# IS THE SUBJECTIVE FINANCIAL WELL-BEING OF POLISH FAMILIES CHANGING WITH TIME? AN EMPIRICAL STUDY BASED ON CONSTRAINED LATENT MARKOV MODELS

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**ABSTRACT**: Poland is one of the EU countries with the lowest level of perceived financial position, according to most recent Eurostat data. To investigate the problem of such a low level of subjective well-being and to show the changing behaviour of Polish families, we apply the dynamic latent variable models in which families can change the latent class over time. We compare the models with different numbers of latent states, different types of constraints and we study the transitions between latent structures at different points in time. We present the tendency of self-reporting income position in each wave of the survey with a special focus on the results for the respondents behaviour in waves preceding and following economic crisis. The study is based on the national longitudinal project (Social Diagnosis) using software of `R`.

**KEYWORDS**: constrained latent Markov model, material well-being, transition matrix

## 1 Introduction

Poland is a country of Central and Eastern Europe which have just been through a structural and economic transition, characterised by relatively good growth performance along with rather small (compared to Ukraine, Lithuania, Latvia and Russia) increase in income inequality. However, Poles tend to be very unhappy with their financial situation. The population of Poland is described by the lower than EU-28 average rating for subjective assessment of the material condition, ranked at the 22 position, in accordance with the latest Eurostat data (European-Commission, 2021).

To evaluate the financial assessment of Polish households we base our study on Social Diagonsis (Social-Diagnosis, 2015) panel research with all, eight waves being taken in the following years 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015. We rely our study on the sample of individual responses represented by the heads of each household. The substantive research question, addressed by the presented analysis concerns the evolution of the subjective assessment of the financial satisfaction in Poland. We present the tendency of self-reporting income position in each wave of the survey with a special focus on the results for the respondents behaviour in waves preceding and following economic crisis.

To show the changing behaviour of Polish families, we apply the dynamic latent variable models in which respondents are allowed to switch from one to another latent class over time. We adopt the latent Markov (LM) models (Bartolucci *et al.*, 2013), extended to include the survey weights (see also Pennoni & Genge, 2020). We compare the models with different numbers of latent structures, different types of constraints and we study the transitions between latent structures at different points in time.

## 2 Latent Markov Models

We conceive the income perception of families as a non-observable, latent feature, evaluated through the questionnaire items. Then, latent Markov (LM) models enable to conceive self-reporting income position as a time-varying latent trait denoted as $\mathbf{S} = (S^{(1)}, \ldots, S^{(T)})$, which is assumed as a hidden stochastic process of first-order having a discrete distribution with latent states.

In our analysis we observe a categorical response variable $X^{(t)}$, for each time occasion $t$, with $t = 1, \ldots, T$ ($T = 8$ waves in our case). The response variable $X^{(t)}$ is designed to monitor financial satisfaction of Polish families and has $l_j$ categories ( $l_j = 5$ in our study), labeled from 0 to $l_j - 1$. We denote by $\mathbf{X}$ the vector with elements $X^{(1)}, \ldots X^{(T)}$, which usually, is referred to repeated measurements on the same respondents at different points in time.

The probability mass function of $\mathbf{S}$ may be expressed as

$$p(\mathbf{S} = \mathbf{s}) = \pi_{s^{(1)}} \prod_{t=2}^{T} \pi^{(t)}_{s^{(t)}|s^{(t-1)}}, \tag{1}$$

where $\mathbf{s}$ denotes a realization of $\mathbf{S}$, with elements $s^{(1)}, \ldots, s^{(T)}$; $\pi_{s^{(1)}} = p(S^{(1)} = s)$ is the initial and $\pi^{(t)}_{s^{(t)}|s^{(t-1)}} = p(S^{(t)} = s | S^{(t-1)} = \bar{s})$ is the transition probability of the model.

In the results, we compare different variants of the LM model (that is, with different types of constraints posed on transition matrix), such as separate, heterogeneous transition matrices for each year, partial time-homogeneous matrices based on two different transitions (one until occasion $T^*$ and the other for transitions after this occasion) as well as homogeneous with one common transition matrix for all years (see Bartolucci *et al.*, 2013, p. 86-96, for details).

## 3 Results

At the first stage of our analysis we select the number of latent states and then we try to simplify the LM model by adopting certain constraints on its parameters. We observe that the lowest *BIC* value (equal to 6, 221.312) is reached for the *LM-part-hetero* with $T^* = 6$ and three number of latent states ($s = 3$). We note also that, the *BIC* value both for *LM-hetero* and *LM-part-hetero* with $T^* = 6$ is lower than the value of this criterion achieved for traditional LC model (see Genge, 2021, Table 7, p.13). On the basis of the estimated conditional probabilities we classify the Polish households to three latent states: $S_1$ – households with the lowest income perception, $S_2$ – households generally satisfied and $S_3$ – households with the highest self-reported financial status.

Interestingly, on the basis of the estimated transition probabilities we can see the difference between the evolution of the income assessment from the first to the fifth wave and from the sixth to the last wave. Notably, the first transition matrix (concerning years before crisis) corresponds to a considerably higher level of persistence in the third, the most positive latent state than the second transition matrix. We can observe also that in the years following the economic crisis the respondents are more prone to remain in the unsatisfied and rather satisfied groups of Poles ($S_1$ and $S_2$) and to switch from the highest to the state characterised by satisfaction of intermediate level. These results might confirm just slightly deterioration of Polish moods reflecting the economic crisis. This feature of Polish nation was already noted by Helliwell *et al.* (2014) or Chzhen (2016). They found that subjective well-being decreased in the EU countries that were heavily affected by the crisis (Greece, Ireland, Italy, Portugal, and Spain). We note that they considered only the early impact of the economic crisis between 2008 and 2011. However, these results might suggest that the crisis affected Polish families in various forms, not only related to cutting their budgets. In a further stage of our study (Genge, 2023) we compare the results with the homogenous version of the LM model, extended to include also time-varying covariates allowing for better characteristics of changing family behaviours. This approach help us to identify the types of families (characterised by different socio-economic features) who are in need of greater social protection.

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