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Abstract

We analyse the determinants of poverty transitions, defined as movements across a low income threshold, in Luxembourg. Data used are those from the Luxembourg socioeconomic panel 'Liewen zu Lëtzebuerg' (PSELL3) running from 2003 to 2009. Using an endogenous switching first-order Markov model, we control for potential endogeneity to low income transitions due to both initial condition and non random attrition. We find that employment protects from both remaining poor and entering poverty. In addition, attrition and initial low income are found to be endogenous processes with respect to low income transitions. Finally, genuine state dependence accounts for a substantial level of aggregate state dependence.

Keywords: poverty dynamics, Luxembourg, Markov transitions models, attrition, initial conditions, state dependence

JEL classification codes: I32

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1 Introduction

Luxembourg is known to be a small country; yet, a wealthy one. Indeed, as emphasized by Allegrezza *et al* (2004), the economic power of Luxembourg has no common measure with the small size of the country in terms of surface and population. Is studying poverty in such a rich country worth the effort? Both normative and consequentialist arguments support a positive answer to that question. From a normative point of view, a minimum rights approach to poverty suggests that a certain level of income is a right for each citizen (Atkinson, 1989, 2008). If the average standard of living in a country like Luxembourg is high, some individuals do lag behind this average. Hence, the government should take care of the economic well-being of the disadvantaged and protect individuals from the consequences of adverse life-cycle events such as job loss or disability (Duncan *et al*, 1993). Consequentialist arguments are based on the negative externalities due to poverty. The evidence about the negative macro-level consequences of poverty on total economic output (see e.g. Bertola, 2000) as well as the negative impact of poverty on individual outcomes such as health or education (Grusky and Kanbur, 2006) pleads in favour of the usefulness of studying poverty in wealthier countries. Luxembourg is not an exception to this situation, especially in the face of the recent financial and economic crisis Luxembourg was confronted to and that is reflected in the recent decline of the GDP annual growth: between 2000 and 2007, the average annual growth rate was 4.7%; in 2008, the growth was very low (0.8%) and in 2009 it became negative at a level of -5.3%.[1]

These arguments certainly contribute to explain why, over the last three decades, a number of studies have been carried out on the topic of both income and non income poverty in Luxembourg with the aim of determining its extent and forms (Berger, 2004). In our paper, poverty is defined as being in the bottom end of the income distribution, below a low income threshold.[2] A salient feature of the Luxembourg income poverty profile is that children have a higher risk to be income poor (22.3% in 2009) than the overall population (14.9%) whereas the elderly have a low-

[1] Figures available from the Luxembourg official statistics office website (STATEC) (last consulted October 11 2011): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=1436&IF_Language=fra&MainTheme=5&FldrName=2&RFPath=22. In 2010, the GDP growth increased again to a value of 2.7%. But this year is not covered by our data.

[2] This income definition of poverty is the most commonly used in European countries (see Atkinson *et al*, 2002). In this paper, we use the terms poverty and low-income interchangeably.

er risk (6%).[3] This age related characteristic suggests that family related transfers, despite being generous (Bradshaw and Chzhen, 2009) are less efficient in helping the low incomes than are pension benefits (Allegrezza *et al*, 2004; Berger *et al*, 2009). Another specificity of Luxembourg is the high level of immigration. In 2010, the Luxembourg population was composed of 42.6% of immigrants (Eurostat, 2010). In 2008, 23% of the immigrants were poor compared to 6% of the natives.

The importance of adopting a longitudinal perspective when analysing poverty is well-acknowledged (Bradbury *et al*, 2001; Jenkins, 2011). Following the low income status of individuals over time provides at least two advantages. First, it allows capturing the dynamic aspect of poverty. Poverty in a given period is certainly a problem but the persistence of poverty over time is much worse. Second, distinguishing between permanent or transitory poverty is important from an anti-poverty policy point of view. Knowing whether the same individuals are always poor or whether there is much mobility into and out of low income, implying that many individuals experience short poverty spells, helps determining whether priority should be given to training and labor market policies or to transfers. Despite the importance of this longitudinal perspective and the availability of panel data, little is known about the turnover in the bottom end of the Luxembourg income distribution.

A notable exception is a study of STATEC (2010) analysing the determinants of poverty transitions in Luxembourg. This valuable study does not however take account for several issues that can potentially bias the estimates such as the initial condition problem or non random attrition. When modelling low income transition between two points in time, the initial condition problem arises if the individuals at risk of being poor in the initial period are a non random sample of the population (Heckman, 1981a). Attrition can also affect the estimates of low income dynamics in the case where individuals leaving the panel are a selected group of the population. The aim of this paper is to analyse the drivers of low income transitions in Luxembourg using the first order Markov model of poverty transitions proposed by Cappellari and Jenkins (2004) that allows tackling these two potential sources of endogenous selection.

[3] An interesting point to highlight is that the current poverty profile is quite different from the one of thirty five years ago, in the mid-eighties, when child poverty was quite low and elderly poverty quite high (Allegrezza *et al*, 2004).

In addition, this model allows analysing the question of state dependence, which has not been done before in Luxembourg. State dependence in low income occurs when experiencing low income today increases the probability of experiencing low income tomorrow (Heckman 1981c). State dependence can be spurious when it is the result of individual heterogeneity: the poor today might possess adverse observed or 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. Policies aiming at changing these individual characteristics, like training, might be privileged. State dependence in low income might also be genuine when today's low income increases *per se* the risk of tomorrow low income. Biewen (2009) proposes several mechanisms to explain such a genuine effect: i) adverse incentives in countries with a minimum-income guarantee, ii) demoralization or depreciation of human capital, (iii) potential health, drug or alcohol problems, (iv) bad networking or (v) household split. In the case of genuine state dependence, it is less straightforward to find tailored policies; however, short term transfers aiming at reducing current poverty might be efficient in the long run. In the words of Poggi (2007), we need to break the 'vicious circle' of poverty. Assessing whether persistence into poverty is due to genuine state dependence or to observed and unobserved heterogeneity has important policy implications (see e.g. Stewart and Swaffield, 1999).

This paper is the first longitudinal analysis of low income in Luxembourg analysing the drivers of low income entry and permanence while tackling the issues of state dependence, non random attrition and initial condition. The data used are those from the *Panel Socio-Economique 'Liewen zu Lëtzebuerg'* (PSELL3) from 2003 to 2009; they will be presented in Section 2 together with some methodological choices. Section 3 provides a literature review on Luxembourg and some descriptive results while Section 4 presents the econometric model used to analyse poverty entry and permanence and Sections 5 discusses the results. Robustness checks are presented in Section 6 and finally, Section 7 concludes.

2. Data and definitions

The main source to analyse poverty in Luxembourg is the *Socio-Economic Panel "Liewen zu Lëtzebuerg*" (PSELL3) which is the Luxembourgish component of the European Union-*Statistics on Income and Living Conditions* (EU-SILC). PSELL3 was launched in 2003, with an initial sample of around 3500 households and around 10000 individuals that were representative of the population living in private households. All households' members aged more than 16 answer a personal questionnaire and the reference person answer the household questionnaire. Original sample members are followed over time and interviewed with intervals of approximately one year. In case of split-off, new households are followed as well as all new co-residents. When children turn 16 they are asked to answer the personal questionnaire. Luxembourg is a country with a high level of immigration and of turnover in the resident population. To account for the evolving characteristics of the population, every year new individuals are included in the sample. Interviewed people provide information about their incomes, living conditions and other personal and household characteristics. PSELL3 is a suitable dataset for our analysis as it provides repeated annual observations since 2003 on the same individuals which allows linking changes in poverty status with changes in household circumstances such as family arrangements or labour market situation. In this paper, we use the seven available waves of the PSELL3 data from 2003 to 2009.

Equivalent income, the main variable used to determine the status of poverty, is constructed by dividing the household total net income by an equivalence scale which allows comparing households of different size and composition. The concept of income used in this paper is quite broad as it comprises earnings from work including company cars, all social benefits received in cash, income from investment and property and inter-households payments. Regarding the equivalence scale, we use the modified OECD equivalence scale, which assigns a value of 1 to the first adult in the household, 0.5 to each other adult and 0.3 to each child under 14 (Atkinson *et al*, 2002). The use of equivalent income implies that income and demographic events will mechanically impact on poverty status (see Jenkins, 2000). More precisely, in a longitudinal perspective, income events reflecting changes in labour market situation or changes in the amount of non labour income received and demographic

events resulting from a joining event (e.g. birth or marriage) or a leaving event (e.g. death or divorce) will have an impact on poverty transitions and permanence (Cantò, 2003). The equivalent income variable, and hence the low income status, is defined at the household level – so that all household members are assumed to share the same status. The unit of analysis is the individual as individuals can be followed over time, even in the case of household split-off.

In the European Union, poverty is defined in relation to the general level of prosperity in a country. The official definition of poverty in the European Union is based on a *relative* poverty line equal to 60% of the equivalent median income. When measured on the basis of relative thresholds, poverty can decrease only if below low-income threshold individuals benefit more from economic progress than above low-income threshold individuals. Hence, this approach can be considered to be a reflection of inequality measuring the proportion of individuals that are left behind in rich countries. The standard poverty line supposed to separate the poor from the non poor – the low income from the high income – is quite arbitrary. This is why in Section 7 we will compare our main results with those obtained with alternative poverty lines. In the next section we provide preliminary results as well as a literature review of poverty in Luxembourg.

3. Literature review and descriptive results

According to the official definition of relative income poverty of the European Union, 12% of the residents of Luxembourg were in 2003 at risk of income poverty. From 2003 to 2008, the poverty rate remained stable between 12% and 14% and significantly increased up to 14.9% in 2009; this last increase mirrors the net decline in GDP growth that occurred in 2009 (see the introduction). These values are lower than the EU27 income poverty rate which was around 16.5% from 2005 to 2009 but higher than in some other European countries such as the Netherlands (11.1% in 2009) or the Czech Republic (8.6%). In 2009, the poverty rate of the neighbouring countries was 12.9% in France, 15.5% in Germany and 14.6% in Belgium.

As mentioned previously, despite the availability of longitudinal data, little is known about the dynamics of poverty in Luxembourg.[4] To our knowledge, STATEC (2010) is the only source that provided a portrait of longitudinal poverty, documented the triggering events associated with poverty entry and exit and analysed their determinants for the period 2003-2008.[5] Out of this six-year window, they find that close to one individual out of four (23.5%) has experienced at least one year of poverty. Hence the proportion of the population ever affected by low income is higher than what the annual poverty rates suggest. The group of individuals that have been at least once poor is quite heterogeneous. Indeed, 7.7% of the Luxembourg residents have been poor only one year – a transitory experience poverty; 9.2% have been poor two, three or four years – a recurrent experience of poverty and finally, 6.6% of individuals have been poor five or six years – a persistent experience of poverty. Even though these results do not account for censoring issues, they are in line with the overall paradox suggested by OECD (2001) and according to which poverty is simultaneously fluid, many individuals being confronted at least once to it, and characterised by long-term traps. In addition, similarly to the cross-sectional poverty profile, the risk of being at least once poor over the period decreases with age (31% of the 0-14 years old against 16.1% of the more than 55) and is higher for individuals with a precarious situation on the labour market (60.3% of the unemployed against 19.1% for full-time workers), immigrants (34.8% of Italians and 47.4% of Portuguese against 15.1% of Luxembourgish) and individuals living in childbearing households.

Another aspect of their study is the analysis of the events associated with poverty entry. The main trigger event into poverty is a decrease in the household income which explains 92% of the transition into poverty. In addition, a change in family structure accounts for only 8.6% of poverty entries and the type of income that decreases is important: 50.1% of the entries in poverty are linked to a decrease in

[4] Regarding related topics, Reinstadler and Berger (2007) analysed the intergenerational transmission of poverty and Van Kerm and Fusco (2008) showed that there is some significant mobility in the income distribution in Luxembourg.

[5] In fact, Duncan *et al* (1993) and OECD (2001) already analysed poverty dynamic in Luxembourg in a comparative perspective using first three waves of the first and second *Socio-Economic Panel 'Liewen zu Lëtzebuerg'* (PSELL1 1984-1986 and PSELL2 – 1994-1997). However, these two studies faced a common problem of small sample size for Luxembourg which prevented them from drawing robust conclusions. Still, Duncan *et al* (1993) presented Luxembourg as a successful example of poverty fighting as almost no short term or long term poverty was identified: "in fact the Luxembourg panel data were not very useful in our poverty transitions analysis because very few families in Luxembourg met any of our definitions of poverty. Despite a considerable influx of foreign workers from poorer EC countries, Luxembourg has combined extremely favorable employment conditions and a safety net of social insurance and assistance programs to reduce (although not eliminate) poverty among its residents. It should serve to remind us of what might be possible in [other countries]".

income from work and 12.8% to a decrease of family allowances. Finally, they analyse the determinants of poverty entries using a logistic regression. The risk of entering poverty increases with the size of the household and with some events such as a divorce/separation or job loss and decreases during the transition from work to pension.[6] This study provides useful evidence about poverty dynamics in Luxembourg. However, it does not account for important issues that might affect the results: state dependence, initial condition and non random attrition.

These issues are illustrated in Table 1. The upper panel of Table 1 reports the pooled poverty transition matrix of individuals present in consecutive pairs of waves, *t-1* and *t*. The probability of being in low income at time *t* is of 70.6% for individuals that were already low income the previous year (this corresponds to the probability of remaining poor) whereas it is equal to 4.2% for those who were not in low income the previous year (this corresponds to the probability of entering poverty) – a difference higher than 65%. This rough measure of aggregate state dependence illustrates that the probability of being poor varies greatly according to the state of poverty in the previous year. In the case of Table 1, observed and unobserved determinant of initial poverty are not controlled for, so that the high state dependence might be due to an endogenous selection mechanism in the case of an overrepresentation of individuals likely to stay poor (resp. non poor) among the group of poor individuals (resp. non poor) at *t-1*.

Table 1. Poverty transitions matrix (in %)

	t			
t-1	non poor	poor	missing	total
individuals with non missing poverty status at t (N=47211)				
non poor	95.8	4.2		100
Poor	29.4	70.6		100
All	87.6	12.4		100
all individuals (N=55226)				
non poor	82.2	3.7	14.1	100
Poor	24.2	58.2	17.6	100
All	74.9	10.6	14.5	100

Source: PSELL3, 2003-2009; authors' computation. Sample restricted to individuals with no missing values in the covariates used in following sections. Sample weights used.

The lower panel of Table 1 reports the poverty transition matrix of all individuals, that is those present in both *t-1* and *t*, but also those who were present in *t-1* and

[6] The determinants of poverty exit, also analysed by STATEC (2010), are not reported here.

exited the panel. It appears that 14.1% of the non poor at time *t-1* and 17.6% of the poor at time *t-1* exited the panel at time *t*. This difference in terms of attrition rates according to the previous year's poverty status illustrates the potential issue of endogeneity of sample retention. If attrition is non random and depends on the poverty status, it might affects our estimates of poverty transitions. This issue is particularly relevant in our case as the PSELL3 presents a non negligible level of attrition, even though it might be counterbalanced by the new sample added yearly (see Section 2).

When analysing the determinants of poverty dynamics and persistence, the issue of attrition and state dependence needs to be tackled. This is why we present in the next section the model proposed by Cappellari and Jenkins (2002a, b and 2004) which is based on a simultaneous modelling of retention, initial poverty and current poverty.

4. Econometric model

Since the seminal work by Bane and Ellwood (1986), many econometric models have been proposed in the literature to assess the determinants of poverty dynamics, such as component of variance models (Stevens, 1999; Devicienti, 2011), hazard regression models (Stevens, 1999; Devicienti, 2011), dynamic discrete choice models (Islam and Shimeles, 2007; Poggi, 2007; Biewen, 2009; Gradín and Cantò, 2011) or dynamics microsimulation models of component processes (Burgess and Proper, 1998) – see Aassve *et al*, (2006) or Jenkins (2000, 2011) for a review. In this paper, we use the methodology proposed by Cappellari and Jenkins (2004) and based on a first order Markov model of poverty transitions controlling for potential endogeneity to poverty transitions due to both initial condition and (potential non-random) attrition (see also Buddelmeyer and Verick, 2008, Ayllón, 2008 or Faye *et al*, 2011. Van Kerm, 2004, applies a variant of this methodology). Our presentation of the trivariate probit model used draws heavily on the papers mentioned above.

Individuals are indexed from *i*=1..N and periods from *t*=1..T. 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* (that is the propensity for an individual with an observed income in *t-1* to have an ob-

served income in *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 model:

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

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. In the words of Ayllón (2008:10) we need "variables that affect the level of household equivalent income but not the change (see Stewart and Swaffield, 1999)."

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 (and time invariant) 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. If the latent propensity of each process for an individual exceeds a certain value, then the individual realize the outcome. Hence, we can define three binary variables of initial poverty (P_{it-1}=1 if $p_{it-1}^{*} > 0$ and zero otherwise), retention (R_{it-1}=1 if $r_{it}^{*} > 0$ and zero otherwise) and current poverty (P_{it}=1 if $p_{it}^{*} > 0$ and zero otherwise).

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. As we will see below, these two sets of parameters can be used to provide a formal test of the absence of genuine state dependence.

In addition to these three equations, and conditional on the existence of valid exclusion restrictions, a fourth part of the model is constituted by three unconstrained cross-equation correlation coefficients that are at the core of the tests of endogeneity of initial condition and retention proposed by Cappellari and Jenkins (2004). ρ_1, ρ_2 and ρ_3 refer to the correlation between the unobservable individual specific factor af-

fecting respectively (sample retention and initial year poverty), (initial poverty and conditional current poverty) and (conditional current poverty and sample retention). A positive value (resp. negative) for each of these correlation coefficients implies that individuals more likely to experiment one outcome are also more likely to experiment the other. For example, if ρ_1 is positive (resp. negative), individuals that were more (resp. less) likely to be poor in the previous year are more (resp. less) likely to remain in the panel compared to those who were more likely not to be poor in the base year. The test of exogeneity or ignorability of sample retention and initial condition can be formulated as follow. If the null hypothesis $\rho_1 = \rho_3 = 0$ cannot be rejected, then the sample retention process is exogenous. 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.[7]

After estimation of the model by simulated maximum likelihood, and taking into account the presence of repeated observations for each household at each point in time and for each individual across time (see Cappellari and Jenkins, 2004 for details), poverty transition probabilities can be derived. The probability of staying poor (equation 4) and the probability of entering poverty (equation 5) can be written as follow:

$$s_{it} = Pr(P_{it} = 1|P_{it-1} = 1) = \frac{\Phi_2(\gamma_1' z_{it-1}, \beta' x_{it-1}; \rho 2)}{\Phi(\beta' x_{it-1})} \quad (4)$$

$$e_{it} = Pr(P_{it} = 1|P_{it-1} = 0) = \frac{\Phi_2(\gamma_2' z_{it-1}, -\beta' x_{it-1}; -\rho 2)}{\Phi(-\beta' x_{it-1})} \quad (5)$$

Φ and Φ_2 stands for the cumulative density functions of the uni- and bi-variate normal distribution. It is worth noting that one advantage of the model is that the predicted transition probabilities are robust to attrition. Indeed, as the covariates are measured at the beginning of the transition, in *t-1*, the predictions can be computed for all individuals present in the base year, even those that are not anymore in the panel in *t*.

[7] In the absence of valid exclusion restriction, another possibility is to impose restrictions on a coefficient of correlation. For example, Buddelmeyer and Verick (2008) did not have valid exclusion restriction for initial poverty so that they had to constrain to 0 the correlation coefficients involving the initial poverty status. This prevented them from testing for the endogeneity of initial condition but they were however able to estimate the correlation coefficient between attrition and current poverty so that they could test for the endogeneity of retention.

Finally, the model is built in a way that allows investigating the question of state dependence, that is the extent to which experiencing low income yesterday increases the probability of experiencing low income today. Cappellari and Jenkins propose measures of aggregate state dependence (ASD) and genuine state dependence (GSD) in low income. Aggregate state dependence is the difference between the aggregate persistence rate and the aggregate entry rate:

$$ASD = \left(\frac{\sum_{i\epsilon\{P_{it-1}=1\}} Pr(P_{it}=1|P_{it-1}=1)}{\sum_i \ P_{it-1}}\right) - \left(\frac{\sum_{i\epsilon\{P_{it-1}=0\}} Pr(P_{it}=1|P_{it-1}=0)}{\sum_i \ (1-P_{it-1})}\right) \quad (6)$$

ASD does not allow differentiating between state dependence resulting from individual heterogeneity and genuine state dependence. Cappellari and Jenkins suggest a formal test for the absence of GSD where the null hypothesis is:

$$\text{H0: } \gamma_1 = \gamma_2 \quad (7)$$

If this null hypothesis cannot be rejected, then the covariates have the same impact on poverty transitions, independently of the initial status of poverty. The measure of genuine state dependence proposed by Cappellari and Jenkins (2004) allows estimating the proportion of aggregate state dependence that is non spurious given the fact that individual heterogeneity (observed or unobserved) is controlled for (see Biewen, 2009). It consists of the average of the individual difference between the predicted probability of low income permanence and low income entry, which allows differencing out the individual unobserved effects:

$$GSD = \frac{1}{N}\sum_{i=1}^{N}[Pr(P_{it} = 1|P_{it-1} = 1) - Pr(P_{it} = 1|P_{it-1} = 0)] \quad (8)$$

Similarly to the poverty transitions predictions, the measures of aggregate and genuine state dependence can be obtained for all the individuals present in *t-1*, whether they are retained or not in the panel.

5. Results

Our empirical application is based on the data and definitions presented in Section 2. 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 an individual lives in. The covariates refer to the individual, the head of the household and the household and are

measured at the beginning of each potential transition (in *t-1*) to avoid a simultaneous change between poverty status and covariate (Jenkins, 2000).[8] At the individual level, age, age squared and gender are controlled for. The household level variables of our model refer to household composition (as measured by number of children aged less than 6, between 6 and 11 and between 12 and 17, number of adults and a dummy for lone parents), the attachment to the labour market (number of household's members at work other than the household head) and the tenure status of the accommodation (outright owner, acceding to property, tenant or rent free). The set of covariates used to describe the head of the household includes its citizenship, employment status, health status, marital status, education, age, age square and gender.[9] We also include dummy variables for each year. Our working sample is an unbalanced panel which consists of 15677 individuals from 5320 original households providing 55235 person-wave observations. Table A1 provide the mean value of the covariates for the whole population and by low income status.

As mentioned in the previous section, a set of exclusion restrictions is needed for identification of the model. We are looking for variables affecting initial poverty and retention but not poverty transitions (conditional on previous poverty and retention) (see Stewart and Swaffield, 1999). For sample retention, we chose 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.[10] 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

[8] Robust standard errors of the estimates are computed to account for the fact that there are repeated observations within each household but also that there are repeated observations for individuals across time. The original household from which the individual was sampled in its first appearance is used as the cluster.

[9] In the PSELL3 data, the head of the household is defined as the person in charge of the accommodation. If two individuals are co-responsible (eg. a couple co-owning a house), the head of the household is the older. We modified this last case and when two persons are in charge of the accommodation, we considered that the main income recipient among them is the head of the household. The hypothesis is that the household member with the highest personal income among the responsible of the accommodation has the highest influence on the household's standard of living. If they both have the same personal income, the older is designed as the head of the household.

[10] Two other variables were tested as exclusion restriction for sample retention: whether an individual was an original sample member, that is whether he is in the sample since the first year of apparition of its household (individuals who joined a household after the first year of apparition of this household are not considered as original sample members, e.g. new partners) and whether the households' answers were considered 'very reliable' by the interviewer. Both variables were not found to be valid exclusion restrictions.

transition.[11] 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. (see Table 2).

Table 2 presents the estimates of model correlations between unobservables. Individuals more likely to be initially in low income are less likely to be retained in the sample the following year (ρ_1 is negative and significant at $p < 0.05$). In addition, individuals more likely to be initially in low income are less likely to stay in low income (ρ_2 is negative and significant at $p < 0.0001$). This result, similar to that obtained by Cappellari and Jenkins (2004) or Ayllón (2008) can be interpreted as a Galtonian regression to the mean – individuals with extreme results, very high or very low, are more likely to converge toward the mean in the subsequent year. Not taking the results about ρ_1 and ρ_2 into account might lead to underestimate the estimates of poverty persistence and entry. Finally, ρ_3 the correlation between poverty transition and retention is not measured precisely.

Table 2. 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 condition and retention			
Initial poverty: H0: $\rho_1 = \rho_2 = 0$	22.31	***	0.000
Retention: H0: $\rho_1 = \rho_3 = 0$	5.87	*	0.050
$\rho_1 = \rho_2 = \rho_3 = 0$	23.73	***	0.000
Test for exclusion restriction			
effect of hoh's father's job on initial poverty	8.74	**	0.003
effect of change of interviewer on retention	6.97	**	0.008
effect of hoh's father's job on transition	3.99		0.136
effect of change of interviewer on transition	0.09		0.954
effect of hoh's father's job and change of interviewer on transition	3.64		0.457
State dependence			
Absence of state dependence. Ho: $\gamma_1 = \gamma_2$	387.62	***	0.000
Aggregate state dependence	0.65		
Genuine state dependence	0.39		

Source: PSELL3, 2003-2009; authors' computation. Sample restricted to individuals with no missing values in the covariates. hoh: head of the household. * p<0.05 ** p<0.01 *** p<0.001, sample weights used.

[11] Other exclusion restrictions for initial condition were tested. Using a module on intergenerational transmission of poverty present only in the third wave referring to the year 2005, interviewees were asked whether when aged between 12 and 16, the household they were living in was confronted to financial difficulties. We attributed the answer of the main income recipient to all the household members and then attributed this answer to all the waves. This inevitably implied a high loss of observations. In addition, following Ayllón (2008), we included the variable as to whether the head of the household suffer from a chronic disease.

The Wald tests of exogeneity of initial condition ($\rho_1 = \rho_2 = 0$) and of exogeneity of income retention ($\rho_1 = \rho_3 = 0$) are both rejected (at $p<0.01$ and $p < 0.05$). When the three coefficients were tested jointly, the null hypothesis was strongly rejected ($p < 0.001$). These results indicate that income retention and initial conditions are endogenous processes. They are similar to those obtained by Cappellari and Jenkins (2004) using British data but different from those obtained by Buddelmeyer and Verick (2008) who find that attrition is exogenous in Australia (and were not able to test for ignorability of initial condition because of a lack of valid exclusion restriction). Ayllón (2008) obtains similar results when using a 50% poverty line, but finds that both initial condition and attrition are exogenous in Spain for a 60% poverty line.

The validity of the exclusion restrictions is tested 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 (see Table 2). The null hypothesis of a null impact of the head of the household's father's job and of the change in interviewer on poverty transition could not be rejected by the Wald tests, both when tested separately (p-values of 0.136 and 0.954) or jointly (p-value of 0.457). In addition, the head of the household's father's job variable was found to have a statistically significant impact on initial poverty; the same result was found regarding the impact of interviewer change on sample retention. These results suggest that the exclusion restrictions we use are valid.

Table 2 also displays the statistics relative to aggregate and genuine state dependence. As mentioned in the previous section a formal test of absence of genuine state dependence is the null hypothesis that $\gamma_1 = \gamma_2$. We obtained a test of 387.62 with 34 degree of freedom and a p-value < 0.0001 that led us to reject the null hypothesis of absence of genuine state dependence. This result implies that the covariates have a differentiated impact on current poverty status conditional on previous year poverty status, as will be confirmed in Table 3 (and as could be expected from the descriptive statistics in Table A1). In Table 1, we reported that a rough measure of aggregate state dependence, measured only on the non attrited individuals, was slightly higher than 65%. After estimating our model, aggregate state dependence, measured on both attrited and non attrited individuals, was found to be equal to 0.65 and genuine state dependence to 0.39. GSD is equal to 60% of ASD. Hence, more than half of aggregate state dependence is accounted for by genuine state depen-

dence; however, the part of state dependence attributable to (un)observed heterogeneity is non negligible. These results suggest that both policies aiming at reducing genuine state dependence - 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 what follows we try to identify these characteristics upon which a policy can be applied.

Table 3 reports the estimates of the conditional current poverty status. Column (2) displays the estimates of current poverty if the individual was already poor in t-1 (γ_1) and column (4) the estimates of current poverty if the individual was not poor in t-1 (γ_2). Regarding the determinants of remaining poor, only few coefficients of covariates are found to be statistically significant. The probability of remaining poor decreases with the age of the individual while it increases with the age of the head of the household, but at a decreasing rate – the maximum is reached when the head of the household is 44 years old. At the household level, as could be expected, an additional individual at work in the household strongly decrease the risk of staying poor. Hence, these results confirm the fact that in Luxembourg, as was already illustrated in the cross-sectional poverty profile, employment seems to be efficient in protecting individuals from staying poor.

Table 3. Estimates of conditional current poverty status

	poor at *t*			
	poor at *t*-1		non poor at *t*-1	
	Coef.	t	Coef.	t
individual characteristics				
female	0.0367	(0.82)	0.0607*	(2.38)
age	-0.00689*	(-2.01)	0.00565**	(2.62)
age squared	0.000134*	(1.98)	-0.000149***	(-3.53)
head of household characteristics				
female	-0.0634	(-0.43)	0.0539	(0.69)
age	0.0388*	(2.10)	0.00613	(0.43)
age squared	-0.000442*	(-2.24)	0.0000409	(0.30)
bad health	-0.0516	(-0.34)	0.356**	(3.28)
Portuguese	0.0383	(0.24)	0.716***	(7.08)
other EU15	-0.0551	(-0.40)	0.189*	(2.17)
non EU15	0.189	(0.86)	0.902***	(6.75)
Single	-0.0570	(-0.41)	0.235*	(2.03)
divorced	-0.115	(-0.67)	0.258*	(2.13)
widow	-0.272	(-0.82)	-0.490**	(-3.23)
lower education	0.138	(0.78)	0.542***	(5.68)
secondary education	0.0895	(0.54)	0.387***	(4.06)
part time	-0.175	(-0.44)	0.861**	(2.67)
unemployed	0.288	(1.33)	0.444*	(2.16)
self employed	-0.252	(-1.37)	0.781***	(7.12)
retired	-0.0502	(-0.22)	0.00547	(0.04)
other	0.290	(1.78)	0.209	(1.55)
household characteristics				
number of children less than 6	-0.0749	(-0.94)	0.257***	(4.94)
number of children between 6 and 11	-0.0164	(-0.19)	0.0858	(1.43)
number of children between 12 and 17	0.0658	(0.73)	0.238***	(4.02)
number of adults	0.105	(1.42)	0.0426	(0.87)
lone parent	0.0961	(0.51)	-0.0565	(-0.35)
number of individuals at work except hoh	-0.504***	(-3.49)	-0.364***	(-5.51)
acceding to property	0.210	(1.36)	-0.182*	(-2.01)
tenant or rent free	0.0910	(0.55)	0.184*	(2.01)
wave 2	0.405*	(2.43)	-0.0465	(-0.46)
wave 3	0.279	(1.90)	0.0157	(0.17)
wave 4	0.0821	(0.64)	-0.145	(-1.48)
wave 5	0.330*	(2.14)	-0.150	(-1.47)
wave 6	0.0871	(0.65)	-0.309**	(-3.04)
constant	-0.203	(-0.35)	-2.953***	(-7.29)
log likelihood	-47299.1			
N	55526			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation. * p<0.05 ** p<0.01 *** p<0.001

More covariates coefficients are found to have a statistically significant impact on the risk of entering poverty, which seems to indicate that there is more heterogeneity in

poverty entry than permanence. Living in a household where the head is in bad health, single or divorced increases the risk of entering poverty. A good education of the head of the household protect from falling into poverty. Luxembourg is a country with high immigration so that nationality is often an important covariate. Living in a household where the head is a non EU15 or Portuguese, and to a lesser extent a EU15, strongly increases the risk of entering poverty compared to living in a household where the head is Luxembourgish. The status on the labour market of the household's head is also a strong determinant of entering poverty: households where the head is unemployed, part time worker or self-employed are at a higher risk of entering poverty compared to when the head is a full-time worker. At the household level, as could be expected, an additional individual at work in the household strongly decreases the risk of entering poor. Contrarily to the persistence into poverty, household composition is correlated with the likelihood of entering poverty: an additional child aged less than 6 or between 12 and 17 increases the probability of entering poverty whereas the coefficient related to the number of children aged between 6 and 11 is not significant. It can be seen as surprising that lone parents do not have a higher risk of staying in or entering poverty. This might be due to low sample size but it might also mean that living in lone parent families increases the risk of being poor, as shown by the determinants of initial poverty in Table 4 and at the cross-sectional level, but not the transitions into poverty (Ayllón, 2008). Being a tenant increases the risk of entering poverty.

As explained in Section 4, the methodology allows analysing the determinants of initial poverty and attrition. Estimates are reported in Table 4. Most of the correlates of initial poverty are similar to those of poverty entry presented in Table 3. An additional effect is the positive impact of living in a lone parent household and of the presence of children aged between 6 and 11. As required for model identification, the exclusion restriction variable has a significant impact on initial poverty. If the father of the head of the household was in a skilled job, the probability of being initially poor is higher. The probability of being retained in the panel is associated with age, the citizenship of the household head, the number of adults and the tenure status. Note that a change in interviewer, the exclusion restriction of the attrition, strongly negatively impacts on the probability of staying in the panel.

Table 4. Estimates of initial poverty status and retention equations

	initial poverty status		retention	
	Coef.	T	Coef.	t
individual characteristics				
Female	0.0623	(1.85)	0.0329*	(2.12)
Age	0.00559**	(2.71)	0.000516	(0.36)
age squared	-0.000151***	(-4.02)	0.0000158	(0.62)
head of household characteristics				
Female	0.153	(1.86)	-0.0345	(-0.70)
Age	-0.0223	(-1.49)	0.0237**	(2.81)
age squared	0.000274	(1.89)	-0.000292***	(-3.59)
bad health	0.192*	(2.27)	-0.136*	(-2.37)
Portuguese	0.894***	(6.92)	0.0451	(0.66)
other EU15	0.363***	(3.43)	-0.0950*	(-2.04)
non EU15	1.361***	(9.90)	-0.387***	(-3.47)
Single	0.191	(1.60)	-0.0414	(-0.68)
divorced	0.148	(1.38)	-0.0479	(-0.76)
widow	-1.082***	(-5.09)	-0.0523	(-0.78)
lower education	0.779***	(6.19)	-0.0193	(-0.39)
secondary education	0.478***	(4.01)	0.0156	(0.33)
part time	0.755**	(2.85)	0.276	(1.08)
unemployed	0.882***	(5.42)	0.119	(0.97)
self employed	0.811***	(6.98)	-0.0853	(-1.20)
Retired	0.0700	(0.46)	0.0521	(0.82)
Other	0.887***	(6.94)	0.0524	(0.81)
household characteristics				
number of children less than 6	0.193**	(3.23)	0.0469	(1.27)
number of children between 6 and 11	0.167**	(3.13)	-0.0580	(-1.65)
number of children between 12 and 17	0.354***	(6.21)	-0.0235	(-0.64)
number of adults	0.113	(1.72)	-0.0882***	(-3.42)
lone parent	0.339*	(1.96)	-0.105	(-1.14)
number of individuals at work except hoh	-0.696***	(-7.72)	-0.0757*	(-2.27)
acceding to property	-0.111	(-0.93)	-0.00594	(-0.12)
tenant or rent free	0.397***	(3.59)	-0.108*	(-1.98)
wave 2	0.0978	(1.51)	0.127*	(2.24)
wave 3	0.161*	(2.46)	0.244***	(4.13)
wave 4	0.197**	(3.01)	0.292***	(5.17)
wave 5	0.140*	(2.06)	0.328***	(5.44)
wave 6	0.159*	(2.34)	0.132*	(2.25)
Exclusion restrictions				
father of household head in skilled job	-0.282**	(-2.85)		
change of interviewer			-0.148**	(-2.64)
Constant	-2.152***	(-4.92)	0.769**	(3.29)
log likelihood	-47299.1			
N	55526			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation. * p<0.05 ** p<0.01 *** p<0.001

6. Robustness checks

We applied two types of robustness checks of our results. First, we reproduced the analysis above using two different poverty lines set at 50% and 70% of the median equivalised income (but still using the modified OECD equivalence scale – see Section 2). Second, we compared our results with those obtained using the 60% median equivalised income poverty line but applying the square root of household size equivalence scale rather than the modified OECD scale (see Section 2).[12] When using this equivalence scale, household income is divided by the square root of household size which implies for example that the needs of a household of four members, independently of their age, are twice as high as the needs of a single individual.

Sensitivity to the poverty line

Setting the poverty line at a higher value increases the chances for someone with a given equivalent income to be poor. The transition matrixes displayed in Table 5 show that both the aggregate persistence rate (respectively 57.4%, 70.6% and 74.2% for a poverty line set at 50%, 60% and 70% of the median equivalised threshold) and entry rate (respectively 2.7%, 4.2% and 6.2% for a poverty line set at 50%, 60% and 70% of the median equivalised threshold) increase with the poverty line. In addition, the risk of exiting the panel for the initially poor decreases when the poverty line increases, while it is stable for those who were not initially poor. This results in a decreasing attrition gap between the initially poor and the initially non poor while the poverty line increases. This decreasing gap is however limited.

[12] Berger *et al* (2001) computed two Luxembourg specific equivalence scales. A simple version of this national scale is similar in spirit to the modified OECD scale and the only criterion used to differentiate the individuals is the age. A detailed version of the scale propose a more sophisticated approach based on age, but also on the status in the household, the number of active people in the household and the number of children. However, these equivalence scales were computed only on the basis of fiscal households whose definition is different than the one used in our analysis. For this reason we did not use these equivalence scales.

Table 5. Poverty transitions matrix (in %) with alternative specification of the poverty line and equivalence scale

		t			
	t-1	non poor	poor	missing	total
	individuals with non missing poverty status at t (N=47211)				
	non poor	97.3	2.7		100
	Poor	42.6	57.4		100
50%	All	93.8	6.2		100
Poverty	*all individuals (N=55226)*				
Line	non poor	83.4	2.3	14.3	100
	Poor	34.9	47	18.1	100
	All	80.2	5.3	14.6	100
	individuals with non missing poverty status at t (N=47211)				
	non poor	93.8	6.2		100
	Poor	25.8	74.2		100
70%	All	80.6	19.4		100
Poverty					
line	*all individuals (N=55226)*				
	non poor	80.6	5.3	14.1	100
	Poor	21.5	62	16.5	100
	All	68.9	16.6	14.6	100
	individuals with non missing poverty status at t (N=47211)				
	non poor	95.9	4.1		100
square	Poor	29.1	70.9		100
root of	All	87.5	12.5		100
household	*all individuals (N=55226)*				
size	non poor	82.2	3.5	14.3	100
equivalence	Poor	24.3	29.2	16.5	100
scale	All	74.8	10.7	14.6	100

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation. * p<0.05 ** p<0.01 *** p<0.001. See Table 1 for the results obtained with a 60% equivalent income threshold.

For our base model, income retention and initial poverty were found to be endogenous processes. When using a 50% poverty line, initial poverty is found to be endogenous while retention is found to be exogenous (see Table 6). For a 70% poverty line, income retention is found to be endogenous while initial poverty is found to be exogenous (though, it would be statistically significant for a less restrictive 10% threshold). In both cases, the test of absence of genuine state dependence is rejected and the proportion of aggregated state dependence accounted for by genuine state dependence is around or higher than 60% which confirms the conclusion of the previous section. By and large, the correlates of poverty entry and persistence are found to be similar with those alternative thresholds (See Table A2.1 and A2.2 in Annex). The main difference when using the 70% threshold is that more covariates are statistically significant when analysing poverty persistence: living in a household

where the head is Portuguese or unemployed or where there is an additional child aged between 12 and 17 increase the probability of staying poor.

Sensitivity to the equivalence scale

We now turn, to the robustness check for the equivalence scale. The transition matrix using the square root of household size equivalence scale show very similar results as our base model (see table 5). The poverty persistence rate is slightly higher than 70% and the poverty entry rate is around 4%. Initial poverty was found to be an endogenous process and attrition is found to be an exogenous process (see Table 6). The test of absence of genuine state dependence is rejected and the proportion of aggregated state dependence accounted for by genuine state dependence is around 60% which confirms the conclusion of the previous section.

With this alternative equivalence scale, the correlates of poverty entry and persistence are found to be similar to that of the base model presented in Section 5 (see Table A2.3 in annex). The main difference when using the square root of household size equivalence scale is that some additional covariates are statistically significant when analysing poverty persistence: living in a household where the head is from a non EU15 citizenship or unemployed increase the probability of staying poor.

Table 6. Estimates of model correlations and tests with alternative specification of the poverty line and equivalence scale

	50% threshold			70% threshold			square root of household size		
correlation coefficients between unobservables affecting:			pvalue			pvalue			
Initial poverty and retention (ρ_1)	-0.07		0.073	-0.06	*	0.044	-0.05		0.135
Initial poverty and conditional current poverty (ρ_2)	-0.43	**	0.002	-0.14		0.336	-0.44	***	0.000
Retention and conditional current poverty ($\rho 3$)	0.10		0.727	0.60	*	0.037	0.07		0.733
Test for exogeneity of initial condition and retention									
Initial poverty: H0: $\rho_1 = \rho_2 = 0$	12.16	**	0.002	4.51		0.105	17.97	***	0.000
Retention: H0: $\rho_1 = \rho_3 = 0$	3.30		0.192	9.23	**	0.009	2.31		0.314
$\rho_1 = \rho_2 = \rho_3 = 0$	12.93	**	0.005	11.01	*	0.012	17.97	***	0.000
Test for exclusion restriction									
effect of hoh's father's job on initial poverty	3.49		0.062	14.63	***	0.000	11.26	***	0.000
effect of change of interviewer on retention	7.18	**	0.007	7.01	**	0.008	7.10	**	0.007
effect of hoh's father's job on transition	0.30		0.861	4.39		0.111	1.66		0.436
effect of change of interviewer on transition	0.91		0.634	0.22		0.897	0.05		0.975
effect of hoh's father's job and change of interviewer on transition	4.49		0.344	5.50		0.239	2.56		0.634
State dependence									
Absence of genuine state dependence. H_0: $\gamma_1 = \gamma_2$	256.7	***	0.000	131.6	***	0.000	431.5	***	0.000
Aggregate state dependence	0.54			0.63			0.67		
Genuine state dependence	0.32			0.42			0.39		
GSD/ASD	59%			66%			58%		

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. * p<0.05 ** p<0.01 *** p<0.001; hoh: head of the household. See Table 2 for the results obtained with a 60% equivalent income threshold.

7. Conclusion

The aim of this paper was to provide an analysis of the drivers of low income transitions in Luxembourg accounting for potential endogeneity due to initial condition or non random attritions. Both processes were found to be endogenous in our base model so that not taking this into account would provide biased estimates of poverty transitions in Luxembourg.

A high proportion of aggregate state dependence was found, around 65%. Genuine state dependence accounts for 60% of aggregate state dependence. Hence, more than half of aggregate state dependence is accounted for by genuine state dependence; however, the part of state dependence attributable to (un)observed heterogeneity is non negligible.

The econometric model highlights the individual and household characteristics associated with poverty entry and permanence. These results usefully complement the Luxembourg cross-sectional poverty profile. 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: employment status, lower education, citizenship, bad health, marital status, self-employment and working part time. Household composition and tenure status also impact on poverty entry.

The conclusions about the characteristics of state dependence in Luxembourg suggest that both policies aiming at reducing genuine state dependence - breaking the vicious circle of poverty - and at changing the above highlighted characteristics that make some individuals more prone to reproduce the state of poverty may be needed.

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Annex: Table A1: descriptive statistics

	all	poor	non poor
individual characteristics			
female	0.51	0.53	0.50
age	38.09	31.31	39.07
main income earner characteristics			
female	0.23	0.30	0.22
age	48.66	44.50	49.27
bad or very bad health	0.08	0.14	0.07
Luxembourgish	0.61	0.30	0.66
Portuguese	0.15	0.35	0.12
other EU15	0.20	0.20	0.20
non EU15	0.04	0.14	0.02
married	0.74	0.69	0.75
single	0.11	0.14	0.10
divorced	0.08	0.14	0.08
widow	0.06	0.03	0.07
tertiary education	0.27	0.10	0.30
lower education	0.37	0.60	0.33
secondary education	0.36	0.31	0.37
full time	0.67	0.63	0.68
part time	0.00	0.01	0.00
unemployed	0.02	0.07	0.01
self employed	0.06	0.06	0.05
retired	0.18	0.09	0.19
other	0.08	0.14	0.07
father of household head in skilled job	0.29	0.14	0.31
household characteristics			
number of children less than 6	0.30	0.47	0.28
number of children less between 6 and 11	0.32	0.47	0.30
number of children less between 12 and 17	0.29	0.47	0.26
number of adults	2.30	2.12	2.32
lone parent	0.04	0.11	0.03
number of individuals at work except household head	0.59	0.34	0.63
outright owner	0.31	0.16	0.33
acceding to property	0.43	0.33	0.45
tenant or rent free	0.25	0.51	0.22
change of interviewer	0.11	0.11	0.11

Source: PSELL3; authors' computation. Based on the 55226 person waves observations with no missing values in the covariates. Sample weights used.

Table A2.1 Estimates of conditional current poverty status, 50% threshold

	poor at *t*			
	poor at *t*-1		non poor at *t*-1	
	Coef.	t	Coef.	t
individual characteristics				
female	0.0254	(0.45)	0.0727*	(2.24)
age	-0.00608	(-1.29)	0.00712**	(2.99)
age squared	0.000135	(1.46)	-0.000203***	(-4.45)
head of household characteristics				
female	-0.0487	(-0.35)	0.0726	(0.76)
age	0.0504	(1.94)	-0.00845	(-0.51)
age squared	-0.000412	(-1.44)	0.000179	(1.15)
bad health	-0.0349	(-0.20)	0.203	(1.70)
Portuguese	0.0560	(0.30)	0.594***	(5.86)
other EU15	0.0768	(0.49)	0.228*	(2.20)
non EU15	0.244	(0.92)	0.780***	(5.08)
single	0.161	(1.04)	0.116	(0.95)
divorced	-0.00798	(-0.05)	0.281*	(2.17)
widow	-1.030*	(-2.49)	-0.542**	(-3.00)
lower education	0.394*	(2.10)	0.473***	(4.49)
secondary education	0.294	(1.73)	0.344**	(3.26)
part time	-0.296	(-0.56)	0.464	(1.38)
unemployed	0.348	(1.66)	0.905***	(5.03)
self employed	-0.225	(-1.12)	0.979***	(8.79)
retired	-0.303	(-1.03)	-0.0369	(-0.26)
other	0.224	(1.00)	0.302*	(2.23)
household characteristics				
number of children less than 6	0.0862	(1.06)	0.156*	(2.56)
number of children between 6 and 11	-0.00690	(-0.08)	0.0662	(1.14)
number of children between 12 and 17	0.0566	(0.54)	0.242***	(4.26)
number of adults	0.0756	(1.02)	0.0283	(0.52)
lone parent	-0.348*	(-2.07)	-0.428***	(-6.68)
number of individuals at work except hoh	0.376	(1.71)	0.0195	(0.10)
acceding to property	0.168	(0.96)	-0.370**	(-3.17)
tenant or rent free	-0.0172	(-0.09)	-0.00836	(-0.07)
wave 2	0.436*	(2.19)	0.0648	(0.57)
wave 3	0.286	(1.37)	0.215	(1.86)
wave 4	-0.105	(-0.55)	-0.0982	(-0.95)
wave 5	-0.0385	(-0.15)	-0.00911	(-0.08)
wave 6	-0.201	(-1.03)	-0.162	(-1.43)
Constant	-1.237	(-1.67)	-2.603***	(-5.62)
log likelihood	55226			
N	-39607.0			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

Table A2.2 Estimates of conditional current poverty status, 70% threshold

	poor at *t*			
	poor at *t*-1		non poor at *t*-1	
	Coef.	t	Coef.	t
individual characteristics				
female	0.0655	(1.77)	0.0648*	(2.54)
age	-0.00474	(-1.60)	0.00464*	(2.08)
age squared	0.0000803	(1.42)	-0.000117**	(-2.76)
head of household characteristics				
female	0.0541	(0.54)	-0.0107	(-0.14)
age	0.0385*	(2.25)	-0.0210	(-1.42)
age squared	-0.000415*	(-2.42)	0.000213	(1.57)
bad health	0.113	(0.88)	0.191	(1.87)
Portuguese	0.438**	(2.71)	0.769***	(6.84)
other EU15	0.0689	(0.57)	0.144	(1.67)
non EU15	0.293	(1.38)	0.811***	(4.81)
single	0.0118	(0.09)	0.103	(1.01)
divorced	-0.242	(-1.71)	0.455***	(3.85)
widow	-0.677**	(-2.67)	-0.414**	(-3.03)
lower education	0.299	(1.85)	0.709***	(7.06)
secondary education	0.186	(1.28)	0.414***	(4.46)
part time	0.305	(0.73)	1.282***	(3.40)
unemployed	0.728***	(3.80)	0.454*	(2.15)
self employed	-0.0214	(-0.12)	0.836***	(6.73)
retired	0.0819	(0.43)	0.325**	(2.78)
other	0.392*	(2.41)	0.671***	(4.70)
household characteristics				
number of children less than 6	0.0484	(0.67)	0.234***	(4.20)
number of children between 6 and 11	0.105	(1.45)	0.0911	(1.39)
number of children between 12 and 17	0.179*	(2.33)	0.262***	(4.00)
number of adults	0.0628	(0.89)	0.0857	(1.91)
lone parent	-0.587***	(-5.00)	-0.343***	(-5.13)
number of individuals at work except hoh	0.0535	(0.31)	-0.0515	(-0.27)
acceding to property	-0.00915	(-0.07)	-0.0147	(-0.15)
tenant or rent free	0.220	(1.64)	0.209*	(2.01)
wave 2	0.0903	(0.71)	0.0181	(0.20)
wave 3	0.136	(1.10)	0.185*	(2.28)
wave 4	0.107	(0.86)	0.0477	(0.51)
wave 5	0.247*	(2.01)	-0.0340	(-0.35)
wave 6	-0.0632	(-0.49)	-0.119	(-1.24)
Constant	-0.916	(-1.68)	-2.263***	(-5.49)
log likelihood	55226			
N	-55458.2			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

Table A2.3 Estimates of conditional current poverty status, square root of household size

	poverty status at t			
	poor at t-1		non poor at t-1	
	Coef.	t	Coef.	t
individual characteristics				
female	0.0215	(0.52)	0.101***	(3.60)
age	-0.00592	(-1.80)	0.00353	(1.78)
age squared	0.000115	(1.70)	-0.000125**	(-3.22)
head of household characteristics				
female	0.00957	(0.07)	-0.0149	(-0.18)
age	0.0361*	(2.17)	-0.000401	(-0.03)
age squared	-0.000329	(-1.88)	0.0000760	(0.56)
bad or very bad health	0.187	(1.05)	0.276*	(2.47)
Portuguese	0.141	(0.97)	0.775***	(7.32)
other EU15	0.0517	(0.45)	0.115	(1.21)
non EU15	0.525*	(2.50)	0.546***	(3.32)
single	0.134	(1.10)	0.0130	(0.11)
divorced	-0.0201	(-0.14)	0.190	(1.75)
widow	-0.657**	(-2.63)	-0.277*	(-2.07)
lower education	0.304	(1.74)	0.473***	(4.25)
secondary education	0.267	(1.65)	0.286**	(2.62)
part time	0.391*	(2.01)	0.518*	(2.47)
unemployed	0.107	(0.26)	0.689	(1.81)
self employed	-0.122	(-0.70)	0.777***	(7.00)
retired	-0.0947	(-0.49)	0.0206	(0.18)
other	0.0598	(0.37)	0.128	(1.05)
household characteristics				
number of children less than 6	0.0275	(0.37)	0.168**	(3.08)
number of children less between 6 and 11	0.0457	(0.60)	0.00210	(0.04)
number of children less between 12 and 17	0.0729	(0.96)	0.0311	(0.56)
number of adults	0.0273	(0.45)	0.0306	(0.52)
lone parent	0.101	(0.60)	0.00639	(0.04)
number of individuals at work except hoh	-0.463***	(-3.31)	-0.483***	(-6.48)
acceding to property	-0.0203	(-0.16)	0.000137	(0.00)
tenant or rent free	-0.0197	(-0.15)	0.257**	(2.60)
wave 2	0.202	(1.24)	-0.0290	(-0.30)
wave 3	0.176	(1.11)	0.0416	(0.45)
wave 4	0.0835	(0.56)	-0.107	(-1.07)
wave 5	0.0745	(0.42)	-0.179	(-1.71)
wave 6	-0.0976	(-0.68)	-0.138	(-1.26)
constant	-0.304	(-0.61)	-2.457***	(-5.78)
N	55226			
log likelihood	-47271.8			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

Table A3.1 Estimates of initial poverty status and retention equations, 50% threshold

	initial poverty status		retention	
	Coef.	T	Coef.	t
individual characteristics				
female	0.00327	(0.09)	0.0330*	(2.12)
age	0.00894***	(4.19)	0.000497	(0.34)
age squared	-0.000205***	(-5.20)	0.0000161	(0.63)
head of household characteristics				
female	0.251**	(2.70)	-0.0339	(-0.69)
age	-0.0323*	(-2.14)	0.0237**	(2.81)
age squared	0.000346*	(2.30)	-0.000292***	(-3.59)
bad health	0.137	(1.39)	-0.136*	(-2.38)
Portuguese	0.704***	(5.36)	0.0450	(0.66)
other EU15	0.319***	(3.47)	-0.0952*	(-2.05)
non EU15	1.153***	(8.24)	-0.389***	(-3.49)
Single	0.114	(0.84)	-0.0406	(-0.67)
divorced	0.199	(1.71)	-0.0468	(-0.75)
widow	-1.064***	(-5.92)	-0.0523	(-0.78)
lower education	0.610***	(5.18)	-0.0190	(-0.38)
secondary education	0.349**	(3.12)	0.0161	(0.34)
part time	0.868***	(4.26)	0.272	(1.06)
unemployed	0.949***	(5.41)	0.119	(0.98)
self employed	0.902***	(7.86)	-0.0868	(-1.22)
retired	0.0423	(0.31)	0.0525	(0.83)
other	0.968***	(7.41)	0.0519	(0.80)
household characteristics				
number of children less than 6	0.0552	(0.88)	0.0472	(1.28)
number of children between 6 and 11	0.117	(1.94)	-0.0571	(-1.63)
number of children between 12 and 17	0.272***	(4.51)	-0.0230	(-0.63)
number of adults	0.111	(1.64)	-0.0879***	(-3.41)
lone parent	-0.679***	(-7.67)	-0.0757*	(-2.27)
number of individuals at work except hoh	0.164	(0.97)	-0.105	(-1.14)
acceding to property	-0.107	(-0.90)	-0.00637	(-0.12)
tenant or rent free	0.279**	(2.67)	-0.108*	(-1.97)
wave 2	0.0421	(0.57)	0.126*	(2.22)
wave 3	0.142	(1.83)	0.245***	(4.12)
wave 4	0.295***	(3.66)	0.291***	(5.16)
wave 5	0.133	(1.75)	0.328***	(5.43)
wave 6	0.116	(1.36)	0.131*	(2.24)
Exclusion restrictions				
father of household head in skilled job	-0.152	(-1.63)		
change of interviewer			-0.150**	(-2.68)
Constant	-2.035***	(-4.54)	0.770**	(3.28)
log likelihood	55226			
N	-39607			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

Table A3.2 Estimates of initial poverty status and retention equations, 70% threshold

	initial poverty status		retention	
	Coef.	T	Coef.	t
individual characteristics				
female	0.0540	(1.94)	0.0328*	(2.12)
age	0.00322	(1.59)	0.000501	(0.35)
age squared	-0.000110**	(-2.97)	0.0000159	(0.63)
head of household characteristics				
female	0.141	(1.89)	-0.0339	(-0.69)
age	-0.0219	(-1.55)	0.0237**	(2.81)
age squared	0.000228	(1.74)	-0.000292***	(-3.60)
bad health	0.152*	(2.00)	-0.138*	(-2.40)
Portuguese	1.014***	(9.24)	0.0460	(0.67)
other EU15	0.256**	(2.82)	-0.0948*	(-2.04)
non EU15	1.449***	(13.69)	-0.389***	(-3.48)
Single	0.171	(1.56)	-0.0417	(-0.69)
divorced	0.188	(1.78)	-0.0490	(-0.79)
widow	-0.923***	(-5.76)	-0.0549	(-0.82)
lower education	0.902***	(8.52)	-0.0209	(-0.42)
secondary education	0.553***	(5.32)	0.0125	(0.27)
part time	0.938***	(3.74)	0.264	(1.04)
unemployed	0.861***	(5.14)	0.126	(1.02)
self employed	0.700***	(6.24)	-0.0836	(-1.18)
retired	0.276*	(2.13)	0.0535	(0.85)
other	0.856***	(7.60)	0.0554	(0.85)
household characteristics				
number of children less than 6	0.159**	(2.88)	0.0442	(1.19)
number of children between 6 and 11	0.181**	(3.18)	-0.0588	(-1.68)
number of children between 12 and 17	0.369***	(6.75)	-0.0228	(-0.63)
number of adults	0.146**	(2.68)	-0.0880***	(-3.41)
lone parent	-0.647***	(-9.38)	-0.0768*	(-2.29)
number of individuals at work except hoh	0.334	(1.77)	-0.103	(-1.13)
acceding to property	-0.159	(-1.57)	-0.00789	(-0.15)
tenant or rent free	0.385***	(3.85)	-0.111*	(-2.03)
wave 2	0.0792	(1.54)	0.130*	(2.29)
wave 3	0.0738	(1.34)	0.248***	(4.17)
wave 4	0.180**	(3.24)	0.292***	(5.18)
wave 5	0.176**	(3.01)	0.331***	(5.49)
wave 6	0.150*	(2.49)	0.134*	(2.30)
Exclusion restrictions				
father of household head in skilled job	-0.301***	(-3.34)		
change of interviewer			-0.153**	(-2.77)
Constant	-1.797***	(-4.41)	0.776***	(3.31)
log likelihood	55226			
N	-55458.2			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

Table A3.3 Estimates of initial poverty status and retention equations, square root of household size

	initial poverty status		retention	
	Coef.	t	Coef.	t
individual characteristics				
female	0.0343	(1.10)	0.0329*	(2.12)
age	0.00472*	(2.32)	0.000500	(0.35)
age squared	-0.000148***	(-3.92)	0.0000160	(0.63)
main income earner characteristics				
female	0.204*	(2.42)	-0.0339	(-0.68)
age	-0.0284*	(-1.97)	0.0237**	(2.81)
age squared	0.000328*	(2.41)	-0.000292***	(-3.59)
bad health	0.207*	(2.52)	-0.137*	(-2.38)
Portuguese	0.894***	(7.59)	0.0443	(0.65)
other EU15	0.340***	(3.47)	-0.0951*	(-2.05)
non EU15	1.317***	(9.07)	-0.389***	(-3.49)
single	0.124	(1.02)	-0.0402	(-0.66)
divorced	0.0654	(0.60)	-0.0466	(-0.74)
widow	-1.144***	(-7.07)	-0.0520	(-0.78)
lower education	0.807***	(6.83)	-0.0189	(-0.38)
secondary education	0.501***	(4.51)	0.0161	(0.35)
part time	0.945***	(5.65)	0.119	(0.98)
unemployed	0.632*	(2.53)	0.275	(1.07)
self employed	0.772***	(6.58)	-0.0868	(-1.22)
retired	0.0703	(0.53)	0.0532	(0.84)
other	0.853***	(6.90)	0.0522	(0.81)
household characteristics				
number of children less than 6	0.167**	(2.85)	0.0475	(1.29)
number of children less between 6 and 11	0.171**	(3.06)	-0.0571	(-1.62)
number of children less between 12 and 17	0.174**	(2.92)	-0.0230	(-0.63)
number of adults	-0.0899	(-1.31)	-0.0879***	(-3.41)
lone parent	0.505**	(2.89)	-0.105	(-1.14)
number of individuals at work except hoh	-0.727***	(-8.75)	-0.0756*	(-2.27)
acceding to property	-0.137	(-1.20)	-0.00570	(-0.11)
tenant or rent free	0.399***	(3.74)	-0.108*	(-1.96)
wave 2	0.0886	(1.49)	0.126*	(2.22)
wave 3	0.105	(1.78)	0.244***	(4.10)
wave 4	0.203**	(3.07)	0.291***	(5.15)
wave 5	0.171**	(2.60)	0.327***	(5.43)
wave 6	0.126	(1.86)	0.131*	(2.24)
exclusion restrictions				
father of household head in skilled job	-0.306**	(-3.24)		
change of interviewer			-0.149**	(-2.66)
constant	-1.414***	(-3.30)	0.768**	(3.27)
N	55226			
log likelihood	-47271.8			

Source: PSELL3, 2003-2009; authors' computation. Sample weights used. The reference person is a man living in a household whose head is a Luxembourgish well-educated married man, working full time and who owns its accommodation.
* p<0.05 ** p<0.01 *** p<0.001

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