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CONSISTENT POVERTY DYNAMICS IN SPAIN

by

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Consistent Poverty Dynamics in Spain

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Abstract.

This paper aims to analyse the evolution of consistent poverty, defined as the combination of income and living conditions to identify deprived people. The conclusions of other papers that show a high amount of poverty exits depending on temporary shocks of income are tested.
In this paper we find a high degree of immobility in the extreme situations since the improvement of living standards of deprived people is not expected and most changes are expected to be caused by temporary shocks of income.
This study is based on the ECHP data for Spain (1994-2000)

JEL codes: I32, C33, C35
Keywords: consistent poverty, households, panel data.

1. Introduction

The increasing availability in the developed countries of databases of longitudinal information has boosted the study of the dynamics of poverty. Thus, scholars have analysed questions such as the persistence of poverty, falling into, climbing out of and falling back into poverty, the characteristics of households or individuals that stimulate exit from this situation or suppose a burden difficult to overcome.

As far as Spain is concerned, this analysis has chiefly been undertaken using the micro-economic data from the Household Budget Continuous Survey (ECPF[2]), as is the case with Cantó (1996, 2000, 2000b and 2002). However, the creation of the European Community Household Panel (ECHP) allows us to measure the evolution of poverty – monetary as well as non-monetary – and to compare poverty across the EU, as it is a harmonised survey.

In this current article we also intend to study the dynamics of poverty. However, in addition to studying monetary poverty, the variable object of our analysis will be multi-dimensional poverty. Thus, the two main lines of research are combined in our study: on the one hand, considering poverty as a multi-dimensional phenomenon; and on the other, the study of its temporal evolution.

This combination (multi-dimensionality and dynamics) is also behind one of the objectives pursued by the European Union states – social cohesion – since social exclusion can be defined as a multi-dimensional process. In the majority of the National Social Inclusion Plans following on from the Lisbon European Council, there is the aim to identify not only the households or individuals with more probability of becoming excluded, but also those that are more likely to remain in that situation. This explains the relevance of the analysis presented here, since it provides information concerning the persistence of poverty as well as changes occurring in excluded households.

In the following we undertake a brief review of the literature concerning the two lines of research mentioned above.

Multi-dimensional poverty

In order to make a brief introductory comment on the first aspect, we can say that in recent years there has been an increase in the number of studies attempting to measure poverty directly by means of a set of direct indicators. In fact, the European Commission defines poor people as "*persons, families or groups of persons where resources (material, cultural or social) are so limited as to exclude them from a minimum acceptable way of living in the Member State in which they live*" – a definition that establishes a broad idea of poverty related with the standard of living of the person or household, rather than the simple inability to satisfy subsistence needs.

Nevertheless, some questions about the measure do arise: how should we measure living standards? What is that minimum standard of living? When can we say that a person is below that minimum?

There have been attempts to resolve these questions, above all by means of different variables, poverty lines and thresholds, as much in the academic as in the political sphere. One of these methods – the use of direct non-monetary indicators – was employed in an earlier work (Pérez-Mayo, 2002) to identify the Spanish households in a situation of multi-dimensional poverty. This is the starting point for the current work.

The pioneer in this line is Townsend (1979), who built a deprivation index founded on several non-monetary indicators. This has since been developed, by among others Mack and Lansley (1984) and Halleröd (1994), and in recent years by Nolan and Whelan (1996), Layte *et al.* (1999, 2000), Whelan *et al.* (2001a and b) and Muffels and Fouarge (2001). In this type of study researchers attempt to determine the living standards of the households directly, and subsequently identify those situated at lower levels. However, also in the analysis of poverty according to this approach there are various strategies to evaluate, weight and aggregate the households, strategies that can be reviewed in Martínez and Ruiz-Huerta (1999) and Brandolini and D'Alessio (2000). In Spain, in addition to the work of Zarzosa (1992) and Zarzosa *et al.* (1996) on the multi-dimensional measure of social well-being, Martínez and Ruiz-Huerta (1999, 2000) are opening a line of research on the measure of poverty as a multi-dimensional variable.

Dynamic analysis of poverty

Basically, two different lines of research are followed[3]. On the one hand, scholars study consecutive observations given a particular state, following Bane and Ellwood (1986); and on the other, they try to distinguish between different longitudinal experiences of poverty, and speak of incidence, persistence, and repetition of poverty spells.

Specifically ,(Jenkins, 2000), we can find the longitudinal models of poverty trajectories, as in Hill and Jenkins (1999); the variance components models, for example, Duncan (1983) and Stevens (1999); the transition probability models, such as Schluter (1997), Stevens (1995, 1999), Cantó (1996, 2000a and 2000b), Cantó, del Río and Gradín (2002) and Devicenti (2000); or the structural models in Burgess and Propper (1998).

It could be considered that the models for the study of the evolution of multi-dimensional poverty or deprivation presented in this current work are to be situated among the transition probability models, since they attempt to explain the probability of passing from one category to another, conditioned solely by the category belonged to in the previous time period, at first, and in addition by other variables related with the household, later.

The models most employed in the literature on poverty estimate probabilities of climbing out of and falling back into poverty according to the following expressions:

$$P(\textit{not being poor in year } t \mid \textit{being poor in year } t-1; Z, X_t) \tag{1.a}$$

$$P(\textit{being poor in year } t \mid \textit{not being poor in year } t-1; Z, X_t) \tag{1.b}$$

where Z is a vector of constant covariates and X_t another vector formed by dynamic covariates. That is, it is considered that the probability of moving between both categories is conditioned by the state occupied at the previous time period, and moreover, by some demographic or economic variables of the household or individual apart from poverty. By "apart from" we do not mean that these variables have no relation with poverty, but rather that their nature is different from the phenomenon under analysis.

An important question is the existence of a heterogeneous behaviour in the evolution followed by individuals. Blumen *et al.* (1955) showed that a first-order Markov model – where the value of the variable at each moment is considered to depend solely on the value at the previous moment – tends to underestimate immobility, that is, the elements of the main diagonal of the transition matrix. Thus, they propose a model known as the *mover-stayer* model, which divides the population into two groups with similar behaviours: one group is given the condition of immobility, i.e., its transition matrix is the identity matrix; and the other represents the individuals or households that change categories.

The previous model was further developed by Poulsen (1982), who amplified the number of subpopulations and did not impose any restriction on the transition probabilities of each group. Applying the latent class models it is possible to divide the population into homogeneous subpopulations with similar change behaviours.

In the light of the previous comments, one might think that it is a longitudinal trajectory model. However, after looking at two examples of the classification of households and individuals according to their movements into and out of poverty we will see the differences between them.

In the first place, Hills (1998) presents a typology[4] of different trajectories based on data from the BHPS (British Household Panel Survey). The author distinguishes between the following trajectories: flat, rising, falling, "blips" and others.

A household or individual is situated in each category according to the following definitions:

- Flat: No change of category in any of the years under analysis. In it we distinguish between, on the one hand, flat poor households or individuals, where all observations are situated in the poverty category; and on the other, the flat non-poor.
- Rising: the household or individual climbs a category one year, and from then on there is no further change of category. Consequently, while Hills (1998) distinguishes between non-poor rising and rising climbing out of poverty, we only consider this latter in this current work.

- Falling: the opposite of the previous category. At one time there is movement into poverty (downwards movement) and the following movements are stationary. This trajectory can also be termed falling into poverty.
- Blip: its name comes from the phenomenon that it represents. This is a flat trajectory apart from one year in which there is a change of category and then a return to the previous one. Thus, we have two possible trajectories in this group: blips out of poverty (poor households and individuals in all years except one where their situation improves); and blips into poverty (where they are not in a situation of poverty except in one isolated year).
- Others: in this type of trajectory the possibilities not included in the other cases are considered.

Finally, Walker (1994) classifies households and individuals according to their temporal evolution with regards poverty. Thus, the author distinguishes between the non-poor (these are never below the poverty line), transitory poverty (only one period in such a situation), occasional poverty (more than one period, without any of these lasting more than one year), recurring (repeated periods of poverty, some separated by more than a year, or being longer than one year others), persistent (one sole period of poverty lasting more than two years), chronic (repeated periods separated by at most one year) and permanent (always below the poverty threshold).

As can be seen in both examples, the classification is totally subjective: the authors observe the movements of the households or individuals and subsequently construct a typology of the movements according to their direction or their duration in a particular category. In contrast, the latent subgroups of the models presented in this work are estimated and not defined by the author; and hence can be included within a structural model.

In addition, they do not mean exactly the same as in the previous typologies. They are subsets of the population that follow homogeneous evolutions within groups and heterogeneous evolutions between groups. In consequence, they refer to groups made up of households or individuals possessing similar transition probabilities, but they are not necessarily limited to the abovementioned categories or groupings of categories.

Nevertheless, the final result of both approaches may be very similar. This similarity resides in the fact that the transition probabilities of each group may determine some trajectories similar to those outlined earlier. For example, the subgroup formed by those households or individuals who are not expected to change category will follow, according to Hills, a flat trajectory.

Finally, we should cite some work that studies the evolution or dynamics of deprivation undertaken by Whelan and others. In these articles the persistence of deprivation and poverty is analysed in European countries by means of the descriptive calculation, fundamentally, of the duration of periods of poverty and deprivation.

Structure of work

After this introduction and literature review, in the following section we introduce the variables that we shall use, as well as make some comments about the database we employ. In Section 3, we outline the dynamic models of latent variables proposed for the analysis. The empirical results of this analysis are reported and commented in the following section. To end, we present the appropriate conclusions in the final section.

2. Prior concepts and data

In order to define deprivation we have developed the concept of poverty established by the EU. Thus, we have attempted to gather as much information as possible about the living standards of individuals in Spain. This article extends the analysis carried out in a previous work.

The method used in that work can be included in multivariate statistical analysis. Specifically, in view of the aim pursued, the identification of different groups in the population according to their living standards (categorical variable), and the type of data available (discrete variables), we considered that the latent class model (Lazarsfeld, 1950; Lazarsfeld and Henry, 1968; Haberman, 1979) was the most suited to measure living standards. Thus, poor households will be considered to be those situated in the population group with the lowest living standards.

To build this indicator we selected 33 variables[5] from the European Community Household Panel concerning the economic situation, quality of housing and possession of certain durable goods by the households. Thus, three different dimensions of deprivation or multi-dimensional poverty were considered: basic needs, housing conditions and finally, secondary needs. We should point out that belonging to the "non-deprivation" category does not imply "high well-being" or "high quality of life", but rather the satisfaction of a set of needs. Thus, by deprivation or multi-dimensional poverty we mean the impossibility of doing or having something because of being unable to obtain the goods, activities and opportunities identified as appropriate for participation by the community in question.

In spite of choosing as object of research a different variable (living standards compared to income), we are still left with an important problem. What is the threshold? How should we distinguish between the poor and non-poor? There are various options to determine this dividing line:

- establish an income threshold, such as in Townsend (1979). The poverty line is the value below which deprivation clearly rises. This option has the problem that it presupposes a strong relation between living standards and income. If this hypothesis does not apply it is difficult to find a clear poverty line.
- use only the information included in the living conditions indicators. It is then necessary to establish a value for the deprivation index (indices) that divides the population into two groups. However, this is not an easy task. For example,

Mack and Lansley (1985) proposed two conditions to determine the threshold (the poor population also lack some unnecessary goods, along with a usually low income); and Muffels and Fouarge (2001) opt for the weighted average of the deprivation index.

- finally, it is possible to identify the poor population by means of a combination of the previous criteria – i.e., monetary income and living conditions. This has been employed in the work of Halleröd (1995) and Nolan and Whelan (1996) to find the "real poor" and "consistent poor", respectively.

In Pérez-Mayo (2002), the author opted for the second criteria, and first identified the poor households in each dimension. Once the particular analysis was completed, the results of the different dimensions were grouped in order to obtain a general classification.

Since an extension in time is being proposed, we should make some additional comments. First, the housing conditions are not considered, since in earlier work authors have demonstrated the reduced mobility of this dimension in Spain. On the other hand, following the recommendations of Martínez and Ruiz-Huerta (2000), we have opted to combine income and living conditions to classify the individuals.

In determining monetary poverty, we should take into account that in the database used – the European Community Household Panel – two concepts of available income are considered: on the one hand, the "previous year's net income", and on the other, the "current net monthly income". Despite the fact that the former includes all sources of income and is hence more reliable than the latter, we opted for the second concept in view of its advantages for a study such as this. First, it refers to the same period as the living conditions, so that the "possible effect" of panel desertion is reduced; and it also allows us to exploit all the cycles available from the panel. The decision was supported on the other hand by recommendations from the EU Committee of Experts for indicators of social inclusion (Atkinson *et al*., 2002). Finally, following the usual practice in studies on poverty in the EU, as the poverty line we opted for 60% of the median equivalised income per capita, using the modified OECD scale.

Hence, we have a categorical variable with four classes: *consistent poor*, *non-poor with low living standards*, *poor by income* and *consistent non-poor*, depending on the combination of values of the variables "deprivation" and "poverty".

Table 1. Consistent poverty in Spain (1994-2000)

	1994	1995	1996	1997	1998	1999	2000
Consistent poor	8.66%	7.40%	6.94%	5.52%	4.01%	4.41%	3,48%
Non-poor with low livings standards	13.90%	13.07%	10.52%	11.38%	11.78%	11.51%	12.69%
Poor by income	9.30%	7.40%	9.29%	8.30%	5.78%	5.23%	4.12%
Non consistent poor	68.14%	72.13%	73.25%	74.80%	78.43%	78.85%	79.70%

Source: Author's elaboration from ECHP data.

Looking at the results of the above table, we can expect an improvement in the situation of the households since the rate of consistent poverty is falling, while the rate of consistent non-poverty is rising. However, we feel a more detailed analysis is required, because the results may mask situations of permanence in a state of poverty. Likewise, we observe how the category of "non-poor with low living standards" is growing. This finding reflects the phenomenon noted in the literature of coming out of poverty because of a slight increase in income. In this way, a transitory escape from poverty occurs that does not correspond to a real improvement in living standards.

2.1 The database

The data used in this work form part of the European Community Household Panel for all the cycles available (from 1994 to 2000). This is a longitudinal survey beginning in 1994 for all member countries of the EU. The objective pursued by EUROSTAT in creating this panel was comparability among the data and results between the various member countries. To achieve this, there was as far as possible a harmonisation of the questionnaires, data collection, codification and weightings.

Its great advantage lies in its temporal nature. By extending over time it is possible to observe, for example, the effects produced by income mobility or the processes of impoverishment. In addition, the fact that it is a panel – i.e., that the information refers to the same sampling units – means that the trajectories followed by each one can be determined (Hills, 1998a and 1998b), as can the persistence or transience in states, such as in the studies of Stevens (1994 and 1999), Cantó (1996, 1998, 2000a and 200b), Fouarge and Muffels (2000) and Devicenti (2001).

Moreover, it was designed to collect detailed information about the income of each member of the household, as well as other important aspects relating to their material and demographic characteristics. This content makes it preferable to the Survey of Household Budgets for studies on living conditions. The reason is the inclusion of some variables useful for analysing poverty and even social exclusion.

With regards the Household Budget Continuous Survey, we should mention that it does suffer some drawbacks compared to the European Community Household Panel. In the first place, it does not allow deprivation studies to be undertaken, since it collects little information on living conditions and moreover, only reflects if a household possesses a good, without distinguishing whether the lack is voluntary or enforced. On the other hand, although it is a survey that extends over time its high rotation means that the same individuals are followed only for a short period of time, a situation that prevents the determination of some individual effects, as well as the search for a certain degree of heterogeneity in the change.

In spite of the abovementioned advantages, this database does present some weaknesses. There is no information on household expenditure and hence the description obtained by the income and living conditions cannot be completed. For example, if the patterns of consumption were known, we could eliminate the influence of the preference structure on the responses to some of the questions concerning economic capacity.

Likewise, the information on the economic situation and living conditions only refers to the capacity to acquire the good or undertake the activity; it does not measure how many times these actually occur.

For the years considered in this study, the panel has experienced changes in its composition. Information has been gathered during the 7-year period on 21,913 individuals, of whom only 8.535 have remained in all the cycles. The most attritions occurred in the years 1996 and 1997.

Although there are procedures for estimating dynamic multinomial logit models with incomplete data, the estimation is more complicated than with the complete table – i.e., with a balanced panel. In consequence, we need to determine if the attrition follow an ignorable pattern or instead depend on the values of the variables, whereby they may bias the estimates of the parameters.

We built a variable to represent the attrition[6] and related it with the situation of consistent poverty from the previous year, in order to determine if it is more likely for individuals to definitively or temporarily abandon the panel if they are in a particular situation. After carrying out a grouped analysis, we confirmed the independence of the two variables, since for each category of consistent poverty the probability of abandoning the panel was practically identical to that of remaining. Thus, in the empirical analysis we shall opt for the complete panel of individuals.

3. Dynamic latent variable models

The model we propose to study the transition of our discrete variable is the dynamic multinomial logit model. Given certain states or categories s_l and certain covariates $\boldsymbol{x}$, we can express the transition probabilities by means of the following expression:

$$\pi_{s_l|s_{l-1},\mathbf{x}} = \frac{\exp(\alpha_{s_{l-1}s_l} + \sum_j \beta_{s_{l-1}s_l j} x_{s_{l-1}s_l ij})}{\sum_g \exp(\alpha_{s_{l-1}g} + \sum_j \beta_{s_{l-1}gj} x_{s_{l-1}gij})} \tag{2}$$

The estimation is generally undertaken by means of the maximum likelihood method – i.e., the estimates will be those estimated values of the parameters that maximise the likelihood function. To determine the likelihood function, we need to first establish the sampling distribution of the cell frequencies. The most usual are the multinomial and Poisson distributions.

The consideration of at least one latent variable in this model may be due to two distinct phenomena. On the one hand, we may be interested in determining if there is any measurement error. In this case, we analyse the change of an observed variable – a change made up of a real component and a spurious component due to response errors. On the other hand, the latent variables help to recognise the heterogeneity of the population with respect to mobility. That is, the latent variable divides the population into groups that are homogeneous in terms of change – i.e., they have common mobility matrices.

In this work we shall focus on the second aspect: the search for groups of individuals with similar patterns of transition.

The mixed Markov model

The *raison d'être* of this model is the heterogeneity of the population with respect to change – i.e., not all the population necessarily has to follow the same pattern of mobility. *A priori*, the researcher can divide the population into subgroups according to one or more variables and make a dynamic analysis for each one. However, the model described here does not divide *a priori* according to an observed variable, but rather considers that the dynamic process is a mixture of different dynamic processes.

Its origins go back to the work of Blumen *et al.* (1955). These authors found that the Markov processes predicted too much change after many transitions. Specifically, they found that the main diagonal elements of the observed transition matrix tended to be underestimated. To resolve this problem[7], they proposed a model called *mover-stayer*, that divides the population into two groups. One of these, *mover*, is characterised by behaving according to a Markov model – i.e., the probability of passing from category i in period t to category j in period $t+1$ is represented in a usual transition matrix; while the other, *stayer*, is a group of stable individuals – i.e., their transition matrix is the identity matrix.

Later, Poulsen (1982) extended the model to a mixture of S^* groups with common patterns of change – i.e., common transition matrices. Thus, this model supposes that the observed transition probabilities are a mixture of the probabilities of a set of unobserved groups, such that we can say that an unobserved (latent) variable influences the transition probabilities. We shall now describe this model.

Let X be a polytomous discrete variable with X^* categories observed for T periods and let X_t be the concrete observation of that variable at time t. That is, we consider the existence of T polytomous discrete variables X_i, where i ranges from 1 to T, with the same number of categories that measure the same phenomenon.

In addition, we suppose that there exists a discrete unobserved variable S that influences the observed transition probabilities among the variables X_t. This latent variable represents the heterogeneity of the population, as has been mentioned earlier. It is known as the mixed Markov model because it assumes that the transition between the observed variables follow a Markovian model.

The parameters of this model are as follows:

– the initial probability π_s of belonging to each one of the S^* latent groups.

– the initial probability $\delta_{x_1|s}$ of being in each one of the initially observed categories of the variable X_1 given membership of the latent subgroup s.
– the transition probabilities $\tau_{x_t|x_{t-1}s}$ of passing from each category of the variable X_{t-1} at time $t-1$ to the categories of the variable X_t at time t, given membership of latent group s.

For example, consider an observed dichotomous variable over 3 periods and a latent variable that divides the population into two groups. We show how the previous parameters relate to produce the observed probabilities of the abovementioned example.

Given these parameters, the probability of belonging to a cell of the complete distribution is:

$$\pi_{sx_1x_2x_3} = \pi_s \delta_{x_1|s} \tau_{x_2|x_1s} \tau_{x_3|x_2s} \tag{3}$$

This probability distribution of the complete data is again obtained by means of a set of marginal and conditioned probabilities.

From the previous expression, we can determine the joint probability of the observed variables for each of the latent subgroups.

$$\pi_{x_1x_2x_3|s} = \delta_{x_1|s} \tau_{x_2|x_1s} \tau_{x_3|x_2s} \tag{4}$$

However, the problem arises that the variable describing membership of each group is unobserved. Thus, the proportion $P_{x_1x_2x_3}$ of the observed variables is calculated summing over the latent variable the expression (4).

$$\pi_{x_1x_2x_3} = \sum_s \pi_s \delta_{x_1|s} \tau_{x_2|x_1s} \tau_{x_3|x_2s} \tag{5}$$

Equation [5] is a weighted mean of equation [4], where the group probabilities π_s are the weights.

Thus, according to the previous equation, the mixed Markov model is a mixture of S^* independent first-order Markov chains.

If we assume a random sample of N individuals, the frequency $n_{x_1x_2x_3}$ is obtained by means of the multinomial distribution $M(N, \pi_{x_1x_2x_3})$. In consequence, the model that we have is a parametric multinomial model.

In spite of also being a log-linear model, determining the maximum-likelihood estimates of the parameters of this model is more complicated than in the case where all the variables are observed. Different estimation methods are employed, among which the most known are the Newton-Raphson algorithm and the EM algorithm (Dempster, Laird and Rubin, 1977).

The latter is preferable, since like the IPF algorithm it is simple, both in theory and in the calculation. In addition, the initial values chosen at random are generally sufficient to arrive at a solution. It has the disadvantage compared to the Newton-Raphson of requiring more iterations to arrive at a solution. But as each iteration of the EM algorithm is faster, this drawback is not very relevant.

The EM algorithm is an iterative procedure and each iteration is made up of two steps. In the *E*xpectation step, all the expected values are calculated given the observed values and the "current" model parameters. In the *M*aximisation step, the calculation maximises the likelihood function of all the data from the expected values calculated in the previous step. This implies calculating the updated estimates of the model parameters as if no data were missing – i.e., the $\hat{\boldsymbol{n}}_{xabcd}$ estimates are used as if they were observed frequencies. In order to do this, the same procedures are used as when obtaining the maximum-likelihood estimates of a normal log-linear model: Newton-Raphson and IPF. The estimates obtained are used in a new *E*xpectation step to obtain new estimates for the frequencies of the complete table. The iterations continue until convergence is reached.

Once reached, we can find the p+1-th estimates of the parameters that maximise the likelihood function given the probabilities of the previous iteration.

$$\hat{\pi}_s = \frac{\sum_{x_1,x_2,x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{N} \tag{6.a}$$

$$\hat{\delta}_{x_1|s} = \frac{\sum_{x_2,x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{\sum_{x_1,x_2,x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}} \tag{6.b}$$

$$\hat{\tau}_{x_2|sx_1} = \frac{\sum_{x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{\sum_{x_2,x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}} \tag{6.c}$$

$$\hat{\tau}_{x_3|sx_2} = \frac{\sum_{x_1} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{\sum_{x_1,x_2} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}} \tag{6.d}$$

Finally, if the model presents the stationarity restriction – i.e., each subgroup possesses a unique transition matrix for all of the periods – equations [6.c] and [6.d] are replaced by:

$$\hat{\tau}_{x_{t+1}|sx_t} = \frac{\sum_{x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{\sum_{x_2,x_3} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}} + \frac{\sum_{x_1} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}}{\sum_{x_1,x_2} n_{x_1x_2x_3}\hat{\pi}_{s|x_1x_2x_3}} \tag{6.cbis}$$

which is arrived at starting from the expressions commented on above.

4. Analysis of results

In Section 2 we showed the evolution of observed consistent poverty in the different cycles object of our study and we found an improvement in the situation of the Spanish individuals. However, the rates referred to the sample of each year and not to the panel. Thus, it is logical to apply the proposed model to track the trajectory of each individual and not that of each category. In the first place, we shall estimate the transition matrices assuming the population to be homogeneous. Examining the log-linear[8] parameters associated with the dynamic logit model shows that we expect above all immobility for each of the categories. We should mention that the apparent disparity of this compared to Table 2 is due to the low initial proportion of the "consistent poor" class.

Table 2. Transition probabilities of consistent poverty

	t+1			
t	1	2	3	4
1	0.3969	0.3108	0.1237	0.1686
2	0.1228	0.4868	0.0415	0.3489
3	0.0694	0.0777	0.2742	0.5788
4	0.0108	0.0508	0.0443	0.8942

Source: Author's elaboration

The above table shows a gradual polarisation in the individuals. On the one hand, the probability of remaining in a situation of consistent non-poverty is almost 90%. In addition, we can confirm that the incomes are more mobile than the living standards. A poor individual by income at time *t* has a probability of close to 60% of overcoming this situation and their living conditions are barely expected to decline. A notable fact is the transition from consistent poverty to poverty only by living conditions, which is practically identical to the immobility, such that for a consistent poor individual what is most likely is that their living standards will not improve, even if their income rises. These estimations confirm the comments made in the descriptive analysis of the evolution of consistent poverty.

Nevertheless, the above situation may mask some interesting movements between categories to reduce, for example, the effect of the strong immobility of consistent non-poverty or reflect the persistence of poor living conditions. Moreover, it is important to understand the movements of the individuals changing categories, their direction and duration. This proves difficult if we consider the population as a single whole.

Consequently, in the previous model we shall test the homogeneity or heterogeneity of the population, as well as the number of latent subgroups of the population in the latter case. In principle, the results support the adoption of any model. These data are motivated by the large sample size.

Applying various tests and calculating diverse descriptive statistics – described in Hagenaars (1990) – leads us to conclude that the most restrictive model, the stationary homogeneous model, is sufficient to explain the expected transitions.

Table 3. Mixed Markov models for consistent poverty

Model	L^2	Prob.	D.F.	BIC
Non stationary homogeneous	11843.2108	1.000	16308	-135775.674
Stationary homogeneous	12668.4972	1.000	16368	-135493.503
Non stationary heterogeneous (2 classes)	9072.8634	1.000	16232	-137858.075
Stationary heterogeneous (2 classes)	9860.6097	1.000	16352	-138156.560
Stationary heterogeneous (3 classes)	9438.7488	1.000	16336	-138433.590
Stationary heterogeneous (4 classes)	8933.9610	1.000	16320	-138793.547
Stationary heterogeneous (5 classes)	8718.1499	1.000	16304	-138864.527

Source: Author´s elaboration

Thus, we can conclude that there exists a dependence on the state occupied such that a rigid immobility is expected. In addition, the results confirm the conclusions of other work such as Cantó (2000b) for example, where the author demonstrates the instability of low incomes[9] in Spain. This article finds that the probability of remaining outside of poverty is very closely related to the distance between the poverty line and the income achieved by the individual. Thus, if the distance is considerable, we can assume that the individual will not only manage to climb out of poverty, but also substantially improve their living conditions, a fact that our model also makes clear.

Layte and Whelan (2002) also find that the estimated poverty spells are short and due to temporary income shocks, so that it is difficult for individuals to achieve a true escape from poverty – i.e., a real improvement in their living conditions.

This would explain the phenomenon observed in Table 1, where although the rate of consistent poor declined, the number of non-poor with low living standards rose.

5. Conclusions

In this current work, we propose to improve our study of poverty, combining information on income and living conditions. In this case, we do not consider the housing dimension in view of its strong immobility, as well as the limited size of the most deprived category. Moreover, we group the categories of slight and limited deprivation, since the aim is to study the evolution of households for strong deprivation and monetary poverty combined. That is, we can speak of a dynamic analysis of consistent poverty – a highly novel question in the literature because there have been few studies on mobility and social exclusion or deprivation transitions.

On the other hand, the problem of interest in this research is very relevant today, since the member states of the EU consider it fundamental both to identify situations of exclusion and poverty and to determine the persistence of these situations.

We have determined a variable that tries to represent consistent poverty, made up of four distinct classes in which apart from the extreme cases “consistent poor” and “non-poor”, we considered two categories representing poor people according to income in a situation of non-deprivation and the non-poor with low living standards. In 1994, 8.66% of the population was in a situation of consistent poverty, while 68.14% of households were non-poor. The poor by income and the non-poor with low living standards were 9.30% and 13.90%, respectively. In consequence, including living conditions improves the measure of poverty if we compare it with the rate of monetary poverty.

To estimate the transition probabilities we used the dynamic multinomial logit model since it is the most appropriate when we want to study the evolution of a discrete variable over time; and in addition, under certain conditions (Vermunt, 1997), it is equivalent to a discrete-time hazard model. Moreover, it allows latent variables to be introduced into the model to represent unobserved variables. In our case, we first presented and then applied a mixed Markov model to look for groups with similar dynamic behaviours within the population.

However, the assumption of homogeneous transitions has been rejected. Among the results obtained, as well as the high permanence of non-poverty, we should stress the limited transition between the extreme cases. That is, the intermediary categories represent successive situations in the process of impoverishment or inclusion. Slight variations in income have less influence than in the analysis based solely on income, as living conditions are also considered and these change more slowly than incomes. For this reason immobility is relatively high.

We believe that more work is necessary in this line in order to point out to the public authorities and society as a whole the keys to achieve a greater social inclusion, using the most effective keys.

References

Atkinson AB, Cantillon B, Marlier E and Nolan B (2002) *Social Indicators. The EU and Social Inclusion*. Oxford University Press, Oxford.

Bane MJ and Ellwood DT (1986) Slipping into and out of poverty: the dynamics of spells. *Journal of Human Resources* 21 1-23.

Blumen IM, Kogan M and McCarthy PJ (1955) *The industrial mobility of labor as a probability process*. Cornell University Press, Ithaca.

Burgess SM and Propper C (1998) *An economic model of household income dynamics, with an application to poverty dynamic among American women*. CASE paper nº 9. CASE-London School of Economics, London.

Cantó O (1996) *Poverty dynamics in Spain. A study of transitions in the 1990s*. DARP Discussion Paper nº 15. STICERD-London School of Economics, London.

Cantó O (1998) *Income mobility in Spain: How much is there?* Working paper FEDEA EEE 17. FEDEA, Madrid.

Cantó O (2000a) Income mobility in Spain: How much is there? *Review of Income and Wealth*, 46(1), 85-101.

Cantó O (2000b) *Climbing out of poverty, falling back in: low incomes' stability in Spain.* Working paper nº 13, Departamento de Economía Aplicada, University of Vigo, Vigo (Spain)

Cantó O, del Río C and Gradín C (2000) La situación de los estudios sobre la desigualdad y la pobreza en España. *Cuadernos de Gobierno y Administración*, 2, 25-94.

Cantó O, del Río C and Gradín C (2002) *What helps households with children in leaving poverty? Evidence from Spain in contrast with other EU countries.* Working paper 0201, Departamento de Economía Aplicada, University of Vigo, Vigo (Spain)

Dempster AP, Laird NM, Rubin DB (1977) Maximum likelihood estimation from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society B* 39:1-38.

Devicenti F (2001) *Poverty persistence in Britain: a multivariate analysis using the BHPS, 1991-1997*. ISER Working Paper 2001-02. University of Essex, Colchester.

Duncan GJ (1983) The implications of changing family composition for the dynamic análisis of family economic well-being In: Atkinson AB and Cowell FA (eds.) *Panel Data on Incomes*. Ocassional paper nº 2. STICERD-London School of Economics, London.

EUROSTAT (2000) *European social statistics. Income, poverty and social exclusion.* Luxembourg.

Fouarge D and Muffels R (2000) *Persistent poverty in the Netherlands, Germany and the UK. A model-based approach using panel data for the 1990s*. European Panel Analysis Group Working Paper nº 15. University of Essex, Colchester.

Haberman SJ (1979) *Analysis of qualitative data, Vol. 2, New developments*. Academic Press, New York.

Hagenaars JA (1988) Latent structure models with direct effects between indicators: local dependence models. *Sociological Methods and Research,* 16, 379-405.

Hagenaars JA (1990) *Categorical longitudinal data. Log-linear Panel, Trend, and Cohort Analysis*. Sage Publications, London.

Hagenaars, J.A. (1992) Exemplifying longitudinal log-linear analysis with latent variables In Van der Heijden PGM, Jansen W, Francis B and Seeber GUH (eds.), *Statistical modelling*, 105-120, Elsevier Science Publishers, Amsterdam

Halleröd B (1994) *A new approach to the direct consensual measurement of poverty*. Social Policy Research Centre Discusión Paper nº 50. University of New South Wales.

Hill MS and Jenkins SP (1998) *Poverty among British children: chronic or transitory?*. ISER Working Paper 1999-23. University of Essex, Colchester.

Hills J (1998a) Does income mobility mean that we do not need to worry about poverty? In Atkinson AB and Hills J (eds.) *Exclusion, employment and opportunity*. CASE paper nº 4. CASE – London School of Economics, London.

Hills J (1998b) What do we mean by reducing lifetime inequality and incresing mobility? In *Persistent poverty and lifetime inequality: the evidence*. CASE report nº 5. CASE-London School of Economics, London.

INE (1996) *Panel de Hogares de la Unión Europea (PHOGUE). Metodología*. Instituto Nacional de Estadística, Madrid

Jenkins SP (1999) *Modelling household dynamics*. ISER Working Paper 1999-01. University of Essex, Colchester.

Langeheine R and Van de Pol F (1994) Discrete-Time Mixed Markov latent class models In Dale A and Davies RB (eds) *Analyzing social and political change*. Sage Publications, London.

Layte R, Maître B, Nolan B, and Whelan CT (1999) *Income deprivation and economic strain*. European Panel Analysis Group Working Paper nº 5. University of Essex, Colchester.

Layte R, Maître B, Nolan B, and Whelan, C.T. (2000) *Explaining levels of deprivation in the European Union*. European Panel Analysis Group Working Paper nº 12. University of Essex, Colchester.

Layte R and Whelan CT (2002) *Moving In and Out of Poverty: The Impact on Welfare Regimes in the EU*. European Panel Analysis Group Working Paper nº 30. University of Essex, Colchester.

Lazarsfeld PF (1950). The logical and mathematical foundation of latent structure analysis In Stouffer SA et al. (eds.), *Measurement and prediction*, 362-472, Princeton University Press, Princeton.

Lazarsfeld PF and Henry NW (1968) *Latent structure analysis*. Houghton Mifflin, Boston.

Mack J and Lansley S (1985) *Poor Britain*. Allen and Urwin, London.

Martínez R and Ruiz-Huerta J (1999) Algunas reflexiones sobre la medición de la pobreza. Una aplicación al caso español In Maravall JM (ed.) *Dimensiones de la desigualdad. III Simposio sobre igualdad y distribución de la renta y la riqueza.* Vol. 1, 367-428. Fundación Argentaria and Visor Editorial, Madrid.

Martínez R and Ruiz-Huerta J (2000) Income, multiple deprivation and poverty: an empirical analysis using Spanish data. 26ª IARIW General Conference. Krakow, 27/08-02/09.

Muffels R and Fouarge D (2001) *Do European welfare regimes matter in explaining social exclusion? Dynamic analyses of the relationship between income poverty and deprivation: a comparative perspective*. ESPE Conference. Athens.

Nolan B and Whelan CT (1996) *Resources, deprivation and poverty*. Clarendon Press, Oxford.

Pérez Mayo J (2002). *Modelos dinámicos de variables latentes aplicados a la construcción de indicadores económicos y sociales*. Unpublished Ph. D. Thesis

Pérez Mayo J and Fajardo MA (2003) Un método alternativo para identificar los hogares en situación de pobreza. *Estadística Española*, vol. 45, 152, 115-134.

Poulsen CA (1982) *Latent structure analysis with choice modelling*. Aarhus School of Business Administration and Economics.

Raftery AE (1986) Choosing models for cross-classifications. *American Sociological Review* 51:145-146.

Ringen S (1988) Direct and Indirect Measures of Poverty. *Journal of Social Policy*, 17(3), 147-164.

Schluter C (1997) *On the non-stationarity of German income mobility (and some observations on poverty dynamics)*. DARP Discusión Paper nº 30. STICERD-London School of Economics, London.

Sen AK (2000) *Social Exclusion: concept, application and scrutiny*. Social Development Papers, nº1. Asian Development Bank, Manila.

Stevens AH (1994) Persistence in poverty and welfare: the dynamics of poverty spells: updating Bane and Ellwood. *American Economic Review (Papers and Proceedings)*, 84: 34-37.

Stevens AH (1999) Climbing out of poverty, falling back in: measuring the persistence of poverty over multiple spells. *Journal of Human Resources*, 3, 557-588.

Townsend P (1979) *Poverty in the United Kingdom*. Penguin Books, Harmondsworth.

Van de Pol F and de Leeuw J (1986) A latent Markov model to correct for measurement error. *Sociological Methods and Research* 15: 188-141.

Van de Pol F and Langeheine R (1990) Mixed Markov latent class models In Clogg CC (ed.) *Sociological Methodology 1990*. Basil Blackwell, Oxford.

Vermunt JK (1997) *Log-linear Models for Event Histories*. Sage Publications, London.

Walker R (1994) Lifetime poverty dynamics. In *Persistent poverty and lifetime inequality: the evidence*. CASE report nº 5. CASE-London School of Economics, London.

Whelan CT, Layte R and Maître B (2001a) *What is the scale of multiple deprivation in the European Union?* European Panel Analysis Group Working Paper nº 19. University of Essex, Colchester.

Whelan CT, Layte R and Maître B (2001b) *Persistent deprivation in the European Union*. European Panel Analysis Group Working Paper nº 19. University of Essex, Colchester.

Wiggins LM (1973) *Panel analysis*. Elsevier, Amsterdam.

Zarzosa P (1992) *Aproximación a la medición del bienestar social. Estudio de la idoneidad del indicador sintético de la distancia P2*. Unpublished Ph. D. Thesis

Zarzosa P, Zarzosa F and Prieto M (1996) Medición del bienestar social en Castilla-León (disparidades interprovinciales e interregionales) In *Dilemas del Estado del Bienestar, II Simposio sobre Igualdad y Distribución de la Renta y la Riqueza*. Colección Igualdad, vol. 8, 203-220.

APPENDIX 1 Loglinear parameters estimates

P2	
1	-0.6283
2	0.0700
3	-0.4948
4	1.0531
P1.P2	
11	1.1951
12	0.2519
13	-0.1042
14	-1.3428
21	0.2946
22	0.9733
23	-0.9250
24	-0.3429
31	-0.2735
32	-0.8592
33	0.9667
34	0.1660
41	-1.2162
42	-0.3660
43	0.0625
44	1.5197

Source: Estimation from LeM program.

[1] This work is based on an analysis of the data referring to Spain from the European Community Household Panel from the years 1994, 1995, 1996, 1997, 1998, 1999 and 2000. We used the data with the permission of the Spanish National Statistics Institute (INE), which is not responsible for the analysis or interpretations presented here. This research has been undertaken as part of the research project "*Crecimiento, bienestar y pobreza: un análisis regional*" (Growth, well-being and poverty: a regional analysis) (2PR02A102), financed by the Education Ministry of the Regional Government of Extremadura and was started while visiting IRISS at CEPS/INSTEAD (Luxembourg) in 2000.

[2] ECPF: *Encuesta Continua de Presupuestos Familiares*.

[3] With poverty understood as a strictly monetary concept – i.e., "households or individuals situated below an income level considered minimum".

[4] In this work the author defines this typology for an analysis of income mobility, and hence when speaking of rising or falling trajectories describes a situation where all movements are upwards (downwards) or flat. In our case, we adapt this classification to the evolution of poverty, so that we only consider upward (downward) movements.

[5] Among these, not being able to afford new clothes, or a meal of meat or fish at least every two days, being in arrears with ordinary payments, lacking an inside toilet, not being able to afford to partially renew furniture, or not being able to afford a colour TV.

[6] This variable takes the value 1 in cycle *t* if the individual responds in that period, and 2 if they have abandoned the panel.

[7] Another way of resolving the problem can be seen in Shorrocks (1976). This author points out the incompliance with the first-order dependence assumption and proposes a higher-order model to study income mobility.

[8] See Appendix 1.

[9] This work refers to the period 1985-1992.

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