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Abstract

The objective of our study is to identify pattern and causes of households' transitions in and out of poverty using the long household panel data on rural China in the period 1989-2009. We propose a discrete-time multi-spell duration model that not only corrects for correlated unobserved heterogeneity across transitions and various destinations within the transition, but also addresses the endogeneity due to dynamic selection associated with household's livelihood strategies. Duration dependence is generally found to be negative for both poverty exit and re-entry. The household who chose either farming or out-migration as a main livelihood strategy was more likely to escape from this persistent poverty than those who took local non-agricultural employment, while the role of social protection, such as health insurance, was not universally good for alleviating chronic poverty. Overall, the present study emphasises the central role of agriculture in helping the chronically poor escape from poverty.

Key words: poverty transition, discrete-time duration model, correlated unobserved heterogeneity, dynamic selection, rural China
JEL codes: C33, C41, I32, O15

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1. Introduction

Households in rural China have been experiencing both persistent and transient poverty. Substantial reduction in rural poverty had been achieved before 1985 as a result of de-collectivisation of agricultural production and the introduction of Household Responsibility System which dramatically raised agricultural productivity (Lin, 1992), and in the mid 1990s benefited from significant increases in procurement prices of farm product which pushed income growth of rural households (Benjamin *et al.*, 2005). Since then, however, the speed of poverty reduction has been slowed down (Chen and Ravallion, 2008) and it is increasingly difficult for policy and aid to reach the remaining and more dispersed poor in rural areas (World Bank, 2009), for whom deprivation tends to be reproduced in the longer-term. Further worse, there is considerable mobility in and out of the poverty status in rural China (Gustafsson and Sai, 2009). Many of those who have recently escaped are prone to be sliding back again (McCulloch and Calandrino, 2003). Transient poverty, albeit varying with different empirical methods, is non-negligible in total poverty (Jalan and Ravallion, 1998; Duclos *et al.*, 2010) and its attributes differ from those of chronic poverty (Jalan and Ravallion, 2000).

An effort to help the poor better therefore calls for understanding of pattern and causes of households' poverty transitions in such a dynamic world where households may 'use time as an additional degree of freedom' (Barrett *et al.*, 2010, p. 461) to manage livelihoods in response to the changing environment. Incorporating time dimension into the analysis of household poverty is crucial not only for understanding the evolution of households' poverty status and underlying causes, but also for designing and implementing effective anti-poverty programmes. A typical way to do so is including the lagged poverty status as an additional independent variable to capture the dynamics of poverty. Literature in this stream usually assumes first order transition (mainly following Cappellari and Jenkins, 2002). However, this may over-simplify the dynamics and rule out the cumulative nature of poverty if a household's experience of poverty transition in the past beyond a previous round/year of survey contains some clue to understanding the current and the future welfare trajectories.

To address this concern, the present study analyses poverty dynamics by using the duration in which the household has spent. One of the significant advantages of duration analysis is to track individual's unique history and experience. There have been many studies on poverty in developed countries drawing upon duration analysis, such as Canto (2002) for Spain, Devicienti (2002, 2011) for Britain, and Maes (2011) for the elderly in Belgium. By contrast, there have been few works on developing countries. Baulch and McCulloch (2002) use Cox's proportional hazard model to identify the correlates of poverty transitions in rural Pakistan. They bypassed specifying the form of the baseline hazards of poverty exit and entry and assumed that underlying data are continuous, while in reality they are discrete. Recognising this shortcoming, Bigsten and Shimeles (2008) estimate discrete hazards of poverty exit and re-entry for rural Ethiopia and find that households move frequently in and out of poverty but the chronically poor cannot escape easily. Research for China is even thinner. To our knowledge, only two studies have appeared in this area. Glauben *et al.* (2006) find first decreasing and then increasing hazards of exiting and re-entering into poverty. However, their study investigates only a relatively rich province, Zhejiang, and hence is less representative for what has happened to most Chinese rural households. More critically, they based the hazard model on underlying continuous data, while actually using survey data in discrete time. Neither does their model consider the potential bias on the shape of hazard rates caused by household unobserved heterogeneity. You (2011) corrects for these concerns by using the data covering seven provinces between 1989 and 2006 and by constructing discrete-time duration models controlling for unobserved heterogeneity. You's study finds overall negative duration dependence associated with both exit and re-entry rates of poverty. Nevertheless, the distribution of unobserved heterogeneity is modelled in an arbitrary way: the presumed normal distribution.

The present study attempts to add the current literature in the following two ways. First, when exploring the pattern of poverty dynamics, we incorporate unobserved heterogeneity in discrete-time duration models by a fully non-parametric approach. This methodology aims at minimising possible misspecifications to offer more precise estimates. Second, to identify multiple pathways underlying poverty transitions, we propose econometrically a ' "putting time on the map" of poverty analysis' (Clark and Hulme, 2010, p.352) that encompasses not only households' varied duration of past experience of (non-)poverty but also their unique histories of path dependence and shifts across poverty and non-poverty spells endogenously led by their choices of livelihood strategies and participation in social protection schemes. Our framework controls for (i) unobserved heterogeneity that can be correlated across multiple poverty transitions of each household and (ii) the dynamic selection underlying multi-path transitions. This enables us not only to understand trajectories of household well-being during which the strengths and weaknesses of different correlates in aiding in the escape from poverty might vary, but also to identify the optimal strategy by following which households can expect to self-select out of deprivation. Our results will thus carry rich implications for more effective and household-based anti-poverty design recommended by World Bank (2009) for the present rural China so that the policy can be tailored to the poor in accordance with their various paths of life experience over time. Our methodology will also serve as a general tool for the study of poverty dynamics and transition in developing countries.

The rest of the paper proceeds as follows. The next section puts forward our econometric models. Section 3 introduces the data and examines the overall pattern and trend of poverty dynamics in rural China. We then discuss and explain estimation results in Section 4 and offer concluding remarks and policy implications in Section 5.

2. Methodology

2.1. A Background

There are two states, poverty and non-poverty, between which households shift over time. We draw upon discrete-time models because although survival times are actually continuous, we can only observe from the survey data survivals in discrete time with intervals in between where spell lengths are interval-censored. As in Bigsten and Shimeles (2008), the (discrete) survival time is indexed by $t_1, t_2, \ldots, t_j, \ldots, t_k$ with equal intervals for brevity. We consider the rates of exit for those who 'just started a poverty spell'.[1] Among them, d_j households end their poverty spells at t_j. n_j households stay poor in at least j waves and are at 'risk' of moving out of poverty at t_{j+1}. We therefore define the survival function by

$$\hat{S}(t_j) = \prod_{j|t_j \le t} \left(1 - \frac{d_j}{n_j}\right) \tag{1}$$

The hazard rates associated with ending a poverty spell at t_j can be written as

$$h(t_j) = \begin{cases} 1 - \hat{S}(t_j) & if \quad j = 1 \\ \dfrac{\hat{S}(t_{j-1}) - \hat{S}(t_j)}{\hat{S}(t_{j-1})} & if \quad j > 1 \end{cases} \tag{2}$$

The above two equations also allow us to obtain the poverty re-entry rates refer to those who just started a non-poverty spell. The hazard rates of ending non-poverty spells can be calculated analogously.

As survival and hazard functions (Equations (1) and (2)) are essentially aggregate

[1] The concept employed here is in line with Devicienti (2002, 2011) and Bigsten and Shimeles (2008). A household that just has started a poverty (non-poverty) spell at t means that it was in non-poverty (poverty) at t-1 and shifts out of this state at t. Our sample contains 8 waves of the surveys. Therefore, the first (non-)poverty spell starts at the second wave and the maximum duration is 6. The case where the exogenous initial conditions are relaxed will be presented in Section 2.3.

measures of transition into and out of poverty for the full sample, while some households sharing certain characteristics might remain poor/non-poor for a long time. These characteristics can be either observed or unobserved such as the lack of endowments and intrinsic incapabilities. It is hence necessary to investigate whether the revealed shape of poverty transition is a common feature. In what follows, we further explore the correlates of exit from and re-enter into poverty by single competing risk models in Section 2.2 and attempt to map multiple pathways leading to various shapes of poverty transition in Section 2.3 by dependent competing risk models.

2.2.Modelling poverty exit and re-entry

In the baseline model, households are indexed by i. In the time interval j, a standard discrete-time hazard model is defined by:

$$h_i(t_j) = \Pr(T_i = t_j \mid T_i \geq t_j) \tag{3}$$

where T_i is the time a (non-)poverty spell ends. Empirically, we use a complementary log-log specification to accommodate the underlying discrete time when a transition into or out of poverty occurs. As in Devicienti (2002) and You (2011), the probability that household i escapes from poverty at duration d at time t_j, given it has stayed in poverty spells up to t_j, takes the following form:

$$e_i(d, X_{ij} \mid \upsilon_i^P) = 1 - \exp[-\exp(f^P(d) + X'_{ij}\beta^P + u_i^P)] \tag{4}$$

where $f^P(d)$ is the baseline hazard which is a function of duration that i has been stuck in poverty spells; X_{ij} includes household-specific characteristics and aggregate covariates that are time-varying and supposed to affect poverty transition; $u_i^P \equiv \log(\upsilon_i^P)$ denotes the unobserved household-specific heterogeneity which is time-invariant and shared by i's all poverty spells.

By analogy, the probability that household i re-enters poverty at duration d at time t_j, given that it has been non-poor up to t_j, is written by:

$$r_i\left(d, X_{ij} \mid \upsilon_i^N\right) = 1 - \exp\left[-\exp\left(f^N(d) + X_{ij}'\beta^N + u_i^N\right)\right] \tag{5}$$

where $f^N(d)$ is a function of duration that i has successfully maintained non-poverty spells; X_{ij} is defined as before; $u_i^N \equiv \log\left(\upsilon_i^N\right)$ is the unobserved heterogeneity accounting for non-poverty spells.

It is useful to elaborate on two empirical issues which may bias the estimation of the equations (4) and (5). First, how to define two baseline hazards could potentially make significant differences in estimated duration dependence. We attempt three methods without putting a priori choice: (1) a parametric specification making the baseline hazard dependent on the log time spent in (non-)poverty spells, that is, $f^P(d)=\ln(d)$ and $f^N(d)=\ln(d)$ for exit and re-entry regressions, respectively; (2) a piece-wise semi-parametric specification grouping different durations into time periods, that is, three time-period dummies, each of which containing two durations[2] and implicitly assuming that the interval (discrete) hazard rate is constant within each time period but differs across different periods; and (3) a fully non-parametric form, that is, a set of 'duration-interval' specific dummies at which households are at risk of shifting out of (non-)poverty spells.

A more crucial issue is associated with the unobserved heterogeneity. Failure to tackle it would seriously bias the estimated duration-dependence and the proportionate responses of the hazards to estimated coefficients (Jenkins, 2005). In Section 4, we will take into account unobserved heterogeneity in estimating the equations (4) and (5). This second step further involves two problems that should call attention. For one thing, the estimation of hazard models with unobserved heterogeneity requires the knowledge of the distribution of these unobservables in order to integrate them out during the estimation. Empirically, we consider

[2] As mentioned before, because the maximum duration is 6 based on our data, we split them into 3 time-period dummies with 2 durations in each of them. We also experimented with other split-up, but this does not appear to affect qualitatively our conclusion on the shape of duration dependence.

both parametric and non-parametric distributions. For the former, normal and gamma distributions are assumed for the unobserved heterogeneity in turn, while for the latter, we refer to Heckman and Singer's (1984) non-parametric maximum likelihood (NPML) estimation where the distribution of unobserved heterogeneity is approximated by a bivariate discrete distribution with a number of latent classes – also termed as mass points – which are left determined by the data.

Specifically, suppose there are $w \in \{1,2,\ldots,W\}$ groups of households within the study population who are endowed with different but unobserved characteristics that underlie different hazards of poverty exit and re-entry. Falling into the group *w* is attached by a probability π_w with $\sum_{w=1}^{W} \pi_w = 1$. For the type *w*, the hazard functions of poverty exit and re-entry (equations (4) and (5)) can be re-written by:

$$e_i\left(d, X_{ij} \mid \mu_w^P\right) = 1 - \exp\left[-\exp\left(f^P(d) + X'_{ij}\beta^P + \mu_w^P\right)\right] \tag{6}$$

and

$$r_i\left(d, X_{ij} \mid \mu_w^N\right) = 1 - \exp\left[-\exp\left(f^N(d) + X'_{ij}\beta^N + \mu_w^N\right)\right] \tag{7}$$

where μ_w^P and μ_w^N with $w \in \{1,2,\ldots,W\}$ are known as location parameters which are a number of discrete values capturing the effects of the latent classes on the exit and re-entry rates, respectively. The optimal number of the latent classes *W* is determined by the data itself using the Gâteaux derivative method (Lancaster, 1990) and is not necessarily the same across exit and re-entry regressions.

Another issue attached to heterogeneity is that we have so far implicitly assumed that there is no correlation between u_i^P and u_i^N for parametric estimations and independent μ_w^P and μ_w^N in the non-parametric case, i.e., they follow the non-parametric distributions $G\left(\mu_1^P, \mu_2^P, \ldots, \mu_W^P\right)$ and $G\left(\mu_1^N, \mu_2^N, \ldots, \mu_{W'}^N\right)$ with their own optimal numbers of latent classes

W and *W'*, respectively.[3] Put differently, the unobservables pushing households up to a poverty line are irrelevant to those pulling them back again, which, however, appears to be an over-simplified and strict assumption. It would be a matter of concern if the unobservables pertinent to poverty and non-poverty spells were actually correlated. Devicienti (2011) and Maes (2011) introduce a discrete-time hazard model relaxing this potentially unreasonable assumption and allowing for endogenously determined initial poverty status.

To minimise misspecifications, we rely on the non-parametric set-up (equations (6) and (7)) and stick to NPML. Drawing upon Devicienti's work to motivate a simplified version without dealing with endogenous initial conditions,[4] we assume that μ_w^P and μ_w^N are jointly distributed with the un-predetermined distribution function $G\left(\mu_1^P,\ldots,\mu_W^P,\mu_1^N,\ldots,\mu_{W'}^P\right)$ together with optimal numbers of mass points *W* for the exit regression and *W'* for the re-entry one. These adjusted models are again estimated by ML.

The models presented in this sub-section are to identify relevant correlates of poverty exit and re-entry rates. As the estimations are virtually based on pooled (non-)poverty spells across households and over time, these models can also be understood as a *static* examination for poverty transition. In what follows, we proceed to investigate who and why move in and out of poverty by tracking individual household's history of multiple transitions. In this sense, we will provide a *dynamic* picture that will unveil time-varying and 'transition-destination' specific impacts of the important correlates on poverty transitions.

2.3. Modelling multi-path of multiple poverty transitions

We are interested not only in the actual transition outcome which is simply labelled as exit or re-entry in Section 2.2, but also in the specific destinations of such transition. For example,

[3] Here we distinguish *W* and *W'* as distributions of heterogeneity can be different for exit and re-entry regressions.

[4] As with possible endogeneity in households' initial poverty status, we will extend this concept and address endogenously 'dynamic selection' in Section 2.3.

suppose there are two households *A* and *B* who have the same high probability (hazard rate) of shifting out of a poverty spell and they only experience this single poverty spell. The household *A* has realised this probability because it has out-migrated members who can regularly send remittances back, while *B* has escaped because it has managed successfully to increase the efficiency and profitability of their agricultural production. A similar argument can be applied to multiple spells during which two households descend into poverty following its first exit and then escape again. The causes for the first and second shifts out of poverty are not necessarily identical for the same household, or across households. In cases of both single and multiple transitions, latent heterogeneity might also play a role in households' decision making besides their observed characteristics. These complex and endogenous pathways underlying multiple transitions cannot be captured in the baseline models in Section 2.2 unless we track individual household's spells and transitions of (non-)poverty as well as associated choices, and identify the causes for them.

In doing so, we take the approach of ' "putting time on the map" of poverty analysis' (Clark and Hulme, 2010, p. 352) in our econometric modelling. We give particular attention to (i) multiple spells of poverty and non-poverty, (ii) endogenous 'dynamic selection', and (iii) unobserved heterogeneity correlated across spells as well as various destinations within the spell. Figures 1(a) and 1(b) present schematically the intuition behind our modelling strategies. Based on the estimates from Section 2.2, we would be able to identify which covariates are the most relevant to household poverty transition. As illustrated in Figures 1(a) and 1(b), we specifically focus on the two factors which are deemed crucial for rural households: household livelihood strategies and social protection.

[Fig. 1(a) and Fig. 1(b) to be inserted around here]

We classify household livelihood strategies into three categories: farming, local non-agricultural employment and out-migration. Belonging to which category depends on the household's labour allocation. A household, for example, is regarded as a 'farming' household if the household members' labour input in agricultural production is the largest among the three. Defined in this way, three categories are made mutually exclusive and interdependent. That is, they are competing but correlated destinations – also known as 'dependent competing risks' in duration analysis – which face the household when it shifts from the current spell. Each household's transition outcome matches one of the three destinations, while households could engage in other two kinds of activities at the same time. Another merit of this classification is allowing households to switch between agricultural and non-agricultural sectors within the rural space as well as across urban-rural divide in response to households' own endowments and the opportunities open to them.

As shown in Figure 1(a), we have supposedly a full sample prior to the first survey in 1989. In 1989 when we first observed households' poverty status, some of them were poor while others were not, which could be determined by observed as well as certain unobserved characteristics, such as total wealth, intrinsic capability, effort and cognitive ability. Households endogenously 'selecting' to be initially poor in 1989 by either observed or unobserved characteristics started a poverty spell. A few of them might have experienced chronic poverty until the end of the survey in 2009. They remained in a single poverty spell in this case. By contrast, some were able to escape at different durations, i.e., these households would face the 2nd transition and start the 2nd spell (or equivalently speaking, their 1st non-poverty spell). We stop tracking households at the 3rd transition.[5]

As mentioned earlier, the transition (or the hazard rate) at the end of the 1st spell is associated with three correlated destinations derived from households' different livelihood

[5] Three transitions capture 55% of the full sample. See Figure 3 in Section 3 for the distribution of the number of transitions (spells). Theoretically, one may include more subsequent transitions until every household arrives at its observed destination. However, including higher order transitions would reduce further the number of observations having survived to face higher order transitions, which would result in less efficient estimates.

strategies. Latent heterogeneity matters along the entire chain of shifts. The unobserved heterogeneity affecting households' initial poverty status in the first transition and the one forcing them to fulfil different routes of poverty exit and re-entry in the following transitions might be correlated. Moreover, there might be a correlation between unobservables (e.g. ability, skills or entrepreneurship) and observed variables (e.g. educational attainment), which would bias the estimates of observed covariates. This sort of endogeneity along the household's observed sequence of transitions over time is termed 'dynamic selection' in Cameron and Heckman (1998). Its presence could obscure the estimated impacts of observed variables on the hazard of poverty exit at the 2nd transition (Karlson, 2011).

We also explore the function of social protection schemes in terms of health insurance, given the fact that illness and its associated catastrophic medical expenditure is one of the main causes of poverty in rural China (Gustafsson and Li, 2004). As illustrated in Figure 1(b), there are two destinations associated with each shift out of or into poverty: at least one family member is covered by any form of health insurance; or none of the members joins. Again, choices of two destinations within each transition are not independent and dynamic selection might exist.

Having laid out Figures 1(a) and 1(b), we confront multiple transitions in and out of poverty with interdependent destinations at each of them. We therefore follow Jenkins' (2005) multinomial logit framework to estimate dependent competing risks models, while extending the standard one to the multinomial transition model with unobserved heterogeneity (MTMU) developed by Karlson (2011) who applied it to individuals' educational choices. In the remainder of this sub-section, we will first present standard multinomial models but relaxing the well-known assumption of Independent from Irrelevant Alternatives (IIA) at each transition to accommodate dependent competing risks, and then link each transition as in its observed sequence with the jointly distributed unobserved heterogeneity to phase out endogeneity caused by the dynamic selection. This is incidentally the intuition behind the MTMU model.

We assume that each household i embodies unobserved latent propensity y^*_{iak} towards choosing the alternative path a at transition $k \in \{1,2,3\}$. Within each transition, there are A different alternative pathways indexed by a and A could vary across transitions. y^*_{iak} can be described by a number of factors x_{ij} as follows:

$$y^*_{iak} = \sum_{j=1}^{J} b_{ajk} x_{ij} + \varepsilon_{iak} \tag{8}$$

where b_{ajk} measures the influence of the covariate x_{ij} on i's latent propensity for choosing the alternative a at transition k; ε_{iak} denotes the transition-alternative-specific random error terms that are distributed extreme value, $\varepsilon_{iak} \sim EV\left(0,\ \sigma_k^2 \pi^2 / 6\right)$.[6] Let y_{ik} denote household i's observed status at the kth transition. The household i would choose a if it suggests the largest propensity for a, that is,

$$y_{ik} = a \ \text{ if } \ y^*_{iak} > y^*_{ia'k} \ \text{ for all } \ a \neq a' \tag{9}$$

In the standard multinomial logit framework, ε_{iak} ought to be uncorrelated across all alternative pathways within each transition, which is the IIA assumption. Let $a = 1$ be the reference alternative against which other contrast choices (competing risks in the duration analysis) are defined. The probability of choosing $a > 1$ in a standard multinomial form is:

$$\Pr\left(y_{ik} = a \mid x_{ij}\right) = \frac{\exp\left(\sum_{j=1}^{J} \beta_{akj} x_{ij}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \beta_{skj} x_{ij}\right)} \quad \text{for } a > 1 \tag{10}$$

where $\beta_{akj} = b_{akj} / \sigma_k$ is the logit coefficient (log odds-ratio) with the scale factor σ_k; $\beta_{1kj} = 0$ for normalising the model so that the baseline alternative is recognised by $a = 1$.

[6] A standard logit model is traditionally normalised to $\pi^2/6$. See Train (2009) for detailed discussion about the normalisation with *i.i.d.* errors and the scale parameter σ_k.

So far we have presented standard multinomial logit models at each transition *k* with the IIA assumption binding. Recall that we have argued at the end of Section 2.2 that the unobservables could affect simultaneously poverty spells and non-poverty spells. Here the same argument may hold. Households' choices may be correlated through ε_{iak} because if removing one alternative, those who would have chosen this pathway are less likely to randomly distribute their choices across the remaining alternatives (Karlson, 2011). The violation of IIA could therefore be understood as correlated unobserved heterogeneity across alternative choices within the transition. To see this, consider that $\varepsilon_{iak} = \upsilon_{iak} + \xi_{iak}$ where υ_{iak} denotes the household unobserved heterogeneity influencing its choice over a at the k^{th} transition; ξ_{iak} is a random residual which is alternative-irrelevant and satisfies *i.i.d*. By this way, we can also refer to Heckman and Singer (1984) to relax the IIA assumption on ε_{iak} and handle the problem of omitted important unobservables. As in Section 2.2, we assume that households fall into $u_{akw} \in \{u_{ak1}, u_{ak2}, \ldots, u_{akW}\}$ latent classes with the probability π_w being attached to each latent class *w* to approximate the unobserved heterogeneity (υ_{iak}) for household's choosing alternative a at the k^{th} transition. Thus, for those falling into the class *w* at the k^{th} transition, the standard multinomial logistic model (10) can be extended to the one which is conditional on the unobserved heterogeneity as:

$$\Pr\left(y_{ik} = a \mid x_{ij}, \upsilon_{iak}\right) = \frac{\exp\left(\sum_{j=1}^{J} \beta_{akj} x_{ij} + u_{akw}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \beta_{skj} x_{ij} + u_{skw}\right)} \quad \text{for } a > 1 \qquad (11)$$

where u_{akw} is the location parameter. The distribution function $G\left(u_{ak1}, \ldots, u_{akW}, \ldots, u_{Ak1}, \ldots, u_{AkW}\right)$ can be approximated non-parametrically by a number of latent classes for each choice alternative. As such, the choice of each alternative destination within the transition is made dependent through 'jointly distributed' and 'alternative-specific' unobserved heterogeneity of the household.

Now we proceed to link transitions by households' own unique routes. Suppose household i opts for the alternatives a, a' and a'' from the first to the third transition in turn, as illustrated in Figures 1(a) and 1(b). Based on (11), the probability of making three consecutive transitions is defined by:

$$\Pr\left(y_{ik} = a \mid x_{ij}, u_{a1w}\right) \times \Pr\left(y_{ik} = a' \mid x_{ij}, u_{a2w}\right) \times \Pr\left(y_{ik} = a'' \mid x_{ij}, u_{a3w}\right) \qquad (12)$$

Households fall into the latent class w in each transition (i.e., $\left(u_{a1w}, u_{a2w}, u_{a3w}\right)$) with the probability π_w making them to choose the route $\{a, a', a''\}$. The multivariate probability unconditional on unobserved heterogeneity is therefore expressed by a finite mixture model:

$$\begin{aligned}
&\Pr\left(y_{ik} = a, a', a'' \mid x_{ij}\right) \\
&= \sum_{w=1}^{W} \Pr\left(y_{i1} = a \mid x_{ij}, u_{a1}\right) \times \Pr\left(y_{i2} = a' \mid x_{ij}, u_{a2}\right)^{I} \times \Pr\left(y_{i3} = a'' \mid x_{ij}, u_{a3}\right)^{I'} \pi_w \\
&= \sum_{w=1}^{W} \frac{\exp\left(\sum_{j=1}^{J} \beta_{a1j} x_{ij} + u_{a1w}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \beta_{s1j} x_{ij} + u_{s1w}\right)} \times \left[\frac{\exp\left(\sum_{j=1}^{J} \beta_{a'2j} x_{ij} + u_{a'2w}\right)}{1 + \sum_{s'=2}^{A'} \exp\left(\sum_{j=1}^{J} \beta_{s'2j} x_{ij} + u_{s'2w}\right)} \right]^{I} \qquad (13) \\
&\times \left[\frac{\exp\left(\sum_{j=1}^{J} \beta_{a''3j} x_{ij} + u_{a''3w}\right)}{1 + \sum_{s''=2}^{A''} \exp\left(\sum_{j=1}^{J} \beta_{s''3j} x_{ij} + u_{s''3w}\right)} \right]^{I'} \pi_w
\end{aligned}$$

where I (I') is an indicator variable taking the value one if the household who has 'survived' to face the second (third) transition and zero otherwise. As stated earlier, we have assumed a joint unspecified distribution for the unobservables affecting households' separate choices in three transitions. The distribution function $G\left(u_{a1}, u_{a2}, u_{a3}\right)$ is approximated non-parametrically by a number of latent classes w as in Heckman and Singer (1984). Here unobservables are allowed not only to affect alternatives within transitions, but also to be correlated across transitions. This captures the 'dynamic selection' and hence, addresses the endogeneity associated with the initial poverty status.

The finite mixture multinomial logit model (13) is what we mean by MTMU and can be estimated by NPML. Note that distinct scale factors σ_k across transitions hamper direct comparison of the magnitude of the estimated coefficients for the same independent variable x_j but at different transitions (i.e., β_{akj}). We further calculate the average partial effect for each independent variable at each transition, in order to cast light on transition-alternative-specific and time-varying influence of independent variables on the probabilities of choosing multiple pathways. According to Karlson (2011), the predicted probability of alternative a for a household i at transition k is formulated by:

$$\Pr(y_{ik} = a) = \sum_{w=1}^{W} \frac{\exp\left(\sum_{j=1}^{J} \hat{\beta}_{akj} x_{ij} + \hat{u}_{akw}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \hat{\beta}_{skj} x_{ij} + \hat{u}_{skw}\right)} \hat{\pi}_w \tag{14}$$

where again $\beta_{1j} = 0$. The average partial effect (APE) on the probability of alternative a of variable x_j is therefore obtained by taking the partial derivative with respective to x_j for each i and then averaging the partial derivatives across the full study population:

$$\frac{\partial \Pr(y_k = a)}{\partial x_j} = \sum_{i=1}^{N} \left(\hat{\beta}_{akj} - \hat{t}_{kj}\right) \sum_{w=1}^{W} \Pr(y_{ik} = a \mid \hat{u}_{akw}) \hat{\pi}_w \tag{15}$$

where $\hat{t}_{kj} = \dfrac{\sum_{s=2}^{A} \hat{\beta}_{skj} \exp\left(\sum_{j=1}^{J} \hat{\beta}_{skj} x_{ij} + \hat{u}_{skw}\right)}{1 + \sum_{s=2}^{A} \exp\left(\sum_{j=1}^{J} \hat{\beta}_{skj} x_{ij} + \hat{u}_{skw}\right)}$.

In Section 4.2, we will apply the MTMU (Equation (10)) to Figures 1(a) and 1(b), respectively. In each of the application, we first select ‘non-poor’ as the baseline alternative at the first transition, which reveals the pathways of poverty exit, and then ‘poor’ for studying poverty re-entry. The reference alternative at the second and third transitions is the ‘local non-agricultural employment’ for Figure 1(a) and ‘no protection’ in Figure 1(b). We finally calculate APEs for each transition.

3. Data

We employ a balanced panel tracking the same rural households over time. The panel is extracted from China Health and Nutrition Surveys (CHNS) in 1989, 1991, 1993, 1997, 2000, 2004, 2006 and 2009.[7] There are 1,304 rural households in the constructed panel.[8] This study population is equally spread in seven provinces from coastal to inland China,[9] which could offer good representativeness for rural China.[10]

It is worth noting that the choice of poverty indicator could affect largely what picture we can draw from the data about sample households' welfare. Income has been widely used to study poverty in China, while this indicator has been criticised to underestimate China's poverty headcounts by about 10% as average income is 10-20% higher than expenditure (Park and Wang, 2001), overstate income mobility (Naschold and Barrett, 2011) and inflate the dynamics of poverty (Baulch and Hoddinott, 2000) due to greater volatility coming from measurement errors and/or households' consumption-smoothing behaviour. Consumption is therefore believed as a better indicator in both current and long term (World Bank, 2009). Nevertheless, it is still unable to obviate completely the problem of measurement errors. As

[7] We begin by selecting 'rural' households as those with rural registration (*Hukou*) and living in villages in 1989. From this pool, we picked up those who have been re-interviewed in the seven follow-up rounds and kept living in villages full-time, though might have migrant family members. Those living in urban suburbs are excluded.

[8] One might be concerned with non-random attrition and aging of study population in such a long balanced panel. We have detected some non-random attrition at both individual and household levels, but this is unlikely to cause a serious problem. First, the extent of attrition is not so serious. There were on average 24.5% of households in the panel which reported 'excluded' family members in one of the eight survey years. In these households, the average number of 'excluded' family members was around only 1.5 - of which 13% out-migrated and became unregistered with the household and therefore, they were not re-interviewed by the CHNS; 16% were attributed to death; and only 15% remained in the survey areas and were re-interviewed as members of other households. Second, bias would also arise if new household members used to belong to other sample households and were previously interviewed by the CHNS. We find, however, that from 1993, only 4 to 14 households out of the total sample of 1,304 reported new family members in various survey years. Among those households, the average number of new members was 1.33. Hence, repeated interview for new family members is less likely to cause substantial bias in our estimation. Finally, we have re-estimated models in Sections 2.1 and 2.2 for unbalanced panel data and have obtained broadly similar results.

[9] These provinces are Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi and Guizhou. Two north-eastern provinces, Liaoning and Heilongjiang, are excluded from the constructed panel, because the former was not covered by the CHNS in 1997 and the latter has enters the survey since 1997. Excluding these two provinces is less likely to affect the representativeness or bias the estimations of our panel as their economic and general development levels, measured by average provincial real per capita GDP between 1985 and 2009 (according to authors' calculations based on various issues of China Statistical Yearbooks) and National Human Development Indicators 2005, are within the range confined by the included provinces.

[10] See Appendix Table A.1 for the list of variables.

monetary variables, both income and consumption suggest sensitivity to the price deflator. A natural alternative is nutrition measurement, for example, a food poverty line derived from a threshold of nutrition intake per person per day. The limitation however is that this is only an approximation of nutritional intake, and thus may not necessarily reflect the actual nutritional deprivations of household members.

Taking these empirical issues into account, we use consumption as the welfare indicator and study household poverty measured by per capita consumption against a set of monetary poverty lines. Specifically, we first recalculate the international poverty lines of US$1.25/day and US$2/day to accommodate different cost-of-living for the poor in rural and urban areas (37% higher for the urban poor in 2005 as suggested by Chen and Ravallion, 2008). Then, to better insulate consumption from the influence of measurement errors, we follow Devicienti (2002) and define the poor (non-poor) as those whose per capita household consumption falls below (surpasses) 90% (or 110%) of the recalculated poverty lines of US$1.25/day and US$2/day. This is what we mean by ‘adjusted’ poverty lines in the rest of this paper in contrast to the ‘unadjusted’ ones which are simply the recalculated 1.25 dollar-a-day and 2 dollar-a-day lines. At the same time, we use a food poverty line of 620 *yuan* in 2002 prices based on 2,100 calories intake per person per day to check the robustness of poverty statistics derived by the adjusted and unadjusted poverty lines.[11] Based on the constructed panel, the rest of this section explores the pattern of poverty transitions into and out of poverty over time to motivate our model specification in the next section.

Figure 2 depicts the changes of poverty rates measured by household per capita consumption against various poverty lines. Whichever poverty line is referred to, there is an overall decreasing trend of poverty rate over the study time span. As we stated in Section 1, the stagnation of poverty reduction and the concentration of destitution for some extremely

[11] This is an average food poverty line for rural China and is calculated by Ravallion and Chen (2007).

poor households are also confirmed by our data. Over the period 1997-2000, the poverty rate only decreased by 0.15 to 0.53 in percentage points under the three higher poverty lines in Figure 2, and even increased by 54% (4.2 in percentage points) under the food poverty line, which indicates a higher number of the ultra-poor. Poverty reduction seems to have been accelerated again since 2004. However, the lower the poverty line is applied, the slower is the pace of reduction, and vice versa. This also signals that many of those who are at the bottom of consumption distribution remain poor, while the not-so-poor ones grow quickly (especially those lying between US$1.25 and US$2). As supplementary evidence to this, inequality within rural areas keeps increasing over time.

[Fig. 2 to be inserted around here]

The above discussion gives rise to the question as to how many poor households continue to stay in poverty and how many have shifted across poverty lines from time to time. Table 1 presents poverty transition matrices for each poverty line over the entire period between 1989 and 2009. The adjusted poverty line of US$1.25 makes both escape and backsliding more difficult compared with the unadjusted US$1.25, since the adjusted line by construction makes shifts more difficult. There is clearly concentration of the categories of 'poverty-poverty' as well as 'non-poverty and non-poverty' in both years. The average likelihood of shifting out of poverty is higher than that of backsliding, which is consistent with the overall huge poverty reduction in Figure 2. Both of the probabilities of exit and entry are not trivial, implying frequent poverty transitions in rural China.

[Table 1 to be inserted around here]

We proceed to examine poverty transitions in greater detail. As shown in Figure 3, there is a significant degree of transitions as well as pronounced persistence. Under the adjusted

US$1.25, 16.5% of households have shifted across poverty and non-poverty for at least five times out of eight rounds of surveys. Most of households experienced two to four transitions, while there is still a non-negligible proportion (10.7%) only shifting once.

[Fig. 3 to be inserted around here]

Looking at poverty spells in Figure 4, about 52% of households end poverty after one period under the adjusted US$1.25 and 92.4% could escape after three consecutive periods in poverty. About 4% remained in poverty in at least five consecutive periods. The population-weighted averaged length in poverty is two periods under the adjusted US$1.25 and rises quickly to 3.7 under the poverty line of US$2. The higher the poverty line, the more persistent poverty becomes. This indicates that those who have escaped from poverty measured by lower poverty lines do not grow further and lie not-so-far away above the lower poverty lines. This is also consistent with our earlier finding from Figure 2 and may easily cause returning to poverty when these households encounter adverse events or shocks.

[Fig. 4 to be inserted around here]

As a background for Section 4, we have also derived simple non-parametric estimation for the survival and hazard rates of poverty exit and re-entry based on the equations (1) and (2). As shown in Table 2, under the adjusted poverty line of US$1.25/day, the probability of exit is 31.6% if the household only experiences one period in poverty, but declines gradually to 25.6% after remaining in poverty for four consecutive periods. However, the chance of exit increases at longer duration. By comparison, there is overall negative duration dependence between non-poverty spells and the hazards of re-entry. Though an increase in the hazard rate of re-entry appears after five periods in non-poverty, the magnitude is not as much as that in the hazards of exit. Overall, hazard rates of both exit and re-entry after two periods are smaller under the adjusted poverty line than that under the unadjusted one by construction. In the first one to two periods however, the hazards of exit and re-entry look greater under the adjusted poverty line. This may be due to greater volatility in households' consumption stream when they just make transitions than when they have stayed in poverty or non-poverty for some periods.[12]

[Table 2 to be inserted around here]

4. Results and discussion

4.1. Correlates of ins and outs of poverty

Following discussions in Section 2.2, we have estimated single competing risk models without controlling for heterogeneity[13] (corresponding to the equations (4) and (5)) and the model controlling for heterogeneity and allowing for interdependent unobservables across spells of poverty and non-poverty (for the equations (6) and (7)) – the latter of which has been estimated with and without additional covariates (i.e. disaggregated measures of covariates, such as types of health insurance and components of urbanisation). To save the space, we present only the last two cases in Table 3.[14] Columns (1)-(3) report the results for exit from poverty and Columns (4)-(6) show those for re-entry into poverty.

[Table 3 to be inserted around here]

Negative duration dependence is found in the exit regression when we used fully

[12] The estimates in Table 2 essentially hold the assumption that survival and hazard rates are homogeneous across the study population, while some groups of households may actually fare better than others with respect to the outcome of poverty transition. We have used Log-rank and Wilcoxon tests to examine some covariates that we suspect to contribute to the difference between hazard rates. Education, out-migration and health insurance stand out, while local non-agricultural employment and geographic locations of households suggest little impact. The statistics will be provided on request.

[13] We have applied a fully parametric baseline hazard function, the piece-wise semi-parametric specification and the fully non-parametric specification and obtained broadly consistent results.

[14] Broadly similar and consistent results have been obtained for these three cases. The results for other cases are given in Appendix Tables A.2 and A.3.

parametric and the piece-wise semi-parametric specifications for the baseline hazard. However, a fully non-parametric specification clearly lends support to a first decreasing and then increasing duration dependence in Columns (1)-(3) of Table 3. One would have been misled to a biased conclusion if the specification of the baseline hazard were not flexible enough. If the household experiences the poverty spell up to one period (D1) to three (D3), the probability of existing from poverty is decreasing and the coefficient estimates are statistically significant. The more time spent in poverty, the less likely is the household to escape, which could lead to chronic poverty. However, the coefficient turns to increase with a smaller absolute value for D4 and D5, which implies that the probability for exist becomes more or less stable for those who have been chronically poor for three to four consecutive periods. However, the probability of escaping from poverty would increase if they experience five consecutive periods in poverty.[15] On the other hand, consistently negative and increasing duration dependence appears in the re-entry regressions (Columns (4)-(6)) and so do the fully and semi-parametric specifications. Re-entry threatens less for those staying longer in non-poverty. For both exit and re-entry, the magnitude of D1 to D5 reveals non-linearity of negative duration dependence.

Among various demographic characteristics, a significantly negative coefficient of household size for exit indicates that a larger household is more likely to stay in chronic poverty. The household with more adult members is more likely to escape from poverty. Age of the household head is positive and significant for exit, implying that a household with an older head is more likely to exit from poverty.[16] Education plays an important role. The households with more members completing primary, secondary and tertiary education are all more likely to escape from poverty and end their hardship. For re-entry into poverty, the

[15] In contrast, consistently negative duration dependence is found in fully and semi-parametric specifications. This indicates that flexible modelling can reduce the bias caused by the possible misspecification under over-simplified assumptions for the baseline hazard.

[16] The squared term of age cannot be included as this will make convergence during our maximising the likelihood functions impossible.

coefficient estimates of primary and secondary education are insignificant, but that of tertiary education is positive and significant. That is, the households with more members who have completed tertiary education are more likely to exit from poverty as predicted, but, in the meantime, they are more likely to slide into poverty again. This latter result sounds counter-intuitive, while we suspect that the reason may be soaring cost of higher education in China, especially under proportionately declining financial support from the governments and expansion of higher education enrolment since 1997. As reported in Démurger *et al.* (2010), for households in a remote and poor village of Beijing in 2003, the average educational cost for a child under age 16 is 2,000 *yuan*, but jumps to 8,000 *yuan* for a university student. In their survey, most of the households cannot afford this, even though the village belongs to the capital. Chinese rural households tend to endure deprivation again if they have to pay for such high fees (Gustaffson and Li, 2004).[17] Moreover, though higher education may lead to higher incomes in the future, it is not necessary for migrants to find a job and is associated with substantial opportunity costs in rural China (de Brauw and Giles, 2008a). Together with expensive tuition fees, those struggling to afford a university student may well encounter hardship.

On household wealth, more cultivated land helps the poor escape from poverty (Columns (1) and (3)). Land is collectively allocated to each rural resident within the village on a basis of family size and the land rental market has long been nascent. This induces land fragmentation and a mismatch between land and labour, for example, potentially idle land for some affluent families participating mainly in non-farm activities (Jin and Deininger, 2009). Endowing poor rural households who lack access to non-farm opportunities with more cultivated land can bring about substantial agricultural productivity gains (ibid, 2009) and

[17] Unfortunately, the cost of education and the associated argument of the effect on poverty cannot be verified by our data, as CHNS did not collect such expenditure data.

thus, facilitate their escape.[18] On the other hand, agricultural asset accumulation has a poverty-preventing effect (Columns (4)-(6)). It remains unclear whether running small business like commerce, service, and manufactures is able to explain poverty transition as the coefficient estimate is insignificant.

There has been recently a resurgent of interest in the role of agriculture vis-à-vis poverty (Barrett *et al.*, 2010; Christiaensen *et al.*, 2011; de Janvry, 2010; de Janvry and Sadoulet, 2010). Drawing upon cross-country data, Christiaensen *et al.* (2011) find that the poverty-reducing effect of agriculture is most prominent for the poor living under US$2/day. Agricultural development can also be crucial for poverty reduction for economies where there are extensive market failures in the factors market (Dercon, 2009), like China. Echoing the above research, our estimation documents a paramount role of agriculture in determining rural households' poverty status. This is also consistent with the finding that productivity gains in agriculture are the key ingredient to increase rural households' income and to propel huge poverty reduction in China (de Janvry and Sadoulet, 2010; Montalvo and Ravallion, 2010; Ravallion and Chen, 2007), especially for poor and landlocked areas in the west (Christiaensen *et al.*, 2010). However, slowed growth in agriculture compared to manufacturing and services sectors pulls the pace of poverty reduction in China: if the same growth rate could be maintained across three sectors after 1981, the poverty rate at the end of 2001 would have been achieved 10 years earlier (Ravallion and Chen, 2007) and less than half its actual value at the end of 2001 (Montalvo and Ravallion, 2010). Agricultural development is essential for healthier structural transformation, which in turn paves a sustainable pathway out of poverty (Barrett *et al.*, 2010).

More members embarking on local non-agricultural work suggests positive yet

[18] Agricultural productivity gains originate mainly in both land and labour productivity (de Janvry and Sadoulet, 2010). Our estimate of land reveals the poverty-reducing effect stemming from the former. For the latter, Christiaensen *et al.* (2010) find that higher labour productivity in agriculture helps rural households move out of poverty in Gansu and Inner Mongolia.

statistically insignificant influence on poverty exit and prevents re-entry. Limited local non-agricultural participation reflected by our data may explain this statistical insignificance. Only 30-34% of households in different surveys have had family members in local non-agricultural employment and about 90% of those households drew off no more than two labour force in local non-agricultural. Huang *et al.* (2009) also find that participation in off-farm employment is associated more with younger and well-educated households, but less with poorer ones. Another possible reason lies in Ravallion's (2005) finding that it is income generated from agriculture that conveys the strongest poverty-reducing effect and externalities to other non-agricultural activities in rural China. Christiaensen *et al.* (2010) also document a larger benefit for escape from labour productivity gains in agricultural than in off farm.

Village out-migration networks increase considerably the chance of escape from poverty (Columns (2) and (3)). With larger out-migration networks, villagers are more likely to get a job outside as those often kinship networks provide relevant information and reduce the transaction costs during job hunting (Zhao, 2003). Successful out-migration in turn spawns the growth of rural households' income (Du *et al.* 2005) and consumption (de Brauw and Giles, 2008b), which mediates poverty exit. However, these effects of out-migration are not statistically significant for prevention of re-entry into poverty (Columns (5) and (6)).

As revealed by Table 3, another prominent attribute to poverty transitions is health insurance. We observe statistically significant and large effects of health insurance on facilitating poverty-exit as well as prevention from poverty re-entry.[19] Rural residents in China have long been excluded from many social protection schemes that are enjoyed solely

[19] We included two important sources of income shocks facing Chinese rural households who rely mainly on agricultural production as additional regressors and re-estimated Columns (1) and (4). A positive shock, measured as increases in the growth rate of the purchasing price of farm product tends to accelerate considerably rural households' transiting out of poverty. Weather shocks, proxied by the percentage share of cultivated land affected by various natural disasters at the provincial level, on the other hand, tend to perpetuate chronic poverty by reducing the probability of exit.

by urban residents, such as the minimum income support and pension. A typical case is health insurance. Only 12.8% of rural population in 1993 was covered by health insurance including voluntary community-based insurance, public medical care, social medical insurance, and full or semi-labour related medical insurance. Yet, this share was even smaller after a decade of remarkable economic development (11.2% in 2003). If only the voluntary community-based insurance is accounted for, the share was only 6.6% in 1998 and 9.5% in 2003.[20] Since 2003, the government has re-launched community-based cooperative health insurance, New Cooperative Medical Scheme (NCMS), aiming to expand the social welfare for the rural population. Considering an on-going debate on whether and how the introduction of NCMS effectively limits rural households' financial risks (Wagstaff *et al.*, 2009), we are interested in examining the disaggregated effects of different kinds of health insurance. Columns (2) and (5) show that the positive (negative) and significant effect of health insurance on exit from (re-entry into) poverty mainly works through the NCMS, which has significant effects on both increasing exit and reducing re-entry. Free insurance provided by the government which was launched in a small range of areas and population in the early 1990s has no statistically significant influence. The purchase of commercial health insurance tends to significantly barricade escape given that it might incur large opportunity costs and trade-off between such an expensive purchase and current living conditions.

Urbanisation helps rural households end poverty, while it is not significant for preventing re-entry. Urbanisation considered here is not simply the increasing share of urban population[21] in total population defined by the National Bureau of Statistics of China, which is criticised to be due, at least partly, to administrative upgrading of low-level governments. Rather, it is comprehensive development changing rural-urban environment gradually over

[20] The shares in this and the previous sentences are authors' calculations based on data compiled from Liu and Rao (2006) and China Health Statistical Yearbook 2008 published by the Ministry of Health.
[21] Here urban population points to those who permanently live in urban areas, rather than who only register with an urban *Hukou*.

time, such as population structure, economic (typically non-agricultural) activities, marketerisation, infrastructure, communication, and delivery of education, health and other social services. An urbanisation index at the village level incorporating these dynamic socioeconomics has been constructed by Jones-Smith and Popkin (2010) and complied into the CHNS by the survey team. Columns (1)-(3) point out a significant poverty-reducing effect of urbanisation. This variable also provides an opportunity to check the sensitivity of our findings to rapid and wide spread urbanisation across China. This is especially important in our context as we use a long panel covering two decades and some of the initially ‘rural’ areas may have become urbanised to some extent in later surveys, though they are still labelled as ‘villages’ or ‘counties’ in the government’s administrative divisions. Controlling for the degree of urbanisation, we can infer that the revealed shape of duration dependence and other findings are robust and representative for rural China.

We also employ some disaggregated measures of local urbanisation (Columns (3) and (6)). More economic activities in terms of higher wages for ordinary males and the percent of population in non-agricultural work are statistically insignificant in both exit and re-entry regressions. This somehow echoes our previous findings that it is agriculture, rather than local non-agricultural employment, that acts as the key attribute to poverty transitions. This estimate also allows us to shed some light on the indirect effect of rural-urban migration. Christiaensen *et al.* (2010) note that rural agricultural labour market might be tightened as urbanisation expands, i.e., as more rural population out-migrates and engages in local non-agricultural activities. This in turn would entail higher agricultural incomes and facilitate poverty exit. However, the insignificant estimate of local economic activities rejects this indirect effect of out-migration through tightening rural agricultural labour markets, possibly because there are few landless agricultural labourers in rural China under the collective land allocation on the basis of household size. As expected, easier access to markets and more social services in terms of provision of preschool for children under three years old significantly and availability of various insurance benefit poverty exit. However, neither of these village-level factors plays a role in preventing transitions into poverty again.

4.2. Multiple pathways underlying poverty transition

From the analysis in Section 4.1, household livelihood strategies and social protections stand out as important determinants of poverty transitions over time. This sub-section presents our findings on which route steadily lifts households out of poverty by the MTMU models outlined in Section 2.3. In Panel A of Table 4, the baseline alternative at the 1st transition is non-poor. The first column reports coefficient estimates and standard errors for the probability being under ‘initially poor’ after taking account of the endogeneity of initial poverty status. The second transition corresponds to (the transition from poverty to) ‘non-poverty’ for each livelihood strategy. The results for ‘Agriculture’ and ‘Out-migration’ are presented in the second and the third columns. The last two columns are the results for the third transition, ‘poverty’ (from ‘non-poverty) for ‘Agriculture’ and ‘Out-migration’. Because the baseline alternative at the 1st transition is ‘poor’ in Panel B of Table 4, the first transition is for being ‘initially non-poor’, the second transition is ‘poverty’ and the third one is ‘non-poverty’, each of which is conditioned by livelihood strategies. The results for social protection are reported in the same way in Table 5.

Employing Gâteaux derivatives, we have detected two latent classes (i.e., Classes 1 and 2) under each destination-specific transition illustrated in Figures 1(a) and 1(b) as presented in Appendix Table A.4. The distinction between these two classes is determined by the likelihood of a household following specific transitions by taking into account both household observable and unobservable characteristics. In Panel A of Table 4, there is a probability of 44.8% for households to be endowed with Class 2 which predisposes them toward poverty at the first transition, while 55.2% of them fall in Class 1 which makes them intrinsically less likely to be initially poor. Such observations give salience to a concept of persistent poverty of which households with Class 2 unobservables would be in grip. Together with generally negative duration dependence revealed in Section 4.1, households in rural China tend to be captured by two different kinds of persistent poverty caused by their past experiences and respectively. Dynamic selection also appears to exist. In Panel A of Table 4, households who possess Class 1 heterogeneity and are less likely to start with a poverty spell in 1989 consistently have lower likelihood of choosing agriculture or out-migration as a means to escape than choosing local non-agricultural employment in subsequent transitions. Similar patterns are found for social protection.[22] The presence of endogenously initial poverty and dynamic selection justify our use of the MTMU model specification.

We first look at livelihood strategies in Table 4. Taking non-poverty as the baseline alternative at the first transition (Panel A), we find strongly negative duration dependence again because the positive estimate of the logarithm of years in poverty (ln(d)) implies that the longer a household experiences poverty, the more likely it is to be observed poor. That is, there appears to be strong persistence of poverty for some households. However, duration dependence in poverty disappears at the second transition for those choosing agriculture and out-migration, compared to those who embark on local non-agricultural employment as a route to escape. At the third transition, it is striking to find that duration dependence becomes *positive* for both agricultural and out-migration pathways, indicating a good chance to escape at longer duration. That is, a household, while staying longer in 'poverty' in the third transition, is *more* likely to escape from poverty should it engage more in agriculture or out-migration. Comparing these two routes, the likelihood of escape appears to be higher for

[22] Another clue is correlated heterogeneity indicated by non-zero elements in covariance matrices of latent heterogeneity across destination-specific transitions. Full results will be furnished on request.

the households choosing to rely on out-migration, as reflected in the larger absolute value of coefficient estimate of ln(d) in the last column.

[Table 4 to be inserted around here]

In Panel B where poverty is taken as the baseline alternative at the first transition (i.e. those who are initially non-poor are concerned), negative duration dependence first appears at the second transition for those selecting the out-migration route. The significantly positive coefficient estimate of ln(d) implies that longer poverty experience tends to enhance the probabilities of staying in poverty (i.e., reduces the chance of exit). However, had households chosen to rely on agriculture when falling behind at the second transition, they would not have been affected by such captivity of poverty. Moreover, at the third transition, the significantly positive estimated coefficient of ln(d) indicates that the more years the farming households have stayed in non-poverty in the past, the more they are able to remain such a high well-being. Those who opt for out-migration might still face a possibility of backsliding, though the coefficient estimate is insignificant.

Among households' demographic characteristics, a larger family size and the age of head are correlated with a lower likelihood of being initially poor.[23] Particularly at the third transition, both tend to reduce the possibility of re-entry into poverty for the initially poor (Panel A), while Table 3 finds that family size is only correlated with poverty exit. For the initially non-poor (Panel B) at the third transition, a more elderly household head would reduce the chance of exit for those primarily in out-migration, but would not affect agricultural households.

Interestingly, education only 'selects' poverty and non-poverty at the first transition. More members having primary and secondary education can help households reduce the

[23] Again we are unable to include the squared age, as this will make the maximum likelihood functions fail to converge.

possibilities of being poor at the first transition with 11% and 9.5% respectively.[24] However, these variables do not affect significantly either exit or re-entry in the following transitions. For the initially poor, more members receiving tertiary education can increase the chance of initial poverty by 9.3% at the first transition and double the re-entry rate at the third transition for farming households and the average partial effect for those following the route of out-migration is 24.6%.[25] For the initially non-poor, tertiary education increases the probability of re-entering into poverty at the second transition for agricultural households. All these findings are consistent with previous estimates in Columns (4)-(6) of Table 3. It is conjectured that a positive correlation between higher education and poverty exit we have found in Table 3 is largely affected by the initial poverty status. It holds for the initially poor at their second transition (i.e., the first poverty exit) and having more household members receive higher education tends to 'select' agricultural households to climb out of poverty with a higher probability than those on the route of out-migration as the average partial effect on the chance of exit is 46.8% for the former group and 33.8% for the latter. Nevertheless, for the initially non-poor, higher education appears to limit the chance of exit at the third transition (i.e., their second transition to non-poverty) particularly for agricultural households. Once falling behind, at least some of the initially non-poor might struggle to afford expensive higher education. It is conjectured that having suffered from poverty, albeit following a non-poverty spell, could chip away the power of higher education in future exit. As such, past experience of poverty not only incurs persistent deprivation on its own rights (i.e. the negative duration dependence), but also exhibits pronounced influence on otherwise favourable attributes to poverty transitions. Overall, primary and secondary education reduces

[24] One may notice significantly negative estimates of primary and secondary education in Panel B of Table 4, which means that households with more members having completed primary and secondary education are less likely to be initially non-poor. This seems contrary to the corresponding estimates in Panel A. However, when excluding the scaling effects on estimated coefficients, we find that the average partial effects of two educational variables in Panel B are less than Panel A and with larger standard errors. Therefore, the 'net' effects of these two levels of education are still poverty-reducing.

[25] The estimates of APEs for all the variables will be furnished on request.

initial poverty only. Higher education carries threat of re-entry into poverty and its positive role in promoting exit depends on households' initial poverty status.

We find a positive and selective role played by agricultural asset accumulation: it reduces (increases) the probability of being initially poor (non-poor) at the first transition. However, its selectivity dissipates in the subsequent transitions. More cultivated land in Panel A appears to be correlated with initial poverty, which might be ascribable to inefficient land allocation policy in rural China (Brandt *et al.*, 2002), and less likelihood of exit at the second transition, especially for those choosing out-migration and that of the third transition in Panel B. This seems inconsistent with the results in Table 3 which shows that more cultivated land is an impetus to exit. Note that in the MTMU model, we have controlled for households' history of transitions. As the case of higher education, past experience of poverty prior to exit could weaken the positive role of land holdings. It is also found that the cultivated land precludes re-entry into poverty and the coefficient estimate is statistically significant in the MTMU model. Specifically, maintaining a larger area of cultivated land reduces the chance of re-entry into poverty for those who are initially poor and choose the route of out-migration at the third transition (Panel A) and those who are initially non-poor and whichever livelihood strategies they follow at the second transition (Panel B). In this sense, cultivated land holdings and agricultural production attached to it function as safety nets, especially for those migrating to cities for higher incomes but having little likelihood to enjoy social insurance as those with urban registration.

A larger share of household members in local non-agricultural employment appears to associate with a higher probability of initial poverty. Nevertheless, it serves as a valuable complement to the initially poor who select the agricultural route, as it reduces their likelihood of re-entry into poverty by 31.8% at the third transition. Village out-migration networks suggest strong negative (positive) correlation with initial poverty (non-poverty).

This relationship however disappears in the following transitions for the initially poor. By contrast, more village out-migration almost doubles the chance of falling into poverty for those who are initially affluent and choose agriculture at the second transition. At the third transition in Panel B, migration networks help those who are initially non-poor and choose the out-migration route get rid of poverty more easily, while its APE is weakened substantially as opposed to that of earlier transitions.

It is notable that there is no correlation between health insurance and the initially poor in Table 4. The substantial and positive effect of health insurance found in Table 3 mainly comes from the initially non-poor households. This raises the concern as to whether health insurance is an effective tool to bail out the originally poor caused by their latent heterogeneity. In Panel B, a greater coverage of health insurance for family members can increase not only the probability of being initially non-poor, but also the chance of the exit from poverty for those who are initially non-poor but slide back into poverty at the second transition. Health insurance appears to be able to attenuate the aftermath of past experience of poverty: its APE at the third transition is appreciable, 21.2% and 16.7% for agricultural and out-migration routes respectively, as compared with 9.5% at the first transition.

In addition to higher education and land holdings, urbanisation is another variable which we find has been affected by the endogenous 'dynamic selection'. It promotes the exit from poverty in Table 3, but in MTMU models, this only holds for the initially poor at their second transition and for the initially non-poor at their third transition. Agricultural households benefit more from urbanisation compared to those choosing out-migration, which is predictable given the positive relationship between agricultural incomes and the elements of our urbanisation index such as the vitality of local economy, infrastructure, access and integration to markets, and social services. Take the initially poor for example. The APE on the exit rate for agricultural households (57.2%) is three times as high as that for those following out-migration (18.8%). Moreover, urbanisation also stifles re-entry for the initially poor choosing the agricultural pathway during their subsequent transitions. A surprising observation is that at the first transition, a higher degree of urbanisation is associated with a greater (lower) possibility of starting with a (non-)poverty spell. A higher degree of urbanisation can bring about increases in income as well as higher income inequality, which implies that the impact of urbanisation is the trade-off between two counteracting forces (Christiaensen and Todo, 2009). The poverty-reducing and preventing effects are likely to be caused by a dominating income effect, while the positive association with poverty can happen if the inequality effect takes over. It is further noted that the positive association with poverty is only observed at the first transition. Taking account of this as well as earlier results on agriculture and out-migration, we would argue that urbanisation can be considered as an anti-poverty initiative only in later stages of spatial or structural transformations, while agriculture and out-migration are the tools when poverty is still omnipresent in rural areas.

Table 5 presents estimation results of MTMU models based on whether or not households participate in health insurance. We can see similar findings about the effects of covariates on the probability of poverty or non-poverty at the first transition. We will thus focus on interpreting the second and third transitions.

[Table 5 to be inserted around here]

For the initially poor (Panel A) who choose to participate in health insurance at the second transition, education, asset accumulation and urbanisation are unlikely to ease exit, but would rather reduce the exit rate compared to those who are initially poor but do not participate in any form of health insurance. Local non-agricultural employment turns out to drive escape and the APE of out-migration (81.9%) is more appreciable than that of local non-agricultural employment (24.4%). This is also true for the exit (the third transition) for those who are initially affluent and select the route of having health insurance.

At the third transition for the initially poor, higher education and local non-agricultural activities tend to give rise to re-entry into poverty, although they have at least one member covered by health insurance. Age, primary education, land holdings and out-migration can reduce the probability of re-entry, while for the initially non-poor (Panel B) at their second transition, secondary education, agricultural asset accumulation and urbanisation also help with avoiding re-entry.

It is worth noting that for both initially poor and non-poor households, having more family members enjoy health insurance tend to increase the probability of re-entry into poverty with moderate APEs (10-11%). Together with the positive correlation between health insurance and initial affluence (Panel B of Table 5), it could be argued that the favourable role of health insurance on poverty transitions identified by Table 3 reflects its impact on the first transition rather than during subsequent transitions. When households have experienced at least one spell out of poverty, participation of health insurance appears to lose its power in safeguarding households' non-poverty status.[26]

5. Conclusion

The objective of the present study is to identify the pattern and causes of households' transitions in and out of poverty using the long panel household data on rural China in the period of 1989- 2009, which has been constructed from China Health and Nutrition Survey. We have proposed a discrete-time multi-spell duration model that not only corrects for

[26] Another possible explanation of this seemingly atypical poverty-increasing effect of health insurance spins off from households' behaviour in participating in health insurance. Using CHNS in the 1990s, Wagstaff and Lindelow (2008) find evidence of both moral hazard and adverse selection and argue that health insurance does not necessarily limit households' financial risks. Our analysis also lends support to this: those affected by chronic illness are more likely to participate in health insurance, with a correlation coefficient between the incidence of chronic illness and health insurance participation being 0.19 at 1% significance level. Given this, those having social protection can have worsening poverty status over time.

correlated unobserved heterogeneity across transitions and various destinations within the transition, but also addresses the endogeneity due to ‘dynamic selection’ (Cameron and Heckman, 1998) associated with household livelihood. The model identifies multiple pathways of poverty transitions through the household’s endogenous choice on livelihood strategies and participation in social protection schemes. Our main empirical findings are summarised below.

First, there are first decreasing and then increasing hazard rates of exit as households spend more time in poverty and overall negative duration dependence between the re-entry rates and households’ experience of non-poverty. Persistent poverty would arise from negative duration dependence as well as some latent heterogeneity predisposing households to poverty. However, households would still have a good chance to exit even though having long been subject to destitution, were they to engage more in agricultural production or out-migration.

Second, primary and secondary education appears to largely facilitate poverty exit, while they are more effective for those who just become poor (i.e., the initially non-poor). Although higher education tends to increase the probability of re-entry into poverty due possibly to the expensive tuition fees or high opportunity costs, it significantly increases the chance of exiting from poverty if households select to engage more in agriculture in particular, or out-migration.

Third, cultivated land is highly selective for households’ initial poverty status as well as the following transitions by limiting the re-entry into poverty. Agricultural asset accumulation emerges to be an effective means as it reduces the probability of being poor at the initial transition. More importantly, cultivated land provides safety nets for those who rely on out-migration to escape in terms of reducing the chance of re-entry. By contrast, out-migration is less likely to assist the exit from poverty for those who are initially poor; it helps initially non-poor households more. Local non-agricultural employment can be a means to preclude inadvertent backsliding for those following the agricultural pathway out of poverty, but has not turned out to be a way out by itself. Overall, our study finds the primary role of agriculture in alleviating rural poverty given limited influence of local non-agricultural sector and sometimes recurrent hardship accompanied by out-migration rife with various uncertainties associated with unstable jobs in cities and getting enough paid in time in a specific context of China.

Fourth, social protections in terms of health insurance are not universally good for alleviating poverty. It has dual impact depending on households' initial poverty status as well as following experience. On the one hand, it is correlated with initial non-poverty. Households, on the other hand, can hardly escape by simply continuing to participate in health insurance if they initially suffered from deprivation and had already accessed health insurance. Moreover, participation in health insurance even suggests positive correlation with the probability of re-entry for initially affluent households, especially if they decide to purchase possibly expensive commercial insurance.

Deriving any policy implication from the present study needs a great caution given the rapid transformation rural areas of China are now experiencing. However, it would be probably safe to derive the following implications for policy from our empirical findings. First, poverty is a dynamic phenomenon as a majority of rural households have experienced multiple transitions between poverty and non-poverty. Policies to target the poor based on the single-year data would be thus misleading. Public policies which would promote urbanisation during rural transformations should be carefully phased and implemented, as they can have a differential effect on poverty reduction depending on the stage of transformations. Second, though the total number of the poor has been declining, there are a substantial number of households who have been chronically poor and need to be supported by public interventions.

We have seen that poverty tends to be perpetuated particularly if we adopt the lower poverty lines. Third, agriculture holds great potential to address rural poverty. The policy to promote the agricultural sector, in particular providing poor households with a larger area of cultivated land and facilitating their acquisition of agricultural assets would be crucial to help them escape from the chronic poverty in the middle or long run. Alleviating shocks in their agricultural production has also been identified as an important policy dimension. Moreover, there is room for agriculture to serve as safety nets in terms of preventing recurrent poverty, especially for those relying on out-migration to escape because migrants are exposed to many uncertainties but covered by little social protections. Finally, while health insurance was not universally effective as an instrument for alleviating poverty, our disaggregated analysis has shown that only NCMS was effective in helping the poor escape from poverty and prevent the non-poor from backsliding again, which implies that the type of insurance is crucial. In sum, supporting the agricultural sector with a particular focus on the poorest households and providing appropriate measures for insurance for them would be a primal policy focus in order to alleviate poverty in rural China.

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Fig. 1(a) Pathways of poverty transition (by livelihood strategy)

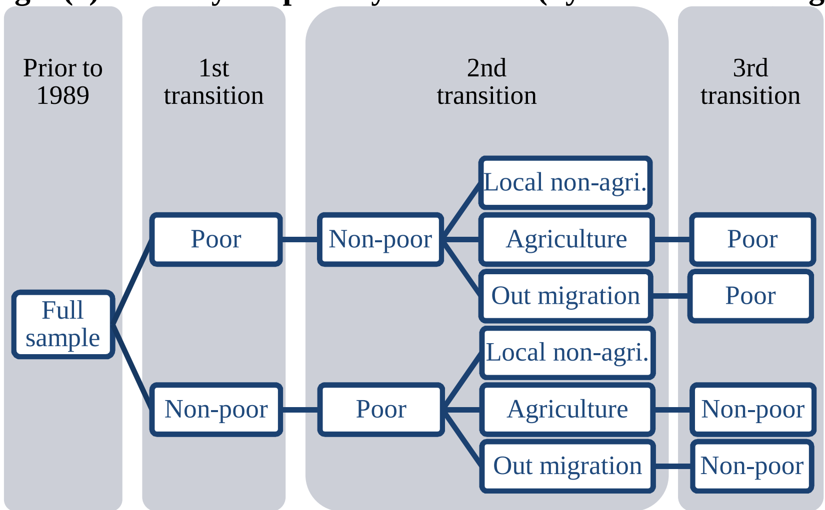


Fig. 1(b) Pathways of poverty transition (by social protection)

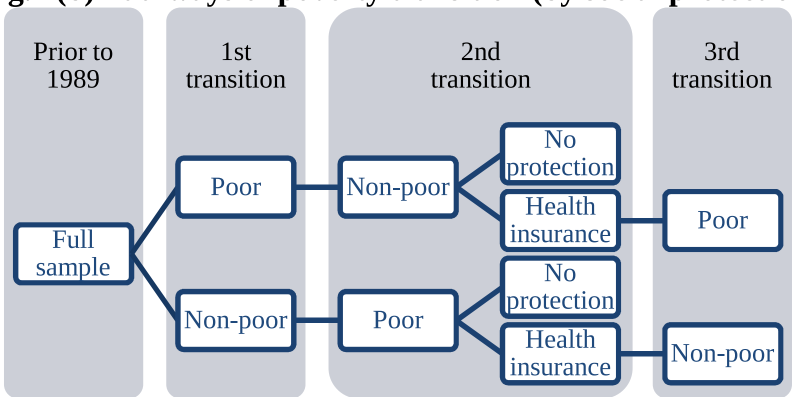
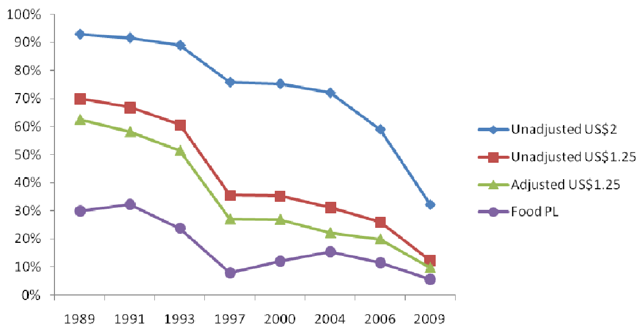
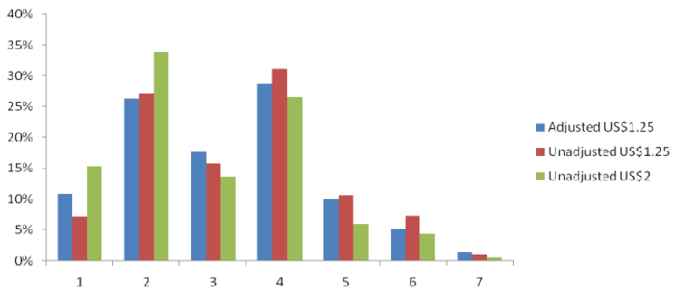


Fig. 2 Profile of poverty rates



Source: Authors' calculation based on CHNS data.

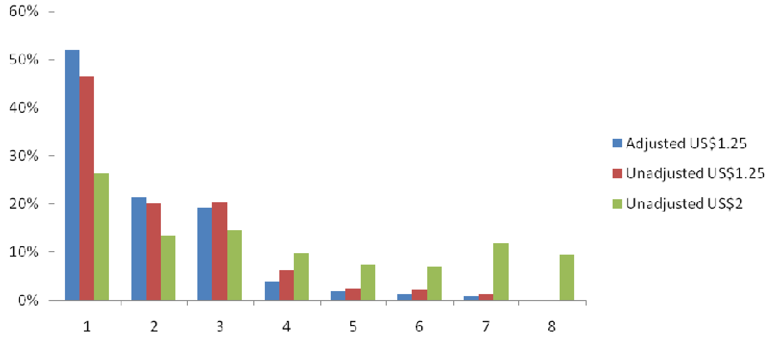
Fig. 3 Distribution of the number of transitions (spells)



Source: Authors' calculation based on CHNS data.

Note: The maximum number of spells is eight given that there are eight rounds of the surveys. However, the eighth is dropped in the figure, because only one household experiences eight spells under adjusted US$1.25 and unadjusted US$2 respectively.

Fig. 4 Distribution of the length of poverty spells



Source: Authors' calculation based on CHNS data.

Note: Pooling multiple poverty spells experienced by each household together, there are 2,080, 1,921 and 2,049 poverty spells under adjusted US$1.25, unadjusted US$1.25 and unadjusted US$2 separately. Of 1,921 poverty spells under adjusted US$1.25, 0.1% suggests the length of 8, while this may not be seen clearly from Figure 4 due to the large scale of the vertical axis.

Table 1 Poverty transition matrices (%), 1989-2009

	Poverty	Non-poverty	Total
Adjusted poverty line of US$1.25			
Poverty	58.36	41.64	100
Non-poverty	18.40	81.60	100
Total	36.01	63.99	100
Unadjusted poverty line of US$1.25			
Poverty	54.77	45.23	100
Non-poverty	23.90	76.10	100
Total	38.26	61.47	100

Source: Authors' calculation based on CHNS data.

Table 2 Survival and hazard functions of poverty transition

Time since the start of spell	Poverty exit			
	Unadjusted US$1.25		Adjusted US$1.25	
	Sur. (s.e.)	Exit (s.e.)	Sur. (s.e.)	Exit (s.e.)
1	1 (.)	. (.)	1 (.)	. (.)
2	0.750 (0.009)	0.286 (0.011)	0.727 (0.008)	0.316 (0.011)
3	0.576 (0.011)	0.263 (0.014)	0.555 (0.010)	0.269 (0.014)
4	0.435 (0.012)	0.278 (0.020)	0.427 (0.011)	0.261 (0.019)
5	0.332 (0.013)	0.270 (0.026)	0.330 (0.012)	0.256 (0.025)
6	0.187 (0.012)	0.578 (0.047)	0.212 (0.012)	0.433 (0.042)
7	0.110 (0.011)	0.520 (0.069)	0.132 (0.012)	0.469 (0.067)
Time since the start of spell	Poverty re-entry			
	Unadjusted US$1.25		Adjusted US$1.25	
	Sur. (s.e.)	Re-ent. (s.e.)	Sur. (s.e.)	Re-ent. (s.e.)
1	1 (.)	. (.)	1 (.)	. (.)
2	0.751 (0.014)	0.345 (0.020)	0.700 (0.013)	0.353 (0.018)
3	0.570 (0.017)	0.212 (0.021)	0.573 (0.015)	0.200 (0.018)
4	0.489 (0.018)	0.153 (0.022)	0.516 (0.016)	0.105 (0.016)
5	0.465 (0.019)	0.050 (0.015)	0.507 (0.016)	0.017 (0.008)
6	0.448 (0.019)	0.037 (0.015)	0.503 (0.016)	0.009 (0.006)
7	0.436 (0.020)	0.027 (0.016)	0.491 (0.017)	0.024 (0.012)

Note: Kaplan-Meier estimates.
Source: Authors' calculation based on CHNS data.

Table 3 Correlates of poverty transition (by disaggregated measures)

Independent variable	Exit			Re-entry		
	(1)	(3)	(4)	(5)	(7)	(8)
Duration dependence						
D1	-0.154	-0.112	-0.142	-0.391	-0.404	-0.381
	(0.073)**	(0.073)	(0.074)*	(0.116)***	(0.116)***	(0.115)***
D2	-0.320	-0.357	-0.285	-0.945	0.961	-0.926
	(0.090)***	(0.089)***	(0.091)***	(0.171)***	(0.171)***	(0.172)***
D3	-0.367	-0.358	-0.352	-2.831	-2.830	-2.830
	(0.110)***	(0.110)***	(0.110)***	(0.453)***	(0.454)***	(0.454)***
D4	-0.033	-0.038	-0.018	-3.568	-3.576	-3.563
	(0.115)	(0.114)	(0.115)	(0.712)***	(0.717)***	(0.712)***
D5	-0.108	-0.096	-0.093	-2.581	-2.566	-2.568
	(0.160)	(0.160)	(0.160)	(0.508)***	(0.508)***	(0.508)***
D6	0.839	0.834	0.848	-3.418	-3.394	-3.433
	(0.204)***	(0.203)***	(0.204)***	(1.007)***	(1.008)***	(1.008)***
Household characteristics						
hh size	-0.043	-0.043	-0.047	0.030	0.041	0.030
	(0.024)*	(0.024)*	(0.024)*	(0.040)	(0.039)	(0.040)
age of hh head	0.021	0.020	0.021	0.001	0.0002	0.002
	(0.003)***	(0.003)***	(0.003)***	(0.004)	(0.004)	(0.004)
% primary edu.	0.442	0.426	0.461	0.171	0.142	0.192
	(0.145)***	(0.143)***	(0.145)***	(0.261)	(0.260)	(0.262)
% secondary edu.	0.588	0.631	0.618	0.256	0.195	0.276
	(0.146)***	(0.145)***	(0.146)***	(0.272)	(0.270)	(0.272)
% tertiary edu.	0.180	0.237	0.262	1.996	1.836	2.035
	(0.183)	(0.185)	(0.184)	(0.311)***	(0.302)***	(0.314)***
no. of adults	0.047	0.085	0.053	-0.018	-0.026	-0.021
	(0.031)	(0.031)***	(0.031)*	(0.049)	(0.049)	(0.049)
Wealth						
ln(cultivated land)	0.065	0.022	0.049	-0.013	0.001	-0.017
	(0.026)**	(0.026)	(0.026)*	(0.042)	(0.042)	(0.042)
index of agricultural assets	0.087	0.043	0.074	-0.628	-0.617	-0.640
	(0.086)	(0.086)	(0.087)	(0.187)***	(0.187)***	(0.187)***
hh small business	0.064	-0.008	0.063	0.003	0.014	0.004
	(0.051)	(0.052)	(0.052)	(0.081)	(0.081)	(0.081)
Access to off-farm labour market						
% local non-agricultural	-0.054	0.111	-0.017	-0.285	-0.368	-0.259

employment within hh	(0.129)	(0.127)	(0.129)	(0.383)	(0.386)	(0.383)
% village out-migration	2.453	1.994	2.178	-0.091	0.145	-0.060
	(0.305)***	(0.310)***	(0.315)***	(0.566)	(0.576)	(0.609)
Social protection						
% hh members having health insurance	1.500		1.572	-0.451		-0.439
	(0.075)***		(0.075)***	(0.168)***		(0.168)***
% hh members having commercial insur.		-0.641			-0.040	
		(0.241)***			(0.798)	
% hh members having government free insur.		-0.313			0.119	
		(0.302)			(0.639)	
% hh members having cooperative insur.		1.515			-0.542	
		(0.075)***			(0.206)***	
Local development						
urbanisation	0.800	1.427		0.009	-0.002	
	(0.210)***	(0.203)***		(0.372)	(0.367)	
economic activity			-0.011			-0.023
			(0.011)			(0.023)
access to markets			0.026			0.001
			(0.008)***			(0.014)
social service			0.054			0.019
			(0.013)***			(0.038)
Log-likelihood	-4413.743	-4435.291	-4405.084	-4413.743	-4435.291	-4405.084

Note: ***, ** and * denote 1%, 5% and 10% significance levels. Standard errors are in parentheses.
Source: Authors' calculation based on CHNS data.

Table 4 Multinomial transition model with unobserved heterogeneity (by livelihood strategies)

Independent variables	1st transition	2nd transition		3rd transition	
	Initial State: Poverty	*Non-poverty*		*Poverty*	
Livelihood Strategy		**Agriculture**	**Out-migration**	**Agriculture**	**Out-migration**
Panel A: baseline alternative at the 1st transition is 'non-poor'					
ln(*d*)	0.399 (0.141)***	-0.107 (0.259)	0.047 (0.283)	-1.349 (0.325)***	-2.378 (0.432)***
hh size	-0.065 (0.030)**	-0.133 (0.107)	-0.152 (0.118)	-0.189 (0.100)*	-0.243 (0.128)*
age of hh head	-0.022 (0.003)***	0.026 (0.014)*	0.019 (0.015)	-0.006 (0.009)	-0.025 (0.012)**
% primary edu.	-0.570 (0.184)***	1.333 (1.292)	1.613 (1.331)	-0.166 (0.618)	-1.121 (0.838)
% secondary edu.	-0.494 (0.199)**	0.711 (1.186)	1.033 (1.227)	0.052 (0.575)	-0.883 (0.782)
% tertiary edu.	0.481 (0.268)*	3.804 (1.532)**	3.935 (1.596)**	6.216 (1.536)***	6.227 (1.582)***
ln(cultivated land)	0.179 (0.042)***	-0.414 (0.188)**	-0.438 (0.200)**	-0.026 (0.140)	-0.764 (0.186)***
index of agricultural assets	-0.397 (0.136)***	0.648 (0.447)	0.547 (0.487)	0.114 (0.467)	-0.738 (0.696)
% local non-agricultural employment in hh	1.063 (0.334)***	-0.234 (0.688)	1.011 (0.774)	-1.721 (0.714)**	-0.616 (0.827)
% village out-migration	-2.157 (0.770)***	2.562 (1.913)	0.042 (2.079)	-2.931 (2.052)	-0.521 (2.273)
% hh members having health insurance	-0.122 (0.145)	-0.279 (0.442)	-0.377 (0.482)	-0.249 (0.359)	0.008 (0.479)
urbanisation	0.724 (0.354)**	4.022 (1.255)***	3.102 (1.331)**	-2.506 (1.329)*	-2.171 (1.405)
Log-likelihood	-5285.704				

	1st transition	2nd transition		3rd transition	
	Initial State: Non-Poverty	*Poverty*		*Non-Poverty*	
Livelihood Strategy		**Agriculture**	**Out-migration**	**Agriculture**	**Out-migration**
Panel B: baseline alternative at the 1st transition is 'poor'					
ln(*d*)	0.102 (0.279)	0.299 (0.368)	0.943 (0.520)*	2.457 (0.509)***	-0.286 (0.686)
hh size	-0.283 (0.061)***	-0.172 (0.160)	-0.139 (0.163)	0.011 (0.112)	-0.221 (0.195)
age of hh head	-0.005 (0.006)	0.005 (0.016)	0.011 (0.016)	0.001 (0.009)	-0.029 (0.015)*
% primary edu.	-0.671 (0.309)**	1.144 (0.949)	0.736 (1.042)	-0.921 (0.691)	-1.985 (1.355)
% secondary edu.	-1.335 (0.388)***	-0.131 (1.155)	-0.186 (1.149)	-1.409 (0.709)	-2.910 (1.235)
% tertiary edu.	-0.793 (0.539)	2.632 (1.291)**	1.285 (1.278)	-4.673 (1.246)***	-3.389 (1.642)**
ln(cultivated land)	-0.098 (0.080)	-0.599 (0.282)**	-0.976 (0.377)***	-0.023 (0.141)	-0.398 (0.262)
index of agricultural assets	0.458 (0.211)**	0.508 (0.912)	0.825 (0.873)	-0.705 (0.486)	-1.012 (0.867)
% local non-agricultural employment in hh	0.364 (0.644)	1.909 (1.596)	1.735 (1.708)	-0.215 (1.332)	-1.639 (2.103)
% village out-migration	5.612 (1.222)***	7.984 (3.807)**	2.288 (3.334)	-2.141 (1.777)	4.621 (2.537)*
% hh members having health insurance	1.867 (0.216)***	0.331 (0.609)	0.604 (0.593)	2.595 (0.591)***	6.024 (1.434)***
urbanisation	-3.995 (0.738)***	1.843 (1.651)	0.777 (1.719)	-7.383 (1.557)***	-8.569 (2.704)***
Log-likelihood	-1679.891				

Note: ***, ** and * denote 1%, 5% and 10% significance levels. Standard errors are in parentheses.

Source: Authors' calculation based on CHNS data.

Table 5 Multinomial transition model with unobserved heterogeneity (by social protection)

Independent variables	1st transition	2nd transition	3rd transition
	Initial State: Poverty	*Non-Poverty*	*Poverty*
Social Protection		**Health insurance**	**Health insurance**
Panel A: baseline alternative at the 1st transition is 'non-poor'			
ln(*d*)	0.399 (0.141)***	-1.163 (0.372)***	-0.930 (0.188)***
hh size	-0.065 (0.030)**	-0.026 (0.125)	-0.099 (0.066)
age of hh head	-0.022 (0.003)***	-0.142 (0.020)***	-0.036 (0.006)***
% primary edu.	-0.570 (0.184)***	-6.895 (1.119)***	-1.141 (0.454)**
% secondary edu.	-0.494 (0.199)**	-5.608 (1.059)***	-0.525 (0.396)
% tertiary edu.	0.481 (0.268)*	-2.606 (1.106)**	1.901 (0.503)***
ln(cultivated land)	0.179 (0.042)***	-0.219 (0.156)	-0.175 (0.085)**
index of agricultural assets	-0.397 (0.136)***	-1.715 (0.714)**	-0.020 (0.290)
% local non-ag. emp. in hh	1.063 (0.334)***	2.194 (1.114)**	1.145 (0.429)***
% village out-migration	-2.157 (0.770)***	7.354 (2.218)***	-2.777 (1.017)***
% hh members having health insurance	-0.122 (0.145)	18.688 (2.338)***	1.215 (0.244)***
urbanisation	0.724 (0.354)**	-2.944 (1.399)**	0.998 (0.623)
Log-likelihood	-3095.580		
	1st transition	2nd transition	3rd transition
	Initial State: Non-Poverty	*Poverty*	*Non-Poverty*
Social Protection		**Health insurance**	**Health insurance**
Panel B: baseline alternative at the 1st transition is 'poor'			
ln(*d*)	0.102 (0.279)	-0.551 (0.359)	0.941 (0.236)***
hh size	-0.283 (0.061)***	-0.004 (0.132)	-0.137 (0.101)
age of hh head	-0.005 (0.006)	-0.068 (0.018)***	-0.035 (0.008)***
% primary edu.	-0.671 (0.309)**	-3.776 (1.152)***	-0.947 (0.585)
% secondary edu.	-1.335 (0.388)***	-3.935 (1.212)***	-0.849 (0.545)
% tertiary edu.	-0.793 (0.539)	0.859 (1.127)	-1.666 (0.838)**
ln(cultivated land)	-0.098 (0.080)	-0.315 (0.176)*	-0.155 (0.130)
index of agricultural assets	0.458 (0.211)	-1.686 (0.879)*	0.088 (0.404)
% local non-ag. emp. in hh	0.364 (0.644)	-1.803 (1.140)	1.716 (0.606)***
% village out-migration	5.612 (1.222)***	-2.011 (2.626)	-1.039 (1.433)
% hh members having health insurance	1.867 (0.216)***	4.164 (0.962)***	1.506 (0.335)***
urbanisation	-3.995 (0.738)***	-3.303 (1.565)**	-1.940 (1.023)*
Log-likelihood	1134.195		

Note: ***, ** and * denote 1%, 5% and 10% significance levels. Standard errors are in parentheses.
Source: Authors' calculation based on CHNS data.

Appendix Table A.1 List of Variables

Variable	Definition	Mean	S.D.
hh per capita consumption	Household per capita consumption in 2009 prices	1839.50	1767.81
hh size	No. of household members interviewed, including those living in the household full-time and currently living elsewhere (due to studying, migration, etc.) but still registering with the household.	4.11	1.51
age of hh head	Age (in years) of household head	49.45	12.54
% primary edu.	% of household members having primary education	0.33	0.27
% secondary edu.	% of household members having secondary education	0.33	0.27
% tertiary edu.	% of household members having tertiary education	0.16	0.22
no. of adults	No. of household members aging between 18 and 60	2.24	1.19
ln(cultivated land)	Log *mu* of cultivated land owned by the household (1 *mu*≈667m^2)	0.20	1.26
index of agricultural assets	The index of agricultural assets owned by the household, which is constructed by principle component analysis	0.17	0.33
small hh business	Categorical variables indicating the types of small business run by the household: 0 as no small business; 1 as commerce, service and peddler; 2 as manufacturing and construction.	0.17	0.53
% local non-agricultural employment in hh	% household members doing local non-agricultural jobs and currently living in the household	0.08	0.18
% village out-migration	% of sample villagers currently working and living outside of the village but still registering with their families in the village	0.08	0.10
% hh members having health insur.	% household members having any form of health insurance	0.26	0.37
% hh members having commercial insur.	% household members having commercial health insurance	0.01	0.09
% hh members having gov. free insur.	% household members having government free health insurance	0.02	0.09
% hh members having cooperative insur.	% household members participating in Newly Cooperative Medical Scheme	0.15	0.31
urbanisation[1]	Index indicating the degree of urbanisation of the village where the household locates.	0.45	0.16
economic activity[1]	Index reflecting typical daily wage for ordinary male worker (reported by community official) and percent of the population engaged in non-agricultural work.	3.28	2.61
access to markets[1]	Index reflecting the distance to the market and number of days of operation for eight different types of market.	3.76	3.46
social service[1]	Index reflecting provision of preschool for children under 3 years old, availability of (offered in community) commercial medical insurance, free medical insurance, and/or insurance for women and children.	1.10	1.76
purchasing price change of farm product[2]	% change (at the provincial level) of price at which farm households selling their agricultural product	0.04	0.11
prov. % cultivated land in natural disasters[3]	% cultivated land affected by natural disasters within the sample province	0.17	0.07

Note: 1. The index is constructed by Jones-Smith and Popkin (2010) and complied into the CHNS data by the CHNS team.

2. Authors' calculations based on the data from China Data Centre at the University of Michigan.
3. Authors' calculations based on the data of natural disasters from Sixty Years of New China Agricultural Statistics (published by the Ministry of Agriculture in 2009) and the data of provincial cultivated land from various issues of China Statistical Yearbooks (published annually by the National Bureau of Statistics of China).

Appendix Table A.2: Correlates of poverty transition (without heterogeneity)

Independent variable	Exit				Re-entry			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Duration dependence								
ln(*d*)	-0.207	-0.271			-1.353	-1.493		
	(0.050)***	(0.053)***			(0.111)***	(0.130)***		
P1			-0.311				-0.730	
			(0.065)***				(0.117)***	
P2			-0.293				-3.796	
			(0.092)***				(0.583)***	
P3			-0.110				-2.613	
			(0.149)				(0.460)***	
D1				-0.242				-0.556
				(0.074)***				(0.128)***
D2				-0.434				-1.104
				(0.094)***				(0.189)***
D3				-0.417				-3.638
				(0.117)***				(0.712)***
D4				-0.129				-4.090
				(0.127)				(1.004)***
D5				-0.372				-2.415
				(0.185)**				(0.509)***
D6				0.537				-3.234
				(0.241)**				(1.009)***
Household characteristics								
hh size	-0.033	0.004	-0.029	-0.029	0.068	0.024	0.067	0.062

	(0.038)	(0.044)	(0.038)	(0.038)	(0.059)	(0.103)	(0.059)	(0.059)
age of hh head	0.031	0.040	0.029	0.028	-0.023	-0.056	-0.017	-0.018
	(0.019)	(0.024)*	(0.019)	(0.019)	(0.027)	(0.035)	(0.027)	(0.027)
(age of hh head)^2	-0.0001	-0.0003	-0.0001	-0.0001	0.0003	0.0006	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)*	(0.0003)	(0.0003)
% primary edu.	0.434	0.178	0.437	0.424	0.061	-0.231	0.045	0.079
	(0.149)***	(0.165)	(0.149)***	(0.149)***	(0.270)	(0.387)	(0.271)	(0.272)
% secondary edu.	0.558	0.307	0.561	0.552	0.176	-0.201	0.194	0.211
	(0.154)***	(0.173)*	(0.154)***	(0.154)***	(0.288)	(0.410)	(0.288)	(0.289)
% tertiary edu.	0.352	-0.036	0.331	0.304	1.773	2.131	1.820	1.814
	(0.225)	(0.251)	(0.226)	(0.227)	(0.386)***	(0.500)***	(0.382)***	(0.386)***
gender of hh head (male=1)	0.050	0.146	0.044	0.043	-0.007	-0.149	0.036	0.041
	(0.078)	(0.089)*	(0.079)	(0.079)	(0.156)	(0.199)	(0.156)	(0.157)
no. of adults	0.012	0.027	0.011	0.014	-0.064	0.041	-0.070	-0.066
	(0.049)	(0.055)	(0.049)	(0.049)	(0.073)	(0.122)	(0.073)	(0.073)
no. of the elderly	-0.017	-0.093	-0.023	-0.025	-0.075	-0.070	-0.071	-0.072
	(0.055)	(0.063)	(0.055)	(0.056)	(0.081)	(0.124)	(0.080)	(0.081)
hh head's occup.: farmer	0.051	0.039	0.046	0.046	-0.028	0.026	-0.040	-0.039
	(0.083)	(0.091)	(0.083)	(0.084)	(0.186)	(0.215)	(0.186)	(0.186)
hh head's occup.: unskilled	-0.382	-0.048	-0.374	-0.381	0.073	-0.329	0.050	0.016
labour	(0.138)***	(0.169)	(0.138)***	(0.138)***	(0.288)	(0.428)	(0.290)	(0.290)
Wealth								
ln(cultivated land)	0.031	-0.025	0.040	0.040	0.057	-0.0001	0.026	0.025
	(0.029)	(0.036)	(0.029)	(0.029)	(0.045)	(0.076)	(0.046)	(0.046)
index of agricultural assets	0.083	0.123	0.074	0.068	-0.560	-0.515	-0.552	-0.534
	(0.091)	(0.100)	(0.091)	(0.091)	(0.191)**	(0.277)*	(0.191)**	(0.191)***
hh small business	0.014	-0.055	0.016	0.019	0.009	-0.086	0.016	0.019
	(0.057)	(0.066)	(0.057)	(0.057)	(0.090)	(0.127)	(0.090)	(0.090)

Access to off-farm labour market								
% local off-farm within hh	0.246	-0.093	0.238	0.270	-0.188	0.419	-0.166	-0.128
	(0.204)	(0.245)	(0.204)	(0.204)	(0.554)	(0.652)	(0.556)	(0.554)
% village out-migration	2.198	0.634	2.138	2.195	-0.332	-0.070	-0.293	-0.197
	(0.334)***	(0.401)	(0.335)***	(0.336)***	(0.641)	(0.829)	(0.640)	(0.639)
Social protection								
% hh members having health	1.526	1.153	1.516	1.505	-0.492	-0.555	-0.518	-0.490
insurance	(0.076)***	(0.092)***	(0.076)***	(0.076)***	(0.189)***	(0.260)**	(0.189)***	(0.189)***
Local development								
urbanisation	0.752	0.014	0.773	0.780	0.065	-0.260	0.015	0.057
	(0.235)***	(0.270)	(0.236)***	(0.236)***	(0.440)	(0.603)	(0.440)	(0.439)
Aggregate shocks								
price ratio of small farm tool		-3.587				1.796		
over machinery farm input		(0.666)***				(1.456)		
% change of purchasing price of		9.268				-0.179		
farm product		(0.496)***				(0.946)		
prov. % cultivated land in		-1.403				0.588		
natural disasters		(0.423)***				(1.074)		
Geographic location								
living in western prov. (yes=1)		0.166				0.050		
		(0.073)**				(0.175)		
Log-likelihood	-2481.033	-1750.783	-2476.615	2468.803	-1004.425	-548.038	-991.525	-987.237

Note: ***, ** and * denote 1%, 5% and 10% significance levels. Standard errors are in parentheses.

Appendix Table A.3: Correlates of poverty transition (with heterogeneity)

Independent variable	Exit				Re-entry			
	Normality	Gamma (2)	NPML	NPML	Normality	Gamma (6)	NPML	NPML
	(1)		(3)	(4)	(5)		(7)	(8)
Duration dependence								
D1	-0.270	-0.270	-0.270	-0.154	-0.487	-0.487	-0.487	-0.391
	(0.065)***	(0.065)***	(0.065)***	(0.073)**	(0.112)***	(0.112)***	(0.112)***	(0.116)***
D2	-0.433	-0.433	-0.433	-0.320	-1.049	-1.049	-1.049	-0.945
	(0.084)***	(0.084)***	(0.084)***	(0.090)***	(0.169)***	(0.169)***	(0.169)***	(0.171)***
D3	-0.479	-0.479	-0.479	-0.367	-2.930	-2.930	-2.930	-2.831
	(0.105)***	(0.105)***	(0.105)***	(0.110)***	(0.452)***	(0.452)***	(0.452)***	(0.453)***
D4	-0.133	-0.133	-0.133	-0.033	-3.667	-3.667	-3.668	-3.568
	(0.110)	(0.110)	(0.110)	(0.115)	(0.711)***	(0.711)***	(0.711)***	(0.712)***
D5	-0.205	-0.205	-0.205	-0.108	-2.686	-2.686	-2.686	-2.581
	(0.157)	(0.157)	(0.157)	(0.160)	(0.507)***	(0.507)***	(0.507)***	(0.508)***
D6	0.756	0.756	0.756	0.839	-3.557	-3.557	-3.557	-3.418
	(0.201)***	(0.201)***	(0.201)***	(0.204)***	(1.006)***	(1.006)***	(1.006)***	(1.007)***
Household characteristics								
hh size	-0.041	-0.041	-0.041	-0.043	0.027	0.027	0.027	0.030
	(0.023)	(0.023)	(0.023)	(0.024)*	(0.038)	(0.038)	(0.038)	(0.040)
age of hh head	0.019	0.019	0.019	0.021	0.001	0.001	0.001	0.001
	(0.002)***	(0.003)***	(0.002)***	(0.003)***	(0.004)	(0.004)	(0.004)	(0.004)
% primary edu.	0.420	0.420	0.420	0.442	0.172	0.172	0.172	0.171
	(0.137)***	(0.137)***	(0.137)***	(0.145)***	(0.248)	(0.248)	(0.248)	(0.261)
% secondary edu.	0.530	0.530	0.530	0.588	0.223	0.223	0.223	0.256
	(0.139)***	(0.139)***	(0.139)***	(0.146)***	(0.259)	(0.259)	(0.259)	(0.272)
% tertiary edu.	0.103	0.103	0.103	0.180	1.931	1.931	1.931	1.996
	(0.173)	(0.173)	(0.173)	(0.183)	(0.298)***	(0.298)***	(0.298)***	(0.311)***

no. of adults	0.042	0.042	0.042	0.047	-0.026	-0.026	-0.026	-0.018
	(0.030)	(0.030)	(0.030)	(0.031)	(0.047)	(0.047)	(0.047)	(0.049)
Wealth								
ln(cultivated land)	0.063	0.063	0.063	0.065	0.003	0.003	0.003	-0.013
	(0.024)***	(0.024)***	(0.024)***	(0.026)**	(0.040)	(0.040)	(0.040)	(0.042)
index of agricultural assets	0.073	0.072	0.073	0.087	-0.593	-0.593	-0.593	-0.628
	(0.083)	(0.083)	(0.083)	(0.086)	(0.177)***	(0.177)***	(0.177)***	(0.187)***
hh small business	0.055	0.055	0.055	0.064	-0.008	-0.008	-0.008	0.003
	(0.049)	(0.049)	(0.049)	(0.051)	(0.079)	(0.079)	(0.079)	(0.081)
Access to off-farm labour market								
% local off-farm in hh	-0.030	-0.030	-0.030	-0.054	-0.168	-0.168	-0.168	-0.285
	(0.124)	(0.124)	(0.124)	(0.129)	(0.354)	(0.354)	(0.354)	(0.383)
% village out-migration	2.322	2.322	2.323	2.453	-0.236	-0.236	-0.237	-0.091
	(0.293)***	(0.293)***	(0.293)***	(0.305)***	(0.547)	(0.547)	(0.547)	(0.566)
Social protection								
% hh members having health	1.399	1.399	1.399	1.500	-0.384	-0.384	-0.384	-0.451
insurance	(0.067)***	(0.067)***	(0.067)***	(0.075)***	(0.158)**	(0.158)**	(0.158)**	(0.168)***
Local development								
urbanisation	0.749	0.749	0.749	0.800	0.068	0.068	0.068	0.009
	(0.198)***	(0.199)***	(0.198)***	(0.210)***	(0.358)	(0.358)	(0.358)	(0.372)
Log-likelihood	-3213.035	-3213.035	-3213.035	-4413.743	-1220.711	1210.711	1210.711	-4413.743
LR test of $\rho = \sigma_u^2/(1+\sigma_u^2) = 0$	5.5e-04	-0.0002			4.4e-04	-0.0003		
(*p*-value)	(0.491)	(0.500)			(0.492)	(0.500)		

Note: 1. The first three columns for exit and re-entry regressions assume uncorrelated unobserved heterogeneity across poverty and non-poverty spells. The last column for two kinds of regressions allows for correlated unobserved heterogeneity.

2. The squared age of household head is dropped in all columns due to the failure of convergence of likelihood functions. Excluding this variable may not fundamentally change our results, as it is statistically insignificant and has small magnitude in Table 4.

3. ***, ** and * denote 1%, 5% and 10% significance levels. Standard errors are in parentheses.

Appendix Table A.4: Estimated latent classes

	Class 1	Class 2
Livelihood strategies		
Panel A: baseline alternative at the 1st transition is 'non-poor'		
1st transition: poor	-4.5e-05	5.5e-05
2nd transition: farming	-6.359	7.828
2nd transition: out-migration	-6.624	8.154
3rd transition: farming	-2.587	3.184
3rd transition: out-migration	-2.800	3.447
Probability	0.552	0.448
Panel B: baseline alternative at the 1st transition is 'poor'		
1st transition: non-poor	-1.4e-06	5.4e-06
2nd transition: farming	-3.306	12.482
2nd transition: out-migration	-3.341	12.615
3rd transition: farming	-1.039	3.924
3rd transition: out-migration	-1.544	5.832
Probability	0.791	0.209
Social protection		
Panel A: baseline alternative at the 1st transition is 'non-poor'		
1st transition: poor	4.3e-05	-3.8e-05
2nd transition: health insurance	-9.728	8.589
3rd transition: health insurance	0.001	-0.001
Probability	0.469	0.531
Panel B: baseline alternative at the 1st transition is 'non-poor'		
1st transition: non-poor	-8.9e-07	5.1e-06
2nd transition: health insurance	-0.855	4.947
3rd transition: health insurance	-0.0001	0.001
Probability	0.853	0.147

Source: Authors' calculation based on CHNS data.