ECONOMETRICS
EKONOMETRIA
Advances in Applied Data Analysis

Econometrics. Ekonometria.
Advances in Applied Data Analysis
Year 2024, Vol. 28, No. 3
ISSN 2449-9994
journals.ue.wroc.pl/eada

Public Support for Emigration Post-EU Accession: An LM Model Analysis

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Quote as: Genge, E. (2024). Public Support for Emigration Post-EU Accession: An LM Model Analysis. *Econometrics. Ekonometria. Advances in Applied Data Analysis*, *28*(3), 9-23.

DOI: 10.15611/eada.2024.3.02

JEL: C33, C52, J61

Abstract

Aim: Since 2004 European countries, such as Germany and the United Kingdom, have noted an unusual upward trend of migrants from Central and Eastern Europe. The author aimed to examine the popular perception of emigration from Poland in the years following EU accession. Moreover, the study presents the effect of the observed socio-economic features (i.e. age, education, marital status, socio-professional status) affecting the conditional probabilities of the response variable, considering also the unobserved heterogeneity between the respondents representing Polish society.

Methodology: The study was based on the Latent Markov (LM) models which allowed finding homogenous groups of respondents on the basis of their definite responses measured at different points in time. The author compared the respondents behaviour in the groups arriving just after EU accession, in relation to the other surveyed surges in migration using the Latent Markov models with different types of constraints. Then, to show the effect of observable socio-economic characteristics, taking into account the unobserved heterogeneity between the subjects, the study employed the version including the covariates in the measurement part of the model.

Results: Based on the Polish longitudinal social survey, i.e. Social Diagnosis, the study shows that the analysed data can be explained by two latent states of Poles sharing the same propensity towards emigration. It was observed that Poles were more stable in their feelings concerning their approach to the emigration in the period 2011–2015 (following the first post-accession phase). Based on the available (time-constant and time-varying) covariates, the author demonstrated that certain types of people are more prone to migrate than others.

Implications and recommendations: The presented approach could be applied to data from other economies – both within the EU and outside it – which have also seen massive outflows of people, to

show the changing behaviour of society. This methodology might also be helpful with policy challenges and the effective management of migration, as well as for future data concerning the attitudes towards refugees from Ukraine coming to Poland at present.

Originality/value: Unlike previous studies, the author assumed that the attitudes toward emigration can vary on the response variable, i.e. because of the unobserved covariate such as 'patriotic behaviour' (unobserved heterogeneity), which may change over time. The study applied the appropriate LM techniques extended to include the covariates in the measurement part of the LM model and the longitudinal weights of the survey. Note that the applied model also allowed achieving a better measure-of-fit compared to the standard random-effect model, and the parameters of the LM model additionally enabled to evaluate the dynamic of the latent trait.

Keywords: constrained Latent Markov (LM) model, covariates, emigration, unobserved heterogeneity, longitudinal data.

1. Introduction

For years, Poland was a country which people left. One could suppose that emigration was a very common phenomenon because of the EU borders opening or an economic crisis. A greater focus on the issues of economic migration in Poland has emerged since 2006, when it was discovered that mass emigration from Poland and the country's growing economy might lead to a shortage in workforce (cf. Budnik, 2007; White, 2011; Witek, 2010). The job vacancy rate and, in particular, the percentage of companies reporting problems with finding employees increased rapidly from 2005 until late 2007 (i.e. in the period of the most dynamic outflow). The number of companies experiencing labour shortages as a barrier to growth varied from practically none prior to 2005 to 14.2% in the third quarter of 2007. Then it fell again to around 6% in 2008. The most seriously affected sectors included construction (35% reporting hiring difficulties) and manufacturing (over 15%) (National Bank of Poland, 2008).

In migration research, persons with a university degree are customarily considered highly skilled workers (Iredale, 2001; Kaczmarczyk & Okólski, 2005). The evidence of brain drain of highly skilled people is widely presented in the literature (see e.g. Biavaschi et al., 2020; Home Office, 2008; Orchard et al., 2007; Fife City Council, 2007). Moreover, the emigration of youth to other EU countries has been, first and foremost, regarded as part of a demographic crisis in Poland. The very low fertility rate in Poland (1.32 in 2014 compared to 1.58 for the EU28, according to Eurostat), accompanied by the high level of emigration, has been perceived as a catalyst for the shrinking and ageing of the Polish population, economic problems, difficulties in providing care services, and the instability of the pension system (CEED, 2015).

Approximately 2.3 million Polish citizens have left the country for at least three months since 2004 (cf. Central Statistical Office of Poland, 2015). Poland ranks first among the post-communist countries in the number of emigrants and the emigration rate[1] (see Genge, 2017, pp. 38, 39). Although the wave of emigration has been falling in recent years, according to UN data, almost 4.5 million Poles still live outside the country. From 2004 to 2019 the number of Polish citizens residing in Great Britain increased by 843 thousand, and in Germany by 448 thousand. Other popular countries for Polish emigration are the Netherlands, Ireland and Norway, with an increase in the number of Poles in the last 15 years of over 100 thousand. The subject of the attitude towards emigration still seems to be pertinent, especially after the United Kingdom's exit from the EU and Ukrainian refugees living in Poland.

Unlike earlier studies, the author assumed that the attitudes of Poles can vary on the response variable, namely because of an unobserved covariate, such as 'patriotic behaviour' (unobserved heterogeneity).

[1] The number of registered departures from the country for a permanent stay abroad divided by the number of residents.

The effect of the unobserved covariate has its own dynamic. In the context of this paper, patriotic behaviour or attitude to the country may change over time (see difficulties with finding a job, emigrating friends, newly arrived refugee groups living in Poland), and are important features to be examined. The author considered the discrete distribution of this unobserved (latent) variable, which in such a context has the role of accounting for the respondents' unobserved heterogeneity by introducing a unit specific random intercept.

The main research question of this study concerns the influence analysis of the observed covariates (i.e. age, education, marital status, socio-professional status) affecting the conditional response probabilities (given the latent state), taking into account the unobserved heterogeneity between subjects. In particular, through a model of this type, one can examine the effect of time-varying unobserved covariate. The other substantive research question addressed by the analysis of this data set, concerns the transition probabilities of the model. Note that one of the hypotheses underlying this model is that the subjects moved between their types of attitudes in a different way when they were in the first period, just after EU accession, with respect to the other years.

For the analysis of the data on emigration, the author adopted latent Markov (LM) models including additionally the longitudinal weights needed to compensate for the non-response, non-coverage or the unequal probability of selection (Kalton, 1989; Thomas & Heck, 2001; Stapleton, 2002). The study compared LM models with different types of constraints to answer, namely the question of whether the attitude towards emigration was different just after the opening of the EU borders. Furthermore, to study the effect of socio-economic features accounting also for unobserved heterogeneity of the analysed society, the author focused on the latent Markov model with covariates with influence on its measurement part. Hence, the latent variable accounted for the unobserved heterogeneity, that is, the heterogeneity between subjects that cannot be explained on the basis of the observable features.

2. Literature Review

Most of the recent studies of the literature on the subject are devoted to the emigration impacts on wages in the countries of destination (Altonji & Card, 1991; Angrist & Kugler, 2003; Card & Lewis, 2007; Jaeger, 2007), as well as other more recent papers (D'Amuri et al., 2010; Glitz, 2012; Manacorda et al., 2012; Ottaviano & Peri, 2012; Dustman et al., 2013; Clemens et al., 2018). A smaller body of work investigated the effect of emigration on the labour markets of the countries of origin (see e.g. Borjas, 2003; Aydemir & Borjas, 2007; Hanson, 2007; Mishra, 2007; Elsner, 2013).

Regarding Polish society, most of the research is concerned with the economic effects of migration flows. Przekota (2011) showed that emigration had a significant impact on wage growth as average wage increased faster in 2005–2008 despite the lower inflation rate. However, several studies found that emigration had a weak impact on wages. Dustman et al. (2015) suggested that emigration from Poland over the 1998–2007 period had a slightly positive effect on the average wages of those who did not emigrate. Kaczmarczyk (2014) proposed a similar conclusion, pointing out that even serious shortages in labour supply due to emigration resulted only in an insignificant increase in aggregated wages – between 2 and 4% in real terms in 2004–2006 (see also Kowalska, 2012). Wojtas & Białowąs (2018) indicated that the post-accession emigration wave was accompanied by a marked decrease of the unemployment rate and increased the pressure for wages growth. In the most recent study, Pszczółkowska et al. (2024) aimed to establish to what degree the Covid-19 pandemic and its management influenced the migration intentions of Polish medical students and junior doctors. The research showed that salary was not a push factor stimulating the emigration intentions. The factors concerning the socio-political situation in Poland, working conditions and the possibility of pursuing a planned career path, indicated that the participants' family situation was much more important. The author noted that the topic related to the inflow of people, especially of foreign-born doctors until the Covid-19 pandemic and the outbreak of war in Ukraine, has become very popular (see Dubas-Jakóbczyk et al., 2020; Domagała et al., 2022; Lock & Carrieri, 2022; Duszczyk et al., 2023; Zhou, 2023).

Despite numerous studies, the situation in the field of migration in Poland is not researched, and the actual rate of emigration is unclear (statistical data record only the officially declared migration). Therefore, the author's empirical research was based on the Polish sociological studies conducted by Czapiński & Panek (2015), carried out systematically. Compared to the previous papers, the author did not focus on the impact of emigration on Poland's economy but rather on the questionnaire section concerning the public perception about emigration changing over time.

3. Methodology

The author assumes that the propensity to leave one's country can vary on the response variable, due to the observed covariates (i.e. education, marital status, age) and unobserved covariate, such as 'patriotic behaviour'. This specific, latent covariate may evolve during the analysed period of observation because of changing family situation, job position, and the increasing number of refugees. Such an unobserved (latent) variable has discrete distribution and the present study relies on the latent Markov model approach. Similarly to the latent class (LC) approach, the study classified the respondents on the basis of the categorical responses. Note that, in the case of the LM approach, the responses are allowed to be measured at different points in time. First, the author presented the basic assumptions of the LM approach (see Section 3.1). Second, to answer the question of whether the attitude towards emigration was different just after the EU borders opened (relative to the other years of the survey), the study employed the different types of constraints imposed on the parameters of the latent part of the LM model (see Section 3.2). Finally, to show the effect of observable socio-economic features, taking into account the unobserved heterogeneity between subjects, the author relied on the version including the covariates in the measurement part of the LM model (see Section 3.3). The choice of the model with the best measure of fit and estimation procedures is described in Section 3.4.

3.1. Basic LM Model

The symbol $X^{(t)}$ denotes a categorical response variable available at t-th time, $t = 1, \dots, T$ ($T = 6$ waves in this case). The response variable might have l_j categories, labelled from 0 to $l_j - 1$. The author also included $\boldsymbol{Z}^{(t)}, t = 1, \dots, T$, namely the vector of time-varying and time-constant covariates observed for each respondent participating in the longitudinal survey. It is worth mentioning that the approach to emigration was conceptualised as a non-observable, latent feature, characterised through the questionnaire positions. Subsequently, the LM model allowed perceiving emigration behaviour as a time-varying latent trait denoted as $\boldsymbol{S} = S^{(1)}, \dots, S^{(T)}$, assumed as a hidden stochastic process of first-order having a discrete distribution with *u* latent states of Poles.

The LM model is characterised by different types of parameters describing:

- the *measurement part of the model* – the conditional distribution of the response variable given the latent state of Poles' attitudes:

$$\varphi_{x|s} = p\left(X^{(t)} = x \middle| S^{(t)} = s\right), t = 1, \dots, T\,, s = 1, \dots, u\,, x = 0, \dots, l_{j-1} \tag{1}$$

- the *latent part of the model* – the initial π_s and the transition $\pi_{s|\bar{s}}^{(t)}$ probabilities, given by the following expressions:

$$\pi_s = p(S^{(1)} = s), s = 1, \dots, u$$
$$\pi_{s|\bar{s}}^{(t)} = p(S^{(t)} = s | S^{(t-1)} = \bar{s}), t = 2, \dots, T\,, \bar{s}, s = 1, \dots, u,$$

where s is a realisation of $S^{(t)}$ and $\bar{s}$ is a realisation of $S^{(t-1)}$.

This paper addressed two types of LM models: constrained variant and LM including covariates in the measurement part of the model.

3.2. Constrained LM Model

To verify the hypothesis concerning the different emigration position in the years just after EU accession compared to the other years of the survey, the constraints imposed on the latent parameters of the model were adopted.

First, consider the simplest constraint on the latent part of the LM model:

$$\prod^{(t)} = \prod, t = 1, \dots, T\ , \tag{2}$$

where $\prod$ is a common transition matrix with elements $\pi_{s|\bar{s}}$, $\bar{s}, s = 1, \dots, u$, corresponding to the hypothesis that the *Markov chain is time homogeneous*.

A weaker version of the constraint presented above was also applied:

$$\boldsymbol{\Pi}^{(t)} = \begin{cases} \boldsymbol{\Pi}^{*(1)}, & t = 2, \dots, T^* \\ \boldsymbol{\Pi}^{*(2)}, & t = T^* + 1, \dots, T, \end{cases} \tag{3}$$

with T^* between 2 and $T - 1$ and $\boldsymbol{\Pi}^{*(1)}$and $\boldsymbol{\Pi}^{*(2)}$ being separate transition matrices, with elements $\pi_{s|\bar{s}}^{*(1)}$ and $\pi_{s|\bar{s}}^{*(2)}$respectively. This corresponded to the hypothesis of *partial time homogeneity* based on two different transition matrices, the first one until time *T** and the second one related to transitions after this time (Bartolucci, 2007). The empirical part compared the results for the LM models with heterogenous matrices (no constraints), partial constraints (for different T^*) and one homogeneous matrix for all six waves of the survey.

3.3. LM with Covariates in the Measurement Model

In the next stage, the author considered the analysis with the inclusion of the covariates affecting the conditional response probabilities (given the latent state), taking into account the unobserved heterogeneity between subjects (heterogeneity which may not be described relying on the observed features). In particular, through a model of this type one can take into account the effect of the unobserved covariate allowing it to evolve during the period of study.

When the individual covariates are included in the measurement model, the conditional distributions of the response variables given the latent states may be parameterised by the generalised logits. In such a situation, the latent variable accounts for the unobserved heterogeneity, namely the heterogeneity between subjects that cannot be explained on the basis of the observable covariates. The advantage with respect to a standard random effects or latent class model with covariates is that the effects of the latent variable for the unobservable heterogeneity is allowed to be time-varying (Bartolucci et al., 2017).

LM with covariates in the measurement model mostly rely on the global logit parametrisation:

$$\log \frac{p\left(X^{(t)} \geq x | S^{(t)} = s, \boldsymbol{Z}^{(t)} = z\right)}{p\left(X^{(t)} < x | S^{(t)} = s, \boldsymbol{Z}^{(t)} = z\right)} = \log \frac{\phi_{x|sz}^{(t)} + \cdots + \phi_{l_{j-1}|sz}^{(t)}}{\phi_{0|sz}^{(t)} + \cdots + \phi_{x-1|sz}^{(t)}} = s_x + \alpha_s + \boldsymbol{z}'\boldsymbol{\beta} \tag{4}$$

for $t = 1, \dots, T$ and $x = 1, \dots, l_j$. Note that, as regards the binary variables analysed ($l_j = 2$), the logits presented in (4) reduce to the standard logit functions. In the formula given in (4), $\boldsymbol{\beta}$ is the vector of regression parameters for the covariates, s_x denotes cut-points and α_s follows a first-order Markov chain (presented in Section 3.1) and describes support points related to each latent state. Note also that it is assumed that every α_s is conditionally independent of $\alpha_1, \dots, \alpha_{t-2}$, given α_{t-1}.

This parametrisation is based on one parameter for each latent state related to people sharing the same propensity towards emigration and one cut-point for each response category. Therefore, in the case of the ordinal response variable, the latent states of attitudes might be ordered according to the highest and lowest propensity to leave the country. It was noted that the cut-points are common to all

the response variables, since these variables correspond to repeated measurements of the same phenomenon. It should also be mentioned that in this formulation usually the homogeneity constraint is posed on the transition matrix of the latent part of the model (see Equation 2). This constraint enables to avoid interpretability problems and reduce the number of estimated parameters. For more details see Chapters 3 and 5 in Bartolucci et al. (2013).

3.4. Estimation and Number of Latent Structures Selection

In order to include the longitudinal survey weights in the estimation part of the study, the author applied the well-known Expectation-Maximisation (EM) algorithm (Baum et al., 1970; Dempster et al., 1977) involving the weighted log-likelihood function with the modified M-step of the EM algorithm (Genge & Bartolucci, 2022; Genge, 2023). The especially adapted version of the algorithm was implemented in the R package LMest (Bartolucci et al., 2017) allowing also for different initialisations of the algorithm.

One of the most important issues regarding latent variable modeling concerns the number of latent components ($s, s = 1, \dots, u$) selection. In particular, the study relied on information criteria such as the Akaike Information Criterion (AIC, Akaike, 1973) and the Bayesian Information Criterion (Schwarz, 1978, BIC). Following a standard rule, at the very beginning the author fitted the LM model for increasing values of *u*, until finding the minimum of the BIC and AIC indices. Then, with a similar criterion, the author tried to simplify this model imposing different constraints until it is not possible to further reduce the value of the BIC and AIC (retaining the previously selected number of latent states).

To evaluate the quality of the selected LM model, the study also considered index $\tilde{S}$ of the quality of classification proposed by (Bartolucci et al., 2009):

$$\tilde{S} = \frac{\sum_{i=1}^{n}\sum_{t=1}^{T}\left[\hat{f}^{*(t)}(\boldsymbol{x}) - 1/u\right]}{(1-1/u)nT}, \tag{5}$$

where $\hat{f}^{*(t)}(\boldsymbol{x})$ is the maximum of the posteriori probabilities, with respect to *s*. Index $\tilde{S}$ is always between 0 and 1, with 1 corresponding to the situation of absence of uncertainty in the classification and very well separated latent states. On the other hand, when the states are not well separated, most of the probabilities $\hat{f}^{*(t)}(\boldsymbol{x})$ are close to 1/u and then $\tilde{S}$ attains value close to its minimum, which is equal to 0.

4. Data and Results

This section presents the results obtained from the application of the latent Markov models to the dataset concerning attitudes toward emigration behaviour described in Section 4.1. The study compared the results achieved for different types of latent variable models, with a special focus on the LM model with covariates affecting the measurement part of the model.

4.1. Data

The study was based on the largest household panel, the Social Diagnosis Survey (Czapiński & Panek, 2015), which is a 15-year observational longitudinal study aimed at presenting the well-being, living conditions (financial, societal, cultural) and health issues of the Polish population aged 16 and above. To date, data have been collected up until 2015, which was the latest available issue.

The study considered the questionnaire section about Polish emigration. The data concern the dichotomous response variable ("Do you plan to go abroad within the next two years in order to work?") and the covariates (gender, social-professional status, marital status, place of residence, education and age) measured on six occasions (since EU accession), namely 2005, 2007, 2009, 2011,

2013, 2015 of the longitudinal survey.[2] The analysed complete data involve *n* = 804 (134 complete observations at each point of time).

The effect of the following covariates influencing the measurement part of the LM model was also studied:

- *gender* (0 – male, 1 – female);
- *socio-professional status* (1. public sector workers, 2. private sector workers and self-employed, 3. farmers, 4. pensioners and retirees, 5. other professionally inactive persons, i.e. unemployed, pupils and students);
- *marital status* (1. other, 2. married);
- *place of residence* (1. big cities, over 500,000 residents, 2. 200–500,000, 3. 100–200,000, 4. 20–100,000, 5. under 20,000, 6. rural areas);
- *education* (1. primary/no education, 2. vocational/grammar, 3. secondary, 4. higher and post-secondary);
- *age*.

4.2. Results for the Basic and Constrained LM Models

First, the study specified the discrete latent variable formulation and estimated the basic LM model (with no constraints and covariates) with different number of latent structures ($s = 1, \dots, u$). Table 1 shows the results in terms of maximum log-likelihood, *BIC*, *AIC* index based on which the author selected $s = 2$ (latent states of attitudes). It is worth mentioning that for $s = 2$, the study also observed a very high value of quality of classification measure $\tilde{S}$, confirming well-separated latent structures in the analysed data set.

Table 1. The choice of optimal LM model

s	$\hat{l}$	$\#par$	AIC	BIC	$\tilde{S}$
1	–202.6340	1	407.2681	409.9787	0
2	–171.8198	13	**369.6397**	**404.8781**	0.9999
3	–167.9474	35	405.8948	500.7676	0.8547
4	–165.9611	67	465.9222	647.5358	0.6517
5	–164.6845	109	547.3690	842.8301	0.3652
6	–160.9350	161	643.8700	1080.2849	0.3498
7	–159.4812	223	764.9623	1369.4376	0.3162
8	–159.1088	295	908.2175	1707.8597	0.3191

Source: own computation in R.

Next, the author verified the hypothesis concerning the transition probabilities of the model, asking whether the transition probabilities from the first to the second occasion (just after joining the EU) were higher than the other transitions. It was assumed that the subjects move between states of attitudes in a different way when they were in the first few waves (first two, three, four, five waves) with respect to when they were in the other waves. Therefore, the study specified the latent variable model with constrained transition matrices of the model, as in Formula 3. Table 2 reports the results of this model selection procedure for the optimal number of states $s = 2$ and different values of T^* between $t = 2$ and $t = 6$. The author also included the results for the LM model with two states and heterogenous transitions (with five different heterogenous matrices), denoted as *LM-hetero*.

Table 2 shows that the lowest *BIC* value (among the different *LM-part-hetero* and *LM-hetero*) was reached for the *LM-part-hetero* with $T^* = 4$. Note that the hypothesis underlying this model was that the subjects move between latent states in the first three waves in a different way with respect to when they are in other waves. These results seem to be particularly interesting for comparing the respondents' behaviour in 2005–2009 and following this period.

[2] Dataset and its complete documentation are found at http://www.diagnoza.com/index-en.html

Table 2. The choice of LM model with $s = 2$ and different types of constraints

s	$\hat{l}$	$\#par$	AIC	BIC
LM (hetero)	–171.8198	13	369.6397	404.8781
LM (part-hetero) $T^* = 2$	–176.9664	7	367.9328	386.9074
LM (part-hetero) $T^* = 3$	–176.9359	7	367.8717	386.8463
LM (part-hetero) $T^* = 4$	–174.8642	7	363.7284	*382.7029*
LM (part-hetero) $T^* = 5$	–177.2083	7	368.4166	387.3911
LM (homo)	–177.2430	5	364.4859	**378.0392**

Source: own computation in R.

Figure 1 presents the estimated conditional probabilities for the partial heterogeneous LM model with the optimum measure of fit, based on which one could compare the first state of attitude, that is, (S_1) – those being against leaving Poland, and the second state of attitude, that is, (S_2) – people planning to work abroad.

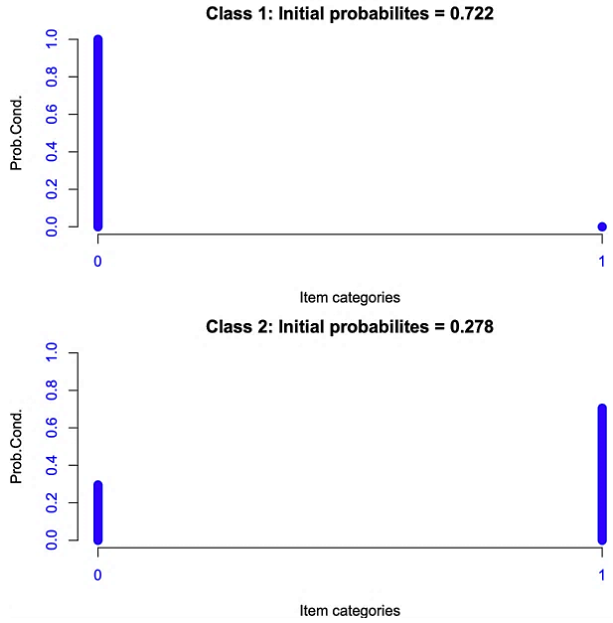

Fig. 1. Conditional probabilities for *LM-part-hetero* with T^* = 4
Source: own computation in R.

On the basis of the estimated transition probabilities given in Table 3, one can see the difference between the evolution of the willingness to work abroad from the first to the third wave (the period of the most dynamic outflow) and from the fourth to the last wave. Notably, the first transition matrix (concerning three waves just after the EU accession) is characterised by the lower persistence in both states of attitudes (compared to the second transition matrix referring to the second period); 90% of Poles ($\hat{\pi}_{1|1}^{(t)} = 0.9033$) were not ready to go abroad and were of the same mind in 2005–2009, whereas nearly 10% were going to change their mind and move on to the state of people being ready to leave the country in order to work ($\hat{\pi}_{1|2}^{(t)} = 0.0967$). Only 28% were consistent in their opinion concerning the propensity to work abroad ($\hat{\pi}_{2|2}^{(t)} = 0.2755$), and most of the respondents (72%) switched to the state of people who do not want to move to another country. As far as the second period is concerned, the higher probabilities on the main diagonal of the transition matrix were observed. The respondents were more prone to remain, especially with the attitude of being afraid to leave the country (S_1), and also that of planning to work abroad (S_2), being more confident and consistent with their opinion in the period 2011–2015. It was noted that after the economic crisis and the years of emigration in pursuit of income, people were clearly more decided about their position.

Table 3. Estimates of the transition probabilities $\hat{\pi}_{s|\bar{s}}^{(t)}$ under LM model with two states of attitudes and partial heterogenous transitions (*LM-part-hetero*) for $T^* = 4$

		$\hat{\pi}_{s\|\bar{s}}^{(t)}$	
T^*	s	$s=1$	$s=2$
I ($t = 1, \dots, 3$)	1	0.9033	0.0967
	2	0.7225	0.2775
II ($t = 4, \dots, 6$)	1	1.0000	0.0000
	2	0.4122	0.5878

Source: own computation in R.

Note also that, if one compares the models with different types of constraints (no constraints, partial constraints, complete constraints), the LM model with homogenous transitions *LM-homo* is characterised by the best measure-of-fit, reaching BIC = 378.0392. Therefore, in the next stage, to evaluate the effect of the covariates on the probability of reporting a propensity to work abroad, the author presented the analysis with the inclusion of individual covariates in the measurement model combined with the constraints $\pi_{s|\boldsymbol{x}} = \pi_s$ and $\pi_{s|\bar{s},\boldsymbol{x}}^{(t)} = \pi_{s|\bar{s}},)$, $t = 1, \dots, T$, $\bar{s}$, $s = 1, \dots, u$. Once the covariates in the measurement part of the model were included, the latent variable was perceived to account for unobserved heterogeneity, i.e. heterogeneity between the respondents that cannot be described by the observed covariates involved in the study. However, Genge (2017) analysed the indirect effect of the covariates on the latent emigration position, with the main interest in modeling the effect of covariates on the latent trait distribution (see also Bartolucci & Farcomeni, 2009; Pennoni & Genge, 2020).

4.3. Results for LM with the Covariates in the Measurement Part of the Model

On the basis of the estimated regression parameters of the model presented in Formula (4), the study showed the effect of *gender*, *socio-professional status*, *place of residence*, *marital status*, *education* and *age*. The significance of the considered covariates at the 5% is denoted as **.

Women tended to report much lower willingness to leave the country than men (the odds ratio for females versus males was exp(1.2418) = 0.2889). In terms of percentual change, one can observe that the ratio for women was more than 70% lower compared to men (see Table 4). Similarly, professionally inactive Poles tended to demonstrate also a higher likelihood of going abroad than those with other socio-professional status (close to 40% higher for inactive compared to other groups). There was a 40% decrease for people living in rural areas and planning to leave the country. The bigger the place of residence, the higher propensity to leave the country (see Figure 2). Intuitively, over the years one could note a decreasing tendency to emigrate. Figure 3 shows that the highest propensity to work abroad (higher than 10%) was reported for people aged 20 and younger. Finally, one can mention that the effect of marital status and education was not significant.

In this example, the time-varying random effects were used to account for the unobserved heterogeneity.[3] The fact that the optimal number of states was *s* = 2 provided evidence for the presence of this type of heterogeneity, namely that the analysed emigration data cannot be only described on the basis of the few covariates included in the model. Note that the applied model also allows achieving a better measure-of-fit (lower values of *BIC* and *AIC*) compared to the standard random-effect model, and the parameters of the LM model enable additionally to evaluate the dynamic of the latent trait.

[3] The estimated support points for the first and the second state are given respectively as $\alpha_1 = -0.1268, \alpha_2 = 8.7007$.

Table 4. Estimates of the covariates coefficients (β_u) under the selected LM model with covariates and two states

Covariate	Coefficient	Odds	Percent of change
Gender	–1.2418∗∗	0.2889	71.11
Socio-professional status	0.8670∗∗	2.3798	137.98
Marital status	0.7648	–	–
Place	–0.8686**	0.4195	58.05
Education	0.5522	–	–
Age	–0.1362∗∗	0.8727	12.73

Source: own computation in R.

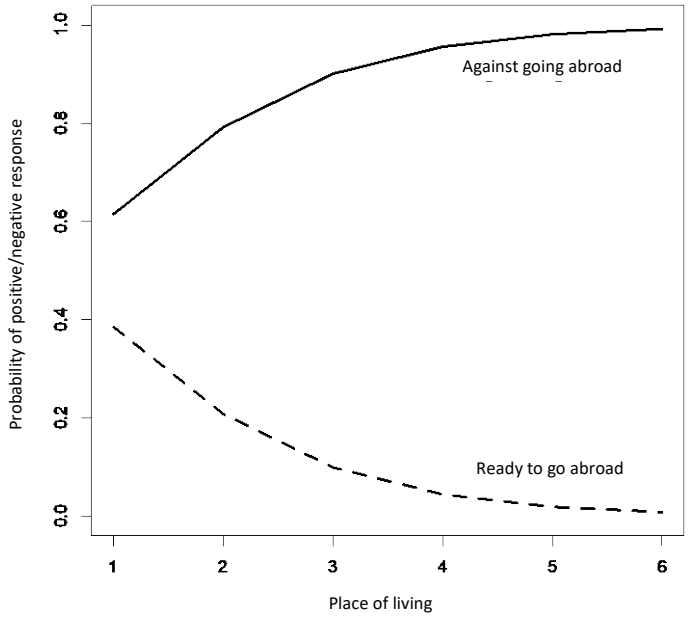

Fig. 2. The effect of *place of residence* covariate for LM model with two states

Source: own computation in R.

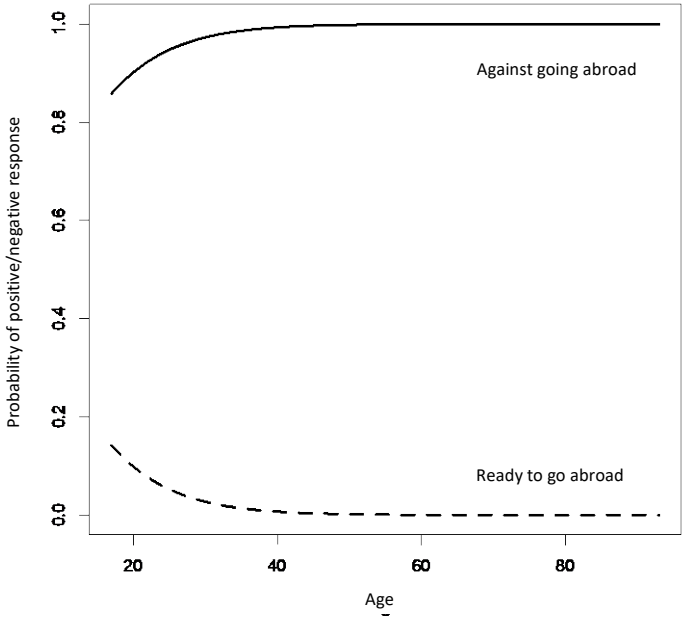

Fig. 3. The effect of *age* covariate for LM model with two states

Source: own computation in R.

Table 5. Estimates of the transition probabilities $\hat{\pi}_{s|\bar{s}}^{(t)}$ under the LM model with covariates in the measurement of the model

$\hat{\pi}_{s\|\bar{s}}^{(t)}$		
s	$s = 1$	$s = 1$
1	0.9908	0.0092
2	0.6338	0.3662

Source: own computation in R.

Regarding the distribution of the latent process for the final LM model, the majority of Poles started in the first latent state of attitude (95%), preferring to stay in Poland, and 5% started out with the attitude of supporting emigration. The estimated transition matrix (see Table 5) indicated a very high persistence in the first instance (π_{11} = 0.9908). The highest probability to switch the positions was π_{21} = 0.6338, observed from the group of the emigration supporters (S_2) to the group of emigration sceptics (S_1). Over 60% of people likely to move to another country changed their mind over a period of ten years. The remaining transition probability was very small (π_{12} = 0.0092), showing high stability of the first state of the matrix.

5. Discussion and Conclusions

The study contributes to the literature by proposing an original approach to changing attitudes toward emigration in Poland. The author proposed a model specially adopted for longitudinal data having a binary or ordinal structure with covariates, time-varying latent effects and longitudinal weights. The model formulation relies on a discrete distribution for the unobserved heterogeneity and gives rise to a latent Markov model. The presented approach was applied to the study of Polish longitudinal survey data set for the period following EU accession (2005–2015). Differently from the previous studies, it was assumed that the attitudes toward emigration can vary on the response variable, namely because of the unobserved covariate, such as 'patriotic behaviour' (unobserved heterogeneity), which may change over time. Moreover, the version including the covariates allowed showing the direct effect of observable (time constant and time-varying) socio-economic features on the measurement part of the model.

Consistent with the main aim of this research, it was shown that the analysed data were not homogenous and could be explained by two latent states of Poles' attitudes sharing the same propensity towards emigration in ten years of the study. To address the research question posed at the outset, the author verified the variety of mindsets of Polish emigrants, exploring different socio-economic features. Compared to other papers (see e.g. Grzymala-Kazlowska & Phillimore , 2019; Lopez Rodriguez, 2010; Ryan, 2011, 2018), this study analysed data observed at different points in time, and investigated the dynamic pattern of Polish attitudes toward emigration. In contrast to Genge (2017), who analysed the effect of different demographic features on the latent trait, the adopted parameterisation on the response variable presented in this paper allows measuring the direct effect of each available (time-constant or time-varying) covariate. Hence, it was demonstrated that certain types of people are more prone to migrate than others. According to Eade et al. (2006), emigration has more of an impact on increasing men's wages than women's, this study reported that men are also more ready to leave the country in order to work. Education level does not appear to have a direct effect on the desire to emigrate. The research has shown that Poles arriving in the United Kingdom were primarily employed in low-skilled and low-paid jobs, even if they had high levels of education. The UK has long been a favourite destination for highly educated Poles, who typically undertake work in low-skilled sectors there (see e.g. Düvell , 2004; Trevena, 2008). As expected, the professionally inactive and young people with open-ended plans who set off with their friends and siblings were more decided to leave Poland. Anacka & Okólski (2010) found that nearly one in ten people in their twenties

left Poland (from May 2004 to January 2007). Concerning the place of residence covariate, it was shown that the bigger the place of residence, the higher propensity to leave the country. In the first few years after accession there was an exodus from the largest cities, after which people were emigrating from all regions in Poland (Strzelecki et al., 2015, p. 144). The flows from traditional emigration regions partly reoriented themselves, particularly at first towards the United Kingdom and Ireland, and later to a wide range of European countries (Kostrzewa & Szałtys, 2013, p. 52).

To answer the research question concerning the attitude towards emigration in the years just after the EU accession, in contrast to the other years of the survey, the study employed the different types of constraints imposed on the parameters of the latent part of the LM model. Based on the constraint variant of the LM model, the author compared the different attitudes of Poles in the post-accession migration phase (reaching its peak in mid-2007) and the years following this period. These results are in line with e.g. Wojtas & Białowąs (2018) and Gumuła et al. (2011), who revealed a clear increase in emigration in pursuit of income in 2004–2008 and a slowdown of labour outflow after 2008 due to deteriorating working conditions in the destination economies. One can observe that Poles were more consistent in their feelings in the period 2011–2015, following the peak of emigration and the economic downturn.

Note that the presented approach could be applied to data from other economies – both within the EU and outside – which have also seen massive outflows of people to show the changing behaviour of the society. This methodology might also be helpful with policy challenges and effective management of migration, as well as for the future data concerning the attitudes toward Ukraine refugees coming to Poland nowadays. The presented approach helps to reveal patterns in age, gender, education, and occupation of those emigrating, which can help with identifying potential skill shortages or surpluses, informing workforce planning and education initiatives. Therefore, these results might also be useful to develop evidence-based integration policies for both the sending and receiving countries, addressing issues such as language barriers, cultural adaptation, and access to services.

The main limitation of many studies concerning the issue of emigration is linked to the limited availability of data. As pointed out by Clemens (2011), detailed statistics are either not collected or are confidential. On the other hand, the publicly available data is often not comparable over time and between countries, and is frequently released with a significant delay (Walerych, 2020). This study was based on the six waves of Social Diagnosis data, with the latest edition published in 2015. In future research it would be valuable to extend the scope to include the most up-to-date data also regarding the response variable with an ordinal nature (to compare the results related to a parameterization based on global logits). However, this will probably be achievable following a different longitudinal survey.

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Poparcie społeczne dla emigracji po przystąpieniu do UE: analiza z wykorzystaniem ukrytych modeli LM

Streszczenie

Cel: Celem badania jest określenie wpływu zmiennych socjodemograficznych (tj. wiek, wykształcenie, stan cywilny, status społeczno-zawodowy) na nastawienie do emigracji po wejściu Polski do UE.

Metodyka: Zastosowano ukryty model Markowa z wykorzystaniem zmiennych towarzyszących, mających wpływ nie na ukrytą, lecz na obserwowaną część modelu LM. Model ten, uwzględniający zmienne w czasie efekty losowe, został wykorzystany w celu analizy zbioru panelowego dotyczącego gotowości Polaków do pracy zagranicą w latach 2005–2015.

Wyniki: Opierając się na polskim panelowym badaniu społecznym, tj. *Diagnozie Społecznej*, pokazano, że analizowany zbiór można wyjaśnić za pomocą dwóch stanów ukrytych, charakteryzujących się podobną skłonnością do emigracji. Zaobserwowano, że w latach 2011–2015 (następujących po pierwszej fazie akcesyjnej) Polacy wykazali większą stabilność w poglądach dotyczących emigracji. Na podstawie dostępnych (stałych i zmiennych w czasie) zmiennych towarzyszących pokazano, że osoby o pewnych cechach są bardziej skłonne do migracji niż inne.

Implikacje i rekomendacje: Przedstawione podejście może być zastosowane w celu ukazania zmieniających się zachowań społecznych również w innych krajach, które doświadczyły masowego odpływu ludności. Ponadto analiza uzyskanych wyników może posłużyć rozwiązywaniu wyzwań politycznych i skutecznemu zarządzaniu migracją, także w przypadku przyszłych danych, dotyczących nastawienia do ukraińskich uchodźców przybywających obecnie do Polski.

Oryginalność/wartość: Główną zaletą zastosowanego modelu, w porównaniu z standardowym modelem z efektami losowymi lub modelem klas ukrytych ze zmiennymi towarzyszącymi, jest to, że nieobserwowalna heterogeniczność może być zmienna w badanym czasie. Inaczej niż w badaniach poprzednich założono tu, że udzielane odpowiedzi respondentów mogą różnić się z powodu nieobserwowalnej, zmiennej w czasie współzmiennej, takiej jak „uczucia patriotyczne". Zastosowany model, uwzględniający również wagi badania panelowego, pozwala także na uzyskanie lepszego dopasowania w porównaniu ze standardowym modelem efektów losowych, zaś parametry modelu LM umożliwiają dodatkowo ocenę dynamiki badanej zmiennej ukrytej.

Słowa kluczowe: emigracja, heterogeniczny oraz częściowo-heterogeniczny ukryty model Markowa, niejednorodność, zmienne towarzyszące