9	79.6	2.2	2.2	1.1
4	16.1	77.7	2.2	2.8	1.2
5 (richest)	17.9	74.6	2.2	3.7	1.5

Some income sources are more variable than others and this variability may also depend upon the overall level of income. Table 3.6 shows the average inter-temporal coefficient of variation of each of the sources of income by income quintile.¹³ Wages are highly variable, although the coefficient of variation decreases with income. The least variable source of income is profits, but the variability of profits increases with income. Net remittances, transfers and asset income are much more variable than other income sources, particularly for households in the bottom quintiles.

Table 3.6 Average inter-temporal coefficient of variation of income sources by income quintile

Intertemporal mean income quintiles	Average inter-temporal coefficient of variation of:				
	wages	profits	net remittances	transfers	asset income
1 (poorest)	1.21	0.34	2.01	1.65	1.81
2	1.16	0.35	2.42	1.62	1.76
3	1.14	0.34	0.87	1.59	1.76
4	1.13	0.36	0.57	1.52	1.71
5 (richest)	1.05	0.38	0.86	1.41	1.65

3.3 Poverty measures

Measures of poverty were calculated using both real consumption and real income per adult equivalent as the welfare measure. There are several advantages to using both measures. Consumption measures in developing countries are commonly regarded as better measures of long-term welfare than income measures because they reflect a household's ability to smooth income shocks over time through saving and dis-saving. On the other hand, income variables, especially when disaggregated by source, can provide useful information on the determinants of poverty and its dynamics. Tables 3.7 and 3.8 present three poverty measures of the Foster-Greer-Thorbecke class (Foster *et al.* 1984) – the poverty headcount, the

¹³ Note that this is calculated by averaging the *inter-temporal* coefficient of variation of each income source for the households in the quintile. That is, the coefficient of variation refers to the variation of each income source across time. This is quite different from the cross-sectional coefficient of variation.

poverty gap and the squared poverty gap. The poverty headcount represents the proportion of households falling below the poverty line; the poverty gap represents the proportionate shortfall in consumption or income from the poverty line averaged over all households; and the squared poverty gap is the squared proportionate shortfall in consumption or income from the poverty line averaged over all households. The squared poverty gap therefore emphasises the poverty of those furthest below the poverty line.

In 1991, the consumption poverty headcount was 15.5 per cent for the lower poverty line and 24.9 per cent with respect to the upper poverty line. When income is chosen as the welfare indicator the poverty headcounts were 14.4 per cent and 21.8 per cent for the lower and upper poverty lines respectively. Between 1991 and 1993 consumption poverty increases slightly from 15.5 per cent to 17 per cent for the lower poverty line and from 24.9 to 26 per cent for the upper poverty line, but income poverty rises dramatically from 14.4 to 20.9 per cent for the lower poverty line and from 21.8 to 28 per cent for the upper poverty line. By contrast, in the last two years of the survey poverty is markedly reduced with consumption poverty falling to 10.4 per cent in 1995 for the lower poverty line and income poverty falling to 11.6 per cent for the same poverty line. Over the five year period the incidence of poverty is reduced by 30–32 per cent for consumption measures and 19 per cent for income measures. A study by Khan (1998) shows a similar poverty reduction trend over 1988–1995 with a reduction of between 33 to 40 per cent. Similarly, the official estimates of the National Bureau of Statistics show a 38 per cent reduction in poverty between 1988 and 1995.¹⁴ The poverty gap and the squared poverty gap follow the same trend as the headcount index with an increase in the first three years, particularly between 1992 and 93, followed by successive decreases in 1994 and 1995.¹⁵

To examine the sensitivity of our results to the choice of the poverty line, in Figures 3.1 and 3.2 we have drawn the cumulative distribution functions (CDF) of per adult equivalent expenditure and income respectively for each of the five years. Whenever the CDF of one year lies completely above another, the incidence of poverty is higher regardless of the choice of poverty line or of poverty measure (a property known as first-order stochastic dominance). Figure 3.1 shows that the CDFs of consumption expenditure for 1991, 1992 and 1993 are extremely close together and cross one another at around 350 and 460 yuan. The slight increases in the poverty headcount between these years will therefore be observed for all poverty lines between 350 and 460 yuan, but this result is not robust to choices of poverty lines outside this range. However, the CDFs for consumption expenditure in 1994 lies well below those of the first three years and that of 1995 lies below that of 1994. Therefore the improvement in the incidence of poverty in the years 1994 and 1995 is robust both to the choice of poverty line and poverty measure.

Figure 3.2 shows quite a different picture for the cumulative distribution of income. The CDFs for 1991, 1992 lie extremely close together between 350 and 420 yuan but diverge for higher incomes.

¹⁴ The higher estimates for poverty reduction in the period 1988 to 1995 are consistent with a slightly higher incidence of poverty in rural Sichuan in the late 1980s, see Yao (1999).

¹⁵ The absolute values of the poverty measures are somewhat lower using the five alternative panel constructions described in the previous section. However, the pattern of changes, with all consumption poverty measures rising between 1991 and 1993 and then falling in 1994 and 1995 is robust to the construction of the panel.

Consequently, the poverty headcount increases between these two years according to the lower poverty line, but decreases with respect to the upper line. However, the marked increase in poverty in 1993 and the subsequent drop in 1994 and 1995 do not depend upon the specific choice of poverty lines.

3.4 Poverty dynamics

Poverty status in any one year is not strictly correlated with the average level of consumption or income over the five year period. Thus it is possible for a household to have an average level of consumption expenditure over the five years which lies below the poverty line, but to have consumption expenditure in some years above the poverty line. Similarly, a household may be above the poverty line on average, but may drop below in one or more years. For the purposes of targeting assistance towards the most needy it is useful to know the proportion of households whose average level of consumption or income lies below the poverty line in any given year. Table 3.9 decomposes both poor and non-poor households into two groups, depending on whether their inter-temporal mean expenditure is below or above the lower poverty line in the first and the last year of the survey. Table 3.10 shows the same results using income rather than consumption.

A remarkable 57 per cent of households that are poor in 1991 have average consumption above the poverty line. This figure is even higher when income is used as the welfare indicator, with more than two-thirds of the income poor in 1991 having average incomes over the five years above the poverty line. At the same time, 25 per cent of households whose average level of consumption over the five years is below the poverty line, are not poor in 1991. This proportion rises to 38 per cent in 1995 because of the reduction in consumption poverty over the five year period. Similarly the proportion of the poor whose average consumption is below the poverty line rises from 43 per cent in 1991 to 54 per cent in 1995. These results underline the dynamic nature of poverty and the potential inaccuracy of targeting assistance based upon measurements from only one year.

The above analysis suggests that there is a high level of transitory poverty with a large number of households experiencing one or more years of poverty. To ascertain whether this was the case we calculated the number of years of poverty experienced by households. Table 3.11 shows the number of years in poverty experienced by households for both the lower and upper poverty lines and for both income and consumption measures. Remarkably only 2.4 per cent of households are consumption poor (using the lower poverty line) in all five years of the survey and only 1.3 per cent of households are income poor in all five years. While income measures are often highly volatile, the fact that such a low percentage of households are consumption poor for the entire period indicates a large amount of movement in and out of poverty in rural Sichuan.¹⁶

¹⁶ We are conscious that this result may be affected by measurement error (see McCulloch and Baulch [2000] for an attempt to tackle measurement error in such circumstances). However, the fact that the figure of 2.4 per cent applies to the consumption measure, which is typically much smoother than income, suggests that there is a great deal of movement in and out of poverty.

Table 3.7 Poverty measures using real per adult equivalent consumption

	1991		1992		1993		1994		1995	
	% of households	% change from previous year	% of households	% change from previous year	% of households	% change from previous year	% of households	% change from previous year	% of households	% change from previous year
<i>Lower poverty line (= 409 yuan)</i>										
Headcount	15.5	-	16.5	6.5	17.0	3.0	13.4	-21.2	10.4	-22.4
Poverty gap	2.5	-	2.5	0.0	3.0	20.0	2.3	-23.3	1.6	-30.4
Squared poverty gap	0.6	-	0.6	0.0	0.9	50.0	0.6	-33.3	0.4	-33.3
<i>Upper poverty line (= 457 yuan)</i>										
Poverty headcount	24.9	-	25.4	2.0	26.0	2.4	22.0	-15.4	17.4	-20.9
Poverty gap	4.3	-	4.4	2.3	4.9	11.4	3.9	-20.4	2.9	-25.6
Squared poverty gap	1.2	-	1.2	0.0	1.5	25.0	1.1	-26.7	0.8	-27.3

Table 3.8 Poverty measures using real per adult equivalent income

	1991		1992		1993		1994		1995	
	% of pop.	% change from previous year	% of pop.	% change from previous year	% of pop.	% change from previous year	% of pop.	% change from previous year	% of pop.	% change from previous year
<i>Lower poverty line (= 409 yuan)</i>										
Headcount	14.4	-	14.8	2.8	20.9	41.2	14.0	-33.0	11.6	-17.1
Poverty gap	2.7	-	2.9	7.4	4.8	65.5	3.4	-29.2	2.6	-23.5
Squared poverty gap	0.8	-	0.9	12.5	1.7	88.9	1.5	-11.8	1.0	-33.3
<i>Upper poverty line (= 457 yuan)</i>										
Poverty headcount	21.8	-	20.5	-6.0	28.0	36.6	19.4	-30.7	17.6	-9.3
Poverty gap	4.4	-	4.4	0.0	6.9	56.8	4.8	-30.4	3.9	-18.8
Squared poverty gap	1.3	-	1.4	7.7	2.6	85.7	2.0	-23.1	1.5	-25.0

Figure 3.1 Cumulative distribution function for consumption expenditure: 1991-95

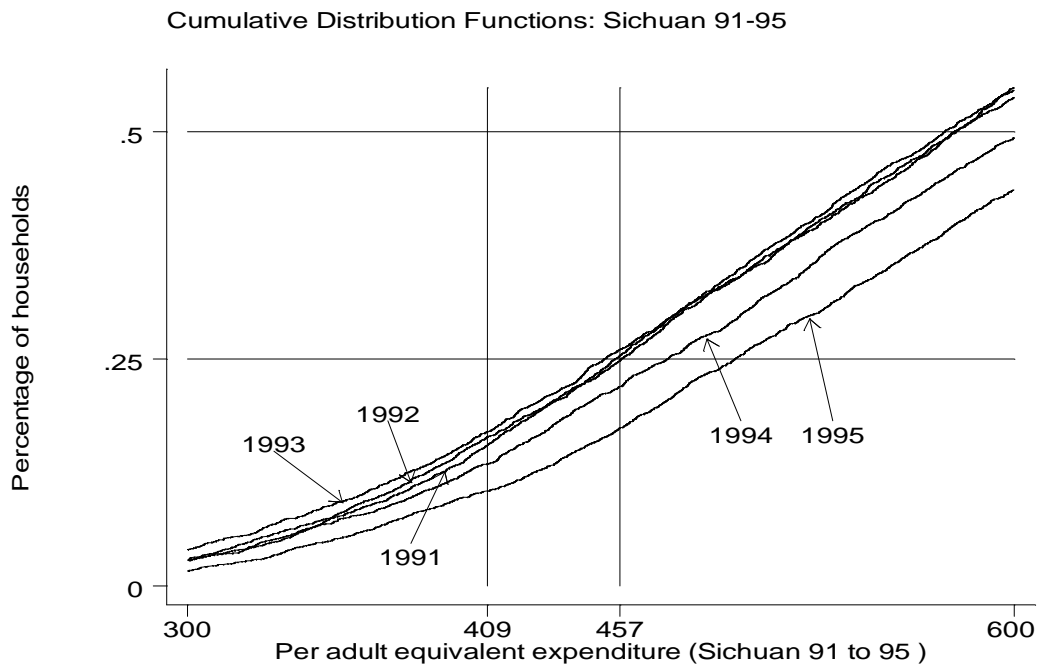


Figure 3.2 Cumulative distribution function for income: 1991-95

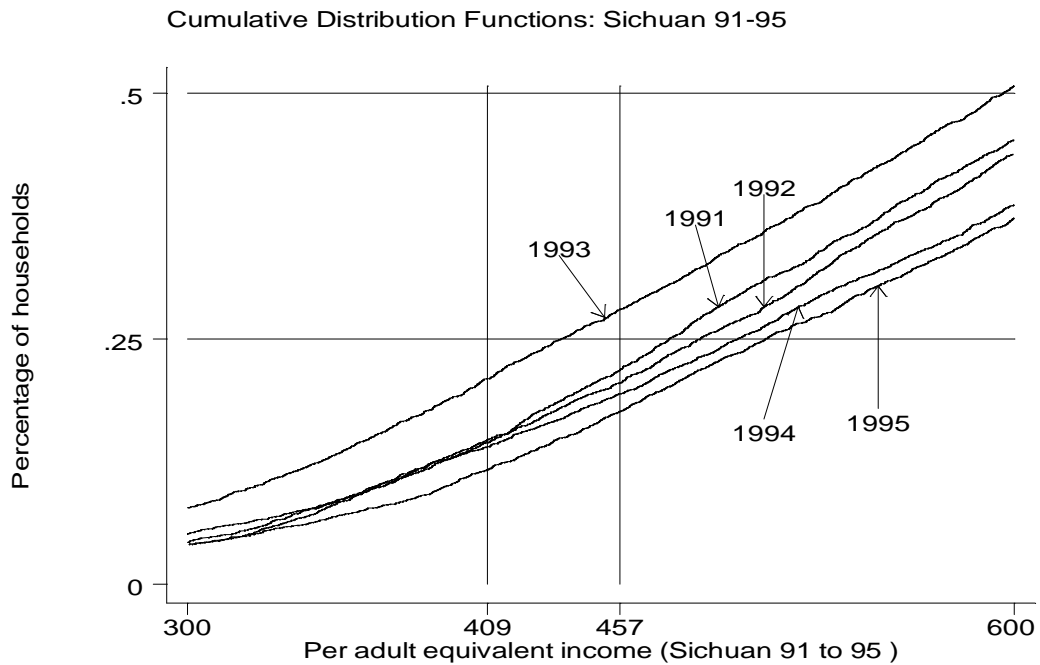


Table 3.9 Household decomposition by inter-temporal mean consumption and poverty status in 1991 and 1995

	1991		1995	
	No. of households with inter-temporal mean consumption...		No. of households with inter-temporal mean consumption...	
	below the poverty line	above the poverty line	below the poverty line	Above the poverty line
	<i>Lower poverty line</i>			
Poor	221	294	181	154
Row %	42.9	57.1	54.0	46.0
Column %	74.9	9.7	61.4	5.1
Non-poor	74	2722	114	2862
Row %	2.6	97.3	3.8	96.2
Column %	25.1	90.2	38.6	94.9
Total	295	3016	295	3016
Row %	8.9	91.1	8.9	91.1

Table 3.10 Household decomposition by inter-temporal mean income and poverty status in 1991 and 1995

	1991		1995	
	No. of households with inter-temporal mean income...		No. of households with inter-temporal mean income...	
	below the poverty line	above the poverty line	below the poverty line	Above the poverty line
	<i>Lower poverty line</i>			
Poor	153	324	144	217
Row %	32.1	67.9	39.9	60.1
Column %	67.1	10.5	63.2	7.0
Non-poor	75	2759	84	2866
Row %	2.6	97.4	2.8	97.2
Column %	32.9	89.5	36.8	93.0
Total	228	3083	228	3083
Row %	6.9	93.1	6.9	93.1

The percentage of households experiencing a given number of years of poverty rises as the number of years of poverty falls. Thus 69 per cent of households never fall below the lower consumption poverty line and a further 11.9 per cent are poor for only one year. However households who experience consumption poverty for only one year constitute 38.5 per cent of households that experience poverty at any point in time. Similar results are obtained if we use the upper poverty line and using income rather than consumption as the welfare indicator. For example, almost half of the households whose income falls below the lower poverty line are poor for only one year.

Table 3.11 Number of households experiencing different periods of poverty

Number of years in poverty	Lower poverty line		Upper poverty line	
	Number of households	Percentage of households	Number of households	Percentage of households
<i>Consumption poverty</i>				
0 (i.e. never poor)	2285	69.0	1853	56.0
1	395	11.9	454	13.7
2	250	7.5	332	10.0
3	188	5.7	262	7.9
4	113	3.4	219	6.6
5 (i.e. always poor)	80	2.4	191	5.8
<i>Income poverty</i>				
0 (i.e. never poor)	2057	62.1	1699	51.3
1	619	18.7	666	20.1
2	327	9.9	387	11.7
3	170	5.1	312	9.4
4	95	2.9	160	4.8
5 (i.e. always poor)	43	1.3	87	2.6

Table 3.11 described the number of years a household spent in poverty. However, these years need not be consecutive. Thus, for households which spent more than one year in poverty it is not clear whether this was due to a prolonged period in poverty or the result of falling into poverty on several separate occasions. Table 3.12 therefore shows a cross-tabulation of the number of consecutive years in poverty by the total number of years in poverty. That is the columns represent the number of years in which household expenditure or income falls below the poverty line (the column totals therefore provide the same information presented in the previous table). The rows show the number of consecutive years in which the households are poor. For example, among the 188 households whose consumption falls below the lower poverty line for three years in total during the five survey years, four have three separate spells of poverty lasting only one year, 53 have two spells of poverty one of which is for two consecutive years, and 131 households experience only one spell of poverty that lasts three years.

Two main points are evident from Table 3.12. Firstly, there are surprisingly few households experiencing more than one spell of poverty (for the lower poverty line, only 15 per cent of households that are consumption poor at some point in time have more than one spell,¹⁷ 17 per cent of households who are income poor have more than one spell). If the total number of years in poverty followed a simple binomial distribution then one would expect that 60 per cent of households experiencing a total of two years in poverty would have two non-consecutive spells of one year's duration. In fact for consumption

¹⁷ Calculated as the sum of the off diagonal elements in the consumption poverty table using the lower poverty line divided by 1,026.

poverty more than three-quarters (198/250) of households with two years in poverty have a consecutive spell of two years. The same is true for long spell lengths with, for example 61 per cent (69/113) of those experiencing four years in consumption poverty having a consecutive spell of four years duration. Thus although poverty is highly dynamic, the experience of poverty is extremely persistent once a household has fallen below the poverty line.¹⁸

Table 3.12 Number of consecutive years in poverty by the total number of years in poverty

	Lower poverty line						Upper poverty line					
	Total number of years in poverty						Total number of years in poverty					
	1	2	3	4	5	Total	1	2	3	4	5	Total
<i>Consumption poverty</i>												
1	395	52	4	0	0	451	454	72	7	0	0	533
2	0	198	53	14	0	265	0	260	66	24	0	350
3	0	0	131	30	0	161	0	0	189	50	0	239
4	0	0	0	69	0	69	0	0	0	145	0	145
5	0	0	0	0	80	80	0	0	0	0	191	191
Total	395	250	188	113	80	1026	454	332	262	219	191	1458
<i>Income poverty</i>												
1	619	117	7	0	0	743	666	150	13	0	0	829
2	0	210	49	11	0	270	0	237	115	15	0	367
3	0	0	114	31	0	145	0	0	184	61	0	245
4	0	0	0	53	0	53	0	0	0	84	0	84
5	0	0	0	0	43	43	0	0	0	0	87	87
Total	619	327	170	95	43	1254	666	387	312	160	87	1612

Note: Rows refer to the number of consecutive years in poverty.

Secondly, the persistence of poverty is much less for income poverty than for consumption poverty. That is, the proportion of households experiencing one consecutive spell of poverty for any given total number of years in poverty is lower when income is used as the welfare indicator than when consumption is used. This serves to underline the volatility of income within the panel.

Further appreciation of the dynamic nature of poverty can be seen by explicitly examining transitions in and out of poverty between pairs of years. Tables 3.13 and 3.14 show transitions between 1991 and 1992 and between 1991 and 1995 for consumption and income measures respectively. Thirty-seven per cent of households that were poor in 1991 were not poor in the following year whilst only 6.3 per cent of non-poor households in 1991 became poor in 1992. The probability of exiting poverty is always greater at

¹⁸ See Lokshin and Ravallion (2000) for evidence from Hungary that poverty is highly persistent, although they find no evidence for 'poverty traps'.

the lower poverty line, while that of entering poverty is greater for the upper poverty line regardless of the welfare indicator used. Income-poverty is characterised by greater dynamism with higher probabilities of entering and exiting poverty for each poverty line and time period. Finally, the fact that the incidence of poverty is lower at the end of the five year period is reflected by the very high probabilities of exiting poverty between 1991 and 1995. For example the probability of exiting income poverty between 1991 and 1995 is 75 per cent at the lower poverty line. At the same time the general reduction in poverty does not benefit all households with 13 per cent of those households that were not income poor at the upper poverty line in 1991 falling below the line in 1995.

Table 3.13 Transition matrices for 1991–1992 and 1991–1995 for real consumption per adult equivalent

		1992			1995		
		Poor	Non-poor	Total	Poor	Non-poor	Total
Lower poverty line							
1991	Poor	323	192	515	160	355	515
	%	62.7	37.3	100	31.1	68.9	100
	Non-poor	177	2619	2796	175	2621	2796
	%	6.3	93.7	100	6.3	93.7	100
	Total	500	2811	3311	335	2976	3311
	%	15.1	84.9	100	10.1	89.9	100
Upper poverty line							
1991	Poor	582	241	823	318	505	823
	%	70.7	29.3	100	38.6	61.4	100
	Non-poor	237	2251	2488	240	2248	2488
	%	9.5	90.5	100	9.6	90.4	100
	Total	819	2492	3311	558	2753	3311
	%	24.7	75.3	100	16.8	83.2	100

3.5 Measuring vulnerability

The above analysis shows that poverty is extremely dynamic in rural Sichuan, in the sense that many households move in and out of poverty each year. Thus targeting assistance upon those who are in poverty in any given year may miss a large number of households who are temporarily out of poverty that year but who have very low levels of long-term welfare, as well as cause a leakage of resources to those who do not really need assistance. If data from more than one year is available, then one way of solving this problem is to focus upon those households whose average income (or consumption) over the period is below the poverty line. However, households whose average consumption or income lies just above the poverty line are unlikely to experience no poverty given the volatility of both income and consumption. Rather, they are likely to be extremely vulnerable to falling into poverty, even though on average they lie above the poverty line.

Table 3.14 Transition matrices for 1991–1992 and 1991–1995 for real income per adult equivalent

		1992			1995		
		Poor	Non-poor	Total	Poor	Non-poor	Total
Lower poverty line							
1991	Poor	240	237	477	119	358	477
	%	50.3	49.7	100	24.9	75.1	100
	Non-poor	215	2619	2834	242	2592	2834
	%	7.6	92.4	100	8.5	91.5	100
	Total	455	2856	3311	361	2950	3311
	%	13.7	82.3	100	10.9	89.1	100
Upper poverty line							
1991	Poor	395	328	723	223	500	723
	%	54.6	45.4	100	30.8	69.2	100
	Non-poor	262	2326	2588	336	2252	2588
	%	10.1	89.9	100	13.0	87.0	100
	Total	657	2654	3311	559	2752	3311
	%	19.8	80.2	100	16.9	83.1	100

The concept of vulnerability is increasingly recognised as an important aspect of illbeing (Chambers 1989; Narayan *et al.* 2000; World Bank 2000). Vulnerability refers not to the current status of a household with respect to a given poverty line, but rather to the risk or probability that a household will fall below the poverty line. Thus a household may be currently below the poverty line, but have a high probability of exiting poverty during the following year because of its human or physical capital. Conversely, a household may be some distance above the poverty line, but have a high probability of falling into poverty. Thus, while the concepts of vulnerability and poverty are related, they are not the same thing.

We adopt an empirical measure of vulnerability adapted from the work of Pritchett *et al.* (2000). The vulnerability of a household may be defined as the probability of it falling below the poverty line in any given year. That is:

$$V_h = P(y_{ht} < z)$$

where V_h is vulnerability, y_{ht} is the total income of household h in year t , and z is the poverty line.

To calculate the probability of total income falling below the poverty line in any given year, it is necessary to make an assumption about the shape of the distribution of inter-temporal income for each household. We assume that this distribution is Normal, but that the mean and variance of the distribution varies by household. Since we have five values for total income for each household we can calculate crude estimates of the inter-temporal mean income, \bar{y} , and the inter-temporal standard deviation of income, s ,

for each household. The probability of total income falling below the poverty line z for household h can then be calculated as:

$$V_h = P\left(\frac{y_{ht} - \mu_h}{\sigma_h} < \frac{z - \mu_h}{\sigma_h}\right)$$

where μ_h is the true inter-temporal mean income for the household and σ_h is its true inter-temporal standard deviation of income. These are both unknown, but we have unbiased estimates of them in the form of \bar{y} and s . Therefore the vulnerability of each household to falling below the poverty line can be estimated as

$$V_h = P\left(\frac{y_{ht} - \mu_h}{\sigma_h} < \frac{z - \bar{y}_h}{s_h}\right)$$

that is, the probability of the standard Normal variate falling below the poverty line normalised by subtracting the estimated inter-temporal mean income and divided by the estimated inter-temporal standard deviation.

Vulnerability calculations were made for all households in the panel. Table 3.15 shows how vulnerability varies with inter-temporal mean consumption expenditure quintiles; Table 3.16 shows the same calculations using income.

Table 3.15 Vulnerability by inter-temporal consumption expenditure quintile

Inter-temporal mean consumption quintiles	Consumption vulnerability		Mean consumption
	Lower poverty line	Upper poverty line	
1	0.51	0.70	406.6
2	0.15	0.27	516.3
3	0.07	0.12	607.9
4	0.04	0.06	727.2
5	0.02	0.03	1016.1

Table 3.16 Vulnerability by inter-temporal income quintile

Inter-temporal mean income quintiles	Income vulnerability		Mean income
	Lower poverty line	Upper poverty line	
1	0.45	0.60	427.0
2	0.17	0.25	556.1
3	0.09	0.13	663.8
4	0.06	0.08	810.2
5	0.03	0.04	1157.5

As expected, vulnerability is highest for those households in the lowest income and consumption quintile. The probability of those in the lowest income quintile falling into poverty is 45 per cent at the lower poverty line; for those in the lowest consumption quintile, the probability is 51 per cent. However, it is notable that the vulnerability of those in the second quintile is still extremely high despite that fact that these households typically have incomes (consumption expenditures) above the poverty line. For example the vulnerability of households in the second income quintile is 25 per cent for the upper poverty line, indicating that they have a one in four chance of falling into poverty in any year, despite having a mean income of Yuan 556.1 which is 22 per cent higher than the upper poverty line. Naturally, vulnerability decreases sharply for households in the upper income and consumption quintiles, although those in the top income and consumption quintiles still have a two to four per cent chance of falling into poverty.

The above measure of vulnerability provides a useful complement to traditional measures of poverty. It shares the advantage of inter-temporal measures of income and consumption in that it is based upon long-term average welfare rather than measures from a single time period. However, unlike income it is not linear, since it increases rapidly as households approach and cross the poverty line. It is therefore heavily biased towards the poor. Furthermore, it takes into account the ability of households of all income and consumption levels to smooth their consumption over time. Thus if a household is above the poverty line but has a very stable income they are, correctly, deemed to be less vulnerable to poverty than a slightly richer household with a highly variable income.¹⁹ The vulnerability index therefore provides a useful additional tool for policymakers concerned with identifying poor and vulnerable households.

4 Summary and conclusions

The poor in rural Sichuan share many of the characteristics of poor households throughout the developing world. They tend to come from larger households with more dependents, have lower levels of education, productive land and physical assets and many live in more remote mountainous areas. Of particular note in Sichuan is the large gender disparity at all educational levels between men and women. In addition, although most of the households living in mountainous areas are in the bottom 20 per cent of the income distribution, the large number of households living in hilly areas mean that the poorest are evenly split between hilly and mountainous areas.

Our calculations suggest that poverty increased between 1991 and 1993, but fell markedly in both 1994 and 1995. However, there appears to be a great deal of movement in and out of poverty, with only 2.4 per cent of households poor for all five years. Indeed, two-thirds of the households who were deemed income poor in 1991 had an inter-temporal mean income above the poverty line, making targeting based upon current poverty status extremely unreliable. Over 30 per cent of households fall below the lower

¹⁹ One drawback of our vulnerability measure is that households with highly variable incomes which are far below the poverty line will be deemed to be less vulnerable than households with similar mean incomes and less variable incomes, whereas one might wish to regard such households as more vulnerable since they have a higher probability of catastrophically low values of income. One extension of our measure might be to incorporate such concerns about asymmetric movements.

consumption poverty line at some stage, but most households that fall into poverty only stay there for one or two years. However, those households who are poor for more than one year are more likely to experience consecutive spells of poverty than isolated years, suggesting that the experience of poverty can reduce the ability to exit from it. Nonetheless, around a third of the consumption poor (and almost half of the income poor) exit poverty each year. Finally, a new measure of vulnerability to poverty shows that households remain highly vulnerable to falling into poverty even when their average consumption is over 20 per cent above the poverty line.

What policy conclusions may be drawn from the above results? We suggest three. Firstly, policy is right to focus on mountainous areas since these are clearly the poorest areas of the province. However, if the aim of policy is to reduce the overall level of poverty, it will be important to pay equal attention to poverty in hilly areas, since these areas contain as many of the poorest households as mountainous areas. Secondly, the gender disparities in educational level are remarkable and suggest a systematic bias against access to education for girls. It will be important to address this problem directly if economic and social indicators in the poorest areas are to improve. Finally, poverty is extremely dynamic in rural Sichuan. This suggests that policymakers should attempt to explore indicators which proxy for long-term welfare rather than focusing upon income and consumption in individual years. Identifying good combinations of educational, demographic, asset and geographical characteristics to serve as such proxies is a subject for future research. In addition, it would be useful to identify the determinants of vulnerability, which may include a large number of different factors including the demographic composition of the household, the health status and educational abilities of its members, as well as its location and its access to various forms of physical, financial, social and natural assets. Long-term poverty reduction may only be possible by reducing the probability of entry into poverty and thereby reducing vulnerability. Consequently it will also be essential to explore how policy affects the vulnerability of households to poverty.

Appendix 1 Adult equivalence scale

Age	Male Weight	Female Weight
0	0.33	0.33
1	0.46	0.46
2	0.54	0.54
3-4	0.62	0.62
5-6	0.74	0.70
7-9	0.84	0.72
10-11	0.88	0.78
12-13	0.96	0.84
14-15	1.06	0.86
16-17	1.14	0.86
18-29	1.04	0.80
30-59	1.00	0.82
60+	0.84	0.74

The equivalence scale is based on a World Health Organisation equivalence scale quoted in Dercon (1998).

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