# The persistence of poverty in rural China:

# Applying an ordered probit and a hazard approach.

**Thomas Glauben,**

Leibniz-Institute of Agricultural Development in Central and Eastern Europe, Halle/ Saale, Germany

**Thomas Herzfeld,**

Department of Agricultural Economics, Christian-Albrechts-University of Kiel, D-24098 Kiel, Germany, therzfeld@agric-econ.uni-kiel.de

**Xiaobing Wang**

Leibniz-Institute of Agricultural Development in Central and Eastern Europe, Halle/ Saale, Germany

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## Introduction

Since the beginning of the economic reforms in the late 1970s, China has experienced rapid economic growth. This has been accompanied by a dramatic reduction in absolute rural poverty, at least until the late 1980s. China alone accounts for over 75 percent of poverty reduction in the developing world over the last twenty years (http://www.worldbank.org.cn/English/Overview/overview_brief.htm). Chinese statistics, which use an official income poverty line of about 0.67 US Dollar per day, indicate a massive decline in the number of rural Chinese in absolute poverty from 250 million in 1978 to 34 million in 1999. Word Bank (2003) estimate, using one Dollar per day poverty line, reports a slightly more modest decline in poverty measured based on households incomes from 260 to 97 million over the same period. However, much depends on the measure that is used. According to recent estimates, the number of rural poor with daily expenditures below a Dollar per day in 1999 was 235 million, more than twice that under the income poverty line (World Bank, 2003). Indeed, using the expenditure criteria, poverty in China increased in the late 1990s.

However, much of the debate on poverty both past and current has focused on the possibility that poverty is a condition that affects few households, but those affected remains in poverty for a remarkable portion of their lifetime. While it is well known that poverty rates such as the head count ratios mentioned above are helpful indicators of poverty in any given year, these rates ignore important underlying dynamics in poverty. From a the cross-sectional perspective it is not possible to detect if a particular poverty level is mainly due to a high-risk of becoming poor combined with a relatively high chance of leaving poverty, or if the poverty level instead is due to a low risk of becoming poor combined with a low chance of leaving

poverty. In the former case poverty is a relatively brief and temporary condition, while it is more persistent and chronic in the latter case. Gaining insights about the flows into and out of poverty is essential from a policy perspective; the effectiveness of different poverty reduction measures depends crucially on the nature of poverty. If poverty is more temporary, programs that aim at stabilization of short term income fluctuations are appropriate. If poverty is more persistent, there seems to be a stronger need for measures improving the long-term labor market outcomes or for social assistance.

Recent estimates (CPRC 2004; p. 87) reveal that between 40 and 65 million Chinese live in persistent poverty, or between 20 and 25 percent of the country's absolute poor. Chronic poverty may be on rise as the 'new poor' join the ranks of those left behind the growth. Further, McCulloch and Calandrino (2003) use data for 1991 till 1995 from rural Sichuan and show that only 6 percent of households were consumption poor in all five years, compared to 44 percent who were poor in at least one year. On the basis of panel data from four southern provinces (Yunnan, Guangxi, Guizhou, and Guangdong) Jalan and Ravallion (1998) applied a components-of-variance approach and find that almost 60 percent of rural poverty in the three poorest provinces, but less then 20 percent in the better-off province Guangdong, is persistent.

In general, previous authors have used different approaches to study the persistence of poverty mostly focused on developed countries like the United States and the United Kingdom. Initial research (e.g. Duncan et al., 1984) made use of newly available longitudinal data to count the number of years households spend poor out of a fixed sample period. Another used method to describe the evolution of earnings over time is the estimation of components-of-variance approach (e.g. Lillard and Willis, 1978; Gottschalk, 1982; Duncan and Rogers, 1991; Stevens, 2000). Though the parameters of these models can be used to derive probabilities of spending any number of years in poverty or low-earnings status, this has not been done in all applications. Further, the estimated variance components are often

used to distinguish permanent from temporary components of income rather than estimating distributions of time spent below the poverty line. Two additional approaches to the measurement of poverty persistence were also used in literature. Spryskov (2003) uses data of the Russian Longitudinal Monitoring Survey and applies an ordered logit model examining the relationship between socio-economic, household and regional characteristics and the number of years households were poor. Hazard approaches to the measurement of poverty persistence were initially introduced by Bane and Ellwood (1986) and used by some other authors subsequently (e.g., Stevens, 1994, 2000; Devicienti, 2001; Jarvis and Jenkins, 1998; Cappellari and Jenkins, 2002; Hansen and Wahlberg, 2004). The works focus on the individual spells in poverty and estimated the probability of ending these spells, allowing for duration dependence. Such analysis particularly permits to examine how much the preceding time of being in poverty increases or decreases the likelihood of remaining poor.

The present study is devoted to the analysis of poverty persistence of Chinese farm households. Using individual data over the period 1995-2000 from 10 villages in the province Zhejiang we firstly apply an ordered probit model to empirically examine household, farm and regional characteristics affecting the probability that households are chronically poor. Since the probit analysis is a static concept that implicitly presupposes that the probabilities of finding households in poverty should be unaltered even with the passage of time, we additionally apply a hazard approach to empirically examine how much of the preceding time in poverty increases or decreases the risk of remaining in poverty. Or in other words, we examine the risk of slipping out of and trapping into poverty. The rest of the work is organized as followed. The next section gives an overview over the data. Section 3 presents the methodologies and the empirical results, and section 4 concludes.

## Data and poverty line

The database is drawn from survey data conducted by State Statistical Bureau's rural survey teams across ten regions in the Zhejiang province. We use individual household data which are linked to village data over the period 1995-2000. The sample covers around 500 households per annum. The village survey provides information on resource endowment, employment and production as well as welfare and social indicators. The individual household data contain detailed information on personal, household and farm characteristics as well as on household income.[1]

Poverty analysis relies crucially on the choice of the income measure and poverty line. In the present paper, we focus on the World Bank's one dollar per day net-income poverty line.[2] The World Bank poverty line results in a head count ratio with on average 24 percent poor over the period 1995-2000.[3] Similar as pointed out in Jalan and Ravallion (1998, 2000) for several Chinese provinces, we find that a major share of farm households in the Zhejiang province experience poverty as a transitory or temporary condition. Considering the one dollar per day income poverty line 76 percent of the households have never been poor during the observation period, and only less than one percent remain in poverty over the whole survey period.

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[1] Official consumer price index (CPI) data have been used to convert all monetary variables, like income, consumption, assets and transfers, into 2000 prices.

[2] We also carry out estimations based on two relative poverty lines, that is the half-mean of the net income per capita and the half-mean of the consumption expenditure per capita, results could be obtained from the authors upon request.

[3] Some studies use remarkably lower poverty lines and consequently reveal lower headcount ratios of 3.2 to 5.3 percent in 1998 (Yao, 2005).

## Methods and empirical results

*Ordered probit approach*

As mentioned above, we firstly apply an ordered probit model (Greene, 2000) to examine several regional, household and farm characteristics affecting the time households spent below the poverty line. We therefore summarize the number of years the households were fallen into poverty until 2000 into three ordered categories:[4] "non-poor" (zero years in poverty), "transitory-poor" (1-3 years in poverty), and "persistently-poor" (4-6 years in poverty).[5] The various works that are devoted to the analysis of poverty persistence differ in the types of covariates included. This is hardly surprising given that while economic theory provides a well-developed framework for studying earnings and income dynamics, no similar and uniform theory exists that could guide us in the more complicated case of poverty dynamics and persistence, respectively. In principle a whole variety of factors can be though of as important determinants of lifetime poverty. We thus have chosen almost all explanatory variables that have been found relevant in literature. The results of the probit approach are shown in Table 1.

*Table 1 about here*

Several studies (e.g. Yao, 2000; de Janvry and Sadoulet, 2000) indicate the importance of household demographics, such as household size (*HHSIZE*), age-composition of the household (*AGE; DEPENDENT*) and education - elementary (*ELEMSH*), secondary (*SECSH)* and higher education (*HIGHSH*) - in explaining chronic poverty. Our results suggest similar relationships. We find that larger households (*HHSIZE*) with more children or older non-working family members (*DEPENDENT*) show a higher probability to be persistently poor.

[4] A more sophisticated approach to distinguish between transitory and persistent poverty is proposed in Jalan and Ravallion (1998) and in Spryskov (2003).

[5] The dependent variable can take the following ordered values: 1 for "non-poor"; 2 for "transitory-poor", and 3 for "persistently-poor".

In contrast, a higher education of household members (*HIGHSH*) seems to prevent rural household from chronic poverty.

Further, de Janvry and Sadoulet (2000) additionally point to the importance of household's assets position, including land (*FSIZE, farm size*), durable production assets (*ASSETS*) and Morduch and Sicular (2002) examine social assets as for example membership in village cadres (*CADRE*) in determining household income and its distribution. Surprisingly, our results indicate that households that are chronically poor are those with a relatively large endowment in production assets (*ASSETS*). The control for heterogeneous income strategies the participation in off-farm employment is captured by a dummy variable (*PARTICIPATION*) and the diversification strategy within the household is included in a Herfindahl-Hirschman concentration index of the activities (*DIVERSIFICATION*). However, none of these covariates is significantly related to the persistence of poverty.

As pointed out in Jalan and Ravallion (2002) geographical and regional conditions turn out to be of special importance in explaining diverging fortunes over times for otherwise identical households in a developing rural economy. Thus we control for differences in several regional conditions such as differences in regional unemployment rate (*UNEMPLOYMENT*), in the share of migrants of the villages (*MIGRATION*), in the population density (*POPDENSITY*) and in the geographic position within the region (*SUBURB, MOUNTAIN, ECONOMICZONE*). Our results indicate that farm households located in, surprisingly, the mountainous areas (*MOUNTAIN*) and in areas with a relatively high population density (*PODENSITY*) are significantly less likely to be chronically poor.

*Hazard approach*

The preceding analysis seeks to identify factors influencing the duration of rural households poverty. However, the probit analysis is a static concept and implicitly presupposes that the probabilities of finding household in long-term poverty should be unaltered even with the passage of time. On of the major advantages of the hazard analysis is that it allows examining

how much of the preceding time in poverty increases or decreases the risk of remaining in poverty. We thus apply a hazard approach to empirically examine the factors and the duration dependence related to the duration in a state, poverty and non-poverty, respectively, or vice versa, the transition from one state to the other.

The concept of the parametric estimation of the hazard model (Kalbfleisch and Prentice, 2002) can be illustrated in the following form, allowing for time-varying covariates.[6] The hazard function is represented by $\lambda_{ji}\left(t,z,\alpha,\beta,\theta\right)=\theta\lambda_{0ji}\left(t,\alpha_{ji},\right)\exp\left[z\left(t\right),\beta_{ji}\right]$. Here $\lambda_{ji}\left(t,z,\alpha,\beta,\theta\right)$ denotes the hazard of the transition from one state to another state $j,i=\left(poverty,nonpoverty\right)\ \ j\neq i$, where *j* represents the original status at time $t_1,...,t_{n-1}$ and *i* denotes the shifted state at time $t_n$. Further $\lambda_{0ji}\left(t,\alpha_{ji}\right)$ indicates the baseline hazard of an event *j,i*, say the transition from poverty to non-poverty, that can be chosen from a parametric family (here Weibull[7]), under the condition $\exp\left[z\left(t\right),\beta_{ji}\right]=0$, that is no heterogeneity among the individuals. Heterogeneity of individuals reflected by differences in the observed ($z$) and unobserved characteristics ($\theta$) might change the individual hazard. The former explains the estimated distributions of time spent in or out of poverty for a household and the latter is proved to change the baseline hazard rate of transition as a latent multiplicative effect, called frailty parameter (Meitzen, 1986; Blau and Riphahn, 1999). Or in other words, if

[6] Reflecting the discussion about the treatment of time-varying covariates, only so-called external time-varying covariates are included in this analysis. These variables are observable independently of the poverty status. Therefore, standard asymptotic estimation techniques provide viable means of estimates of the relative risk parameters $\beta$ (Kalbfleisch and Prentice, 2002, p. 196).

[7] Frequently applied are Weibull, Log-logistic, Exponential, Gompertz, and Erlang-2 distributions. In this paper all models were estimated as a Cox proportional hazard model and with Weibull, Exponential and Gompertz distributions as baseline hazard. The Akaike Information Criterion is used to find the distribution which minimizes this information criterion and, therefore, the Weibull distribution is chosen.

$\exp\left[ z(t), \beta_{ji} \right] > 1$, then the risk of the event *j,i* for this individual would increase, and if $\exp\left[ z(t), \beta_{ji} \right] < 1$ the opposite holds. Thus, the hazard model provides both insights in how the risk changes with an increasing time spent in that respective state and, in addition, with the covariates.

Figure 1 illustrates some main results of the analysis, which are the predicted hazard rates of the exit from poverty and the entry into poverty over time. Obviously, with an increasing time households spend in poverty the chances to climbing out of this state increase; first with increasing and than with decreasing rates. In contrast, while the risk to slip into poverty is constant or increasing during the first two years the rural household is in poverty, it than decreases with every additional year households are poor. There is obviously a good chance to escape poverty over time and poverty seems not to be a very persistent condition. On the other hand, the risk of becoming poor seems to be decreasing the longer the spells of non-poverty.

*Include Figure 1 around here*

*Include Table 2 around here*

Table 2 reports the relationships between several household, farm and geographical characteristics (introduced before) and both the likelihood of exiting poverty and the hazard of falling in poverty. We find that more or less the same characteristics which affect the persistence of poverty within the static ordered probit model significantly are related to transmission probabilities between the two states significantly too. Almost all explanatory variables work in the same direction regarding the risks of both exit from poverty and entry into poverty. Regarding the household attitudes, results suggest that larger households (*HHSIZE*), with older heads (*AGE*), and more non-working family members (*DEPENDENT*) show a higher risk of becoming poor over the whole observation period. On the other hand, larger households' chances to escape poverty are also relatively high, while a higher

education (*HIGHSH*) of household members reduces their probability of exiting poverty. At the first glance this might be a surprising result. However, the results of the ordered probit model (table 1) indicate that households with a higher share of higher educated members show a low probability to be permanently poor that is they only spent few years in poverty. Now, having a look on the predicted hazard rates in figure 1, we see that those households that are only few years in poverty as for example households with higher educated members, show a relatively low probability to escape poverty.

Further results suggest that several geographical attitudes are significantly related to the hazards of transition between poverty and non-poverty. Households that are located in regions with a high unemployment rate (*UNEMPLOYMENT*) and higher population density (*POPDENSITY*) suffer from a relatively high risk of becoming poor, but seem to have on the other hand also good chances to escape poverty. In contrast, in relatively 'rich' regions (*AVINCOME*) and with more migration activities (*MIGRATION*) the hazard of transmission between both states seems to be relatively low.

**Summary**

Persistently poor areas have been not only a concern in least developed countries, but also in nations undergoing economic growth. It is estimated that between 40 and 65 million Chinese, or between 20 and 25 percent of the country's absolute poor, live in persistent poverty. Mapping poverty and its correlates could well be far more than a descriptive tool; it might also hold the key to understanding why and under which circumstances poverty persists, even with robust economic growth. The present study investigates poverty persistence of Chinese farm households in the relatively well-off southeastern Zhejiang province. We firstly apply a probit model examining household, farm and regional characteristics affecting the probability that households are chronically poor. In addition, we apply a hazard approach to identify the risk of falling into and climbing out of poverty. Results of the static probit model suggest as

expected that larger households with more non-working members show a higher likelihood of chronic poverty. Further, we find that the chronically poor households less likely locate in, surprisingly, mountain areas and in regions with high population density. The findings of the hazard approach indicate that with an increasing time households spend in poverty the chance to climbing out of this state increases; first with increasing and followed by decreasing rates. In contrast, while the risk to slip into poverty is constant or increasing during the first two years a rural household is out of poverty, it decreases with every additional year households are non-poor afterwards. Thus poverty seems more a temporary condition and, from a policy perspective, programs that aim at stabilization of short term income fluctuations are superior.

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Table 1: Results of ordered probit

| Variable | Coefficient | Robust standard errors |
|---|---|---|
| *HHSIZE* | 0.128 ** | 0.051 |
| *AGE* | 0.028 | 0.055 |
| *DEPENDEND* | 0.157 ** | 0.069 |
| *ELEMSH* | -0.372 | 0.233 |
| *SECSH* | -0.049 | 0.258 |
| *HIGHSH* | -0.566 * | 0.327 |
| *DHUKOU* | -0.004 | 0.188 |
| *CADRE* | 0.025 | 0.206 |
| *PARTICIPATION* | -0.249 | 0.156 |
| *FSIZE* | 0.084 | 0.097 |
| *ASSETS* | 0.006 * | 0.003 |
| *DIVERSIFICATION* | -0.269 | 0.184 |
| *UNEMPLOYMENT* | 0.573 | 0.909 |
| *MIGRATION* | -7.266 | 6.995 |
| *POPDENSITY* | -0.374 ** | 0.179 |
| *SUBURB* | -0.212 | 0.213 |
| *MOUNTAIN* | -1.349 *** | 0.477 |
| *ECONOMICZONE* | 0.080 | 0.078 |
| *AVINCOME* | 0.00002 | 0.0001 |
| McFadden $R^2$/ N | 0.0611 | 490 |

Note: ***, **, * denote 1%, 5%, and 10% significance level, respectively

Table 2: Results of hazard model

| Variable | | Exit from poverty | | Entry into poverty | |
|---|---|---|---|---|---|
| | | Hazard ratio | Robust standard error | Hazard ratio | Robust standard error |
| *HHSIZE* | | 1.441 *** | 0.087 | 1.325 *** | 0.080 |
| *AGE* | | 1.278 *** | 0.103 | 1.110 | 0.086 |
| *DEPENDEND* | | 1.155 * | 0.097 | 1.138 | 0.093 |
| *ELEMSH* | | 0.891 | 0.273 | 0.973 | 0.276 |
| *SECSH* | | 0.672 | 0.221 | 0.739 | 0.226 |
| *HIGHSH* | | 0.528 | 0.253 | 0.458 * | 0.209 |
| *HUKOU* | | 0.886 | 0.250 | 0.968 | 0.257 |
| *CADRE* | | 1.305 | 0.343 | 1.098 | 0.273 |
| *PARTICIPATION* | | 0.763 | 0.156 | 0.923 | 0.188 |
| *FSIZE* | | 0.915 | 0.114 | 0.937 | 0.115 |
| *ASSET* | | 0.998 | 0.005 | 1.000 | 0.005 |
| *DIVERSIFICATION* | | 1.001 | 0.001 | 1.000 | 0.001 |
| *UNEMPLOYMENT* | | 28.059 *** | 24.371 | 25.512 *** | 22.189 |
| *MIGRATION* | | 0.001 *** | 0.001 | 0.001 *** | 0.001 |
| *POPDENSITY* | | 1.197 * | 0.130 | 1.344 *** | 0.140 |
| *SUBURB* | | 0.878 | 0.201 | 0.818 | 0.183 |
| *MOUNTAIN* | | 0.975 | 0.300 | 1.221 | 0.349 |
| *ECONOMICZONE* | | 0.909 * | 0.050 | 0.932 | 0.046 |
| *AVINCOME* | | 0.9998 *** | 0.00004 | 0.9998 *** | 0.00004 |
| *P* | | 2.544 | 0.112 | 2.116 | 0.080 |
| *Θ* | | 13.070 | 2.362 | 7.099 | 0.811 |
| Wald $\chi^2$ | AIC | 222.93 | 0.603 | 189.97 | 0.631 |
| No. of exits | No. of entries | 421 | | 341 | |

Note: ***, **, * denote 1%, 5%, and 10% significance level, respectively

Figure 1: Predicted hazards