Modelling poverty transitions in Luxembourg: true state dependence or heterogeneity?

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Abstract. We analyse the determinants of poverty transitions, defined as movements across a low income threshold, in Luxembourg using an endogenous switching first-order Markov model. This model allows us to control for potential endogeneity to low income transitions due to both initial condition and non random attrition and to analyse the extent of true versus spurious state dependence. Results show that attrition and initial low income are endogenous processes with respect to low income transitions and genuine state dependence accounts for a substantial level of state dependence. These results are compared to those obtained in other countries.

1 Introduction: true state dependence and heterogeneity

We analyse the drivers of low income transitions in Luxembourg using the first order Markov model of poverty transitions proposed by [3]. This model allows us to tackle two potential sources of endogenous selection: non random attrition and initial condition. In addition, it allows analysing the question of state dependence. State dependence in low income occurs when experiencing low income today increases the probability of experiencing low income tomorrow ([4]). State dependence can be spurious when it is the result of individual heterogeneity: the poor today might possess adverse unobserved characteristics that will increase their probability of being poor tomorrow. In that case, the persistence into low income is due to the persistence of those adverse characteristics and not to the previous experience of poverty. State

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This research is part of the PersiPov project supported by the Luxembourg Fonds National de la Recherche (contract C10/LM/783502) and by core funding for CEPS/INSTEAD from the Ministry of Higher Education and Research of Luxembourg. Comments by Sara Ayllón, Stephen P. Jenkins and CEPS/INSTEAD colleagues are gratefully acknowledged.

dependence in low income might also be genuine when today's low income increases per se the risk of tomorrow low income. Assessing whether persistence into poverty is due to genuine state dependence or to unobserved heterogeneity has important policy implications ([5]). Our results for Luxembourg are compared with those obtained for the United Kingdom by [3], Spain by [1] and Australia by [2].

2 Econometric model

Our presentation of the model draws heavily on [3]. Let (1) p^*_{it-1} be the latent propensity of being poor for individual *i* at time *t*-1, (2) r^*_{it} the latent propensity of being retained in the sample for individual *i* between periods *t*-1 and *t* and (3) p^*_{it} the latent propensity of being poor for individual i at time t. Each process is estimated simultaneously using the following trivariate probit model:

$$\begin{cases} p^*_{it-1} = \beta' x_{it-1} + u_{it-1} & (1) \\ r^*_{it} = \varphi' w_{it-1} + \mu_{it} & (2) \\ p^*_{it} = \left[\gamma_1' P_{it-1} + \gamma_2'(1 - P_{it-1})\right] z_{it-1} + \omega_{it} & (3) \end{cases}$$

x_{it-1}, w_{it-1} and z_{it-1} are vectors of explanatory variables related to individual and household characteristics. The variables included in x_{it-1} (resp. w_{it-1}) are the same as those included in z_{it-1} except that additional exclusion restrictions, which are necessary for model identification, are included. These exclusion restrictions are variables supposed to impact on initial low income (resp. retention) but not on low income transitions (see [3]). The exclusion restriction used for initial poverty status is a dummy variable indicating whether the head of the household's father was in a high skilled job when the head of the household was between 12 and 16 years old. Individuals in that case are expected to have a lower likelihood of being initially low income than their counterpart and this should not affect current poverty transition. For sample retention, the exclusion restriction chosen is a dummy variable indicating whether the interviewer has changed between *t-2* and *t-1*. A change in interviewer is expected to reduce the probability to stay in the sample and not to impact on low income transitions. We tested the validity of these exclusions restrictions by checking whether they had a significant impact on the process they were referring to and a non significant impact on the poverty transition equations. Results suggested that our exclusion restrictions are reliable.

Each error term $(u_{it-1}, \mu_{it}, \omega_{it})$ is assumed to follow a standard normal distribution and is the sum of a normal individual-specific unobserved effect $(\eta_i, \psi_i, \varsigma_i)$ plus a normal orthogonal white noise $(\nu_{it-1}, \lambda_{it}, \tau_{it})$. The joint distribution of the error terms $(u_{it-1}, \mu_{it}, \omega_{it})$ is trivariate normal.

The third equation is an equation of conditional current poverty as each explanatory variable of z_{it-1} can impact differently on the poverty status at *t* depending on poverty status at *t-1*. If P_{it-1}=1 (resp. P_{it-1}=*0*) the column vector γ_1' (resp. γ_2') is relevant and corresponds to the estimates of the determinants of persistence into (resp. entry in) poverty.

A fourth part of the model is constituted by three unconstrained cross-equation correlation coefficients. ρ_1, ρ_2 and ρ_3 refer to the correlation between the unobservable individual specific factors affecting respectively (sample retention and initial year poverty), (initial poverty and conditional current poverty) and (conditional current poverty and sample retention). A positive value for each of these correlation

coefficients implies that individuals more likely to experiment one outcome are also more likely to experiment the other. The tests of exogeneity of sample retention and initial conditions are the following. If the null hypothesis $\rho_1=\rho_3=0$ cannot be rejected, then the sample retention process is exogenous and it is not necessary to model attrition. If the null hypothesis $\rho_1=\rho_2=0$ cannot be rejected, then the initial poverty status is exogenous. If the null hypothesis $\rho_1=\rho_2=\rho_3=0$ is not rejected, then a probit model can be applied to each process separately.

After estimation of the model by simulated maximum likelihood, poverty transition probabilities which are robust to attrition (because the covariates are measured at the beginning of the transition) can be derived (see [3] for details).

Finally, [3] propose measures of aggregate state dependence (ASD) and genuine state dependence (GSD) in low income. ASD is the difference between the aggregate persistence rate and the aggregate entry rate:

$$ASD = \left(\frac{\sum_{i\epsilon\{P_{it-1}=1\}} Pr(P_{it}=1|P_{it-1}=1)}{\sum_i P_{it-1}}\right) - \left(\frac{\sum_{i\epsilon\{P_{it-1}=0\}} Pr(P_{it}=1|P_{it-1}=0)}{\sum_i (1-P_{it-1})}\right) \quad (4)$$

ASD does not allow differentiating between state dependence resulting from individual heterogeneity and genuine state dependence. [3] suggest a formal test for the absence of GSD where the null hypothesis is $H_0 = \gamma_1 = \gamma_2$. If H_0 cannot be rejected, then the covariates have the same impact on poverty transitions, independently of the initial status of poverty. The measure of GSD allows us to estimate the proportion of ASD that is non spurious given the fact that individual heterogeneity is controlled for. It consists of the average of the individual difference between the predicted probability of low income permanence and low income entry, which allows us to difference out the individual unobserved effects:

$$GSD = \frac{1}{N}\sum_{i=1}^{N}[Pr(P_{it}=1|P_{it-1}=1) - Pr(P_{it}=1|P_{it-1}=0)] \quad (5)$$

3 Data and results

The data used are from the *Socio-Economic Panel "Liewen zu Lëtzebuerg*" from 2003 to 2009. Following standard practice, an individual is poor if its equivalent income (annual total net income divided by the modified OECD equivalence scale) is less than the poverty line equal to 60% of the median equivalent income. The dataset is composed of pooled transitions identified through pairs of subsequent waves. The unit of analysis is the individual and the covariates reflect the demographic and working characteristics of the household. Our working sample is an unbalanced panel which consists of 15677 individuals from 5320 original households providing 55235 person-wave observations.

Table 1 presents the estimates of model correlations between unobservables. Individuals more likely to be initially poor are less likely to be retained in the sample the following year and also to stay poor (ρ_1 and ρ_2 are negative). Not taking these results about ρ_1 and ρ_2 into account might lead to biased estimates of poverty persistence and entry. ρ_3 is not measured precisely. The Wald tests of exogeneity of initial conditions and income retention are both rejected. When the three coefficients were tested jointly, the null hypothesis was strongly rejected. These results indicate that income retention and initial conditions are endogenous processes and are similar to those obtained in the UK ([3]) but different from those obtained for Australia: [2] find

that attrition is exogenous. In Spain, [1] obtains similar results when using a 50% poverty line, but finds that both initial condition and attrition are exogenous for a 60% poverty line.

Table 1. Estimates of model correlations and tests

Correlation coefficients between unobservables affecting:			p-value
Initial poverty and retention (ρ_1)	-0.071	*	0.036
Initial poverty and conditional current poverty (ρ_2)	-0.491	***	0.000
Retention and conditional current poverty ($\rho 3$)	0.230		0.190
Test for exogeneity of initial conditions and retention			
Initial poverty: H_0: $\rho_1 = \rho_2 = 0$	22.31	***	0.000
Retention: H_0: $\rho_1 = \rho_3 = 0$	5.87	*	0.050
$\rho_1 = \rho_2 = \rho_3 = 0$	23.73	***	0.000

Source: PSELL3, 2003-2009; authors' computation. hoh: head of the household. * p<0.05 ** p<0.01 *** p<0.001, sample weight used.

As mentioned in section 2, a formal test of absence of genuine state dependence is the null hypothesis that $\gamma_1 = \gamma_2$. We obtained a test of 387.6 with 34 degree of freedom and a p-value < 0.0001 that led us to reject the null hypothesis of absence of GSD. This result implies that the covariates have a differentiated impact on current poverty status conditional on previous year poverty status. ASD is found to be equal to 0.70 and GSD to 0.38. Hence, more than half of ASD (55%) is accounted for by GSD (which is comparable to the result obtained in the UK (59%) and Spain (52%)); however, the part of state dependence attributable to unobserved heterogeneity is non negligible. These results suggest that policies aiming at reducing GSD - breaking the vicious circle of poverty - and at changing the characteristics that make some individuals more prone to reproduce the state of poverty may be needed in Luxembourg.

Due to limited space we do not report the estimates of the different equations presented in section 2. Nevertheless, the main results regarding the determinants of poverty transitions can be summarized as follow. Employment protects from both remaining in low income and entering poverty. In addition, several characteristics of the head of the household positively affect the risk of entering poverty but not of permanence into poverty: unemployment, lower education, citizenship, bad health, marital status. Household composition and tenure status also impact on poverty entry.

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