

ISSN 1732-4254 quarterly

BULLETIN OF GEOGRAPHY. SOCIO-ECONOMIC SERIES

journal homepages:
<https://apcz.umk.pl/BGSS/index>
<https://www.bulletinofgeography.umk.pl/>

Modelling the impact of emigration upon social and economic development of the Carpathian region of Ukraine

Olha Levytska^{1, CDFM}, Olha Mulska^{2, CDFM}, Yulia Shushkova^{3, DR}, Ulana Ivaniuk^{4, DF},
Taras Vasylytsiv^{5, CDF}, Vitaliy Krupin^{6, CR}, Liliya Ivanova^{7, R}

^{1,2,5}*M. Dolishniy Institute of Regional Research of National Academy of Sciences of Ukraine, Department of Social and Humanitarian Development of Regions, Lviv, Ukraine; e-mail: ¹o.levytska@gmail.com (corresponding author); ²oliuchka.mulska@gmail.com; ⁵tgvas77@ukr.net; ³*Ivan Franko National University of Lviv, Department of Financial Management, Lviv, Ukraine, e-mail: shushkova_yulia@ukr.net; ⁴*Lviv Polytechnic National University, Department of Management of Organizations, Lviv, Ukraine, e-mail: ivaniuk.ulana@gmail.com; ⁶*Polish Academy of Sciences, Institute of Rural and Agricultural Development, Warsaw, Poland, e-mail: vkrupin@irwirpan.waw.pl; ⁷*Lviv State University of Physical Culture, Department of Economics and Management, Lviv, Ukraine, e-mail: livanova.lac@gmail.com*****

How to cite:

Levytska, O., Mulska, O., Shushkova, Y., Ivaniuk, U., Vasylytsiv, T., Krupin, V. & Ivanova, L. (2022). Modelling the impact of emigration upon social and economic development of the Carpathian region of Ukraine. *Bulletin of Geography. Socio-economic Series*, 57(57): 141-154. DOI: <http://doi.org/10.12775/bgss-2022-0028>

Abstract. Population migration activity in the Carpathian region of Ukraine is currently high in intensity and scale compared to the national average. This situation is caused by subjective factors (lower living standards and quality of life, employment problems, escalation of armed conflict in the east) and objective factors (globalization and increasing population mobility, development of transnational corporations, digitalization of the economy, simplification of border-crossing procedures). The aim of the research is to model and visualize the impact of population migration on the social and economic development of the Carpathian region of Ukraine and to determine an optimal value and critical range of external migration for the region. Based on the modelling, assuming that socio-economic development of the Carpathian region corresponds to the level of integral coefficient for Poland in 2018 (calculated using a multiplicative approach), the acceptable level of external migration was determined. It is 0.850 for Lviv region (actual migration level was 1.479 in 2018); 0.653 for Chernivtsi region (0.695); and 1.488 for Zakarpattia region (2.149). The critical range of the intensity of external population migration is 0.723–1.264 for Lviv region, 0.499–0.578 for Chernivtsi region, 0.006–0.008 for Ivano-Frankivsk region, and 0.479–0.769 for Zakarpattia region.

Article details:

Received: 15 February 2022

Revised: 14 April 2022

Accepted: 17 July 2022

Key words:

development,
intensity of migration,
Carpathian region,
Ukraine,
Poland

Contents:

1. Introduction	142
2. Methodology	143
3. Results	145
3.1. Integral assessment of social and economic development of the Carpathian region	145
3.2. Modelling the impact of migration intensity on social and economic development of the Carpathian region	148
4. Discussion and conclusion	151
Note	152
References	151

1. Introduction

The current conditions of globalization, the convergence of national education and employment systems, the digitalization of all spheres of public life and the development of migration-service infrastructure are combining to objectively remove institutional, administrative and other obstacles to migration flows. This is leading to an increase in migration aspirations and a growth in potential and actual migration activity (Arango, 2000; Becker & Ferrara, 2019).

Population migration (especially external) is an ambiguous process that has positive and negative implications for both the donor country and the recipient country. This point has been argued by Carletto et al. (2006), Erdal and Lewicki (2016), Vollmer and Malynovska (2016) and others. The positive effects are the growth of labour supply and equalization of demographic and social labour imbalances, an increase in migration mobility and development of intellectual and human capital, growth of incomes, and expansion of investment potential to support the social and economic development of depressed areas. The negative implications are the draining of human and labour potential, the decline of settlements where labour and employment problems are excessive, the breakdown of families, depopulation, etc.

Minimizing the negative consequences, risks, and threats of emigration, as well as better realization of migration potential to accelerate economic growth and strengthen social security, requires high-quality, effective regulation of migration processes and flows, especially concerning external labour migration.

In turn, the formation and implementation of timely and effective tools and means of public policy are grounded in an appropriate information and analytical basis (databases and methods of their analysis). However, in the field of analysis of population migration and their impact on social and economic development nowadays, there is a significant gap that prevents the collecting and processing of necessary data and the preparing of quality information and analytical support for public policy.

Recent scientific and applied developments on the assessment of migration impact on social and

economic development of different regions (Wills et al., 2009; Rahman, 2013; Levytska et al., 2020; Sadova et al., 2020) still do not allow the causes of the social and economic development of regions and population migration to be fully and directly analysed and calculated. Nor can they discern the influence (both direct and reverse) that migration has on certain indicators of social and economic development and *vice versa*; and nor can they identify time lags (periods, intervals) with which the strongest mutual relationships (both positive and negative) between migration and regional development are observed.

During the research, a conclusion was made about the crucial role that the composition of the components of a region's social and economic development plays, and a key indicator of the intensity of external migration was selected. As a result, the research distinguished parameters of social and economic components of regional development: the social were unemployment, economic activity, average wages, disposable income, consumer price index, and level of total household expenditures on food, while the economic were foreign direct and capital investment, gross value added, number of small enterprises, retail trade turnover, volumes of foreign economic activity, and ratio of gross regional product (GRP) to wage fund. The formation of such a system of indicators is based on the results of several studies on the causality of territorial development and population migration (Keijzer et al., 2016; Gómez & Giráldez, 2017). To assess the intensity of migration processes, the ratio of the number of citizen departures from the region to the total population in the region was chosen. It is worth noting that the indicator was adjusted by a coefficient of transit migration. Arthur et al. (2018), Fischer and Pfaffermayr (2018), Williams (2009) and many other scholars have successfully used this approach.

Focusing on the Carpathian region of Ukraine (which consists of the four Ukrainian regions (oblasts) of Zakarpattya, Lviv, Ivano-Frankivsk and Chernivtsi) allows the relevance and practical importance of research results to be strengthened, which supports the development of comprehensive migration policies in both the European Union and Ukraine. Lately, Europe has faced intensified labour migration from east to west – specifically, from

Poland, the Czech Republic, Slovakia and Hungary to Germany, Great Britain, etc. (Hear, Bakewell & Long, 2017; Ryan, 2018; Pitkänen et al., 2019), which simultaneously enhances the demand for quality labour from Ukraine. At the same time, the worsening social and economic situation, the slowing of economic growth, reductions in output, falling employment, declining incomes and the shrinking middle class have become important push factors forcing population emigration and stimulating various forms of external labour migration from Ukraine (Halkiv et al., 2020; Katsarski, 2019; Levytska, 2016). According to Storonyanskiy (2018), the scale of outflows varies from 3.5 to 8.0 million people annually or 20–40% of the total working-age population.

The level of migration activity in the Carpathian region is one of the highest in the country, due to its location and to changes in the vector of labour migration towards the European Union (according to Skeldon, 2008; Valentine, 2008; Sadova et al., 2011; Kravtsiv, 2013; Mulska et al., 2019). In the border oblasts of Ukraine, population outflows to abroad (for the purpose of employment) have become a widespread phenomenon. Most involve seasonal, circular labour movements, a recently growing business migration, and temporary migration that often becomes permanent.

External migration processes in the Carpathian region are becoming more threatening, leading to significant problems, including the loss of human potential, a negative impact of migration on the family, depopulation of rural areas and small towns, labour shortages and labour market imbalances.

The western region of Ukraine accounts for about 70% of external labour emigrants in total Ukrainian emigration, with most of them coming from the four oblasts of the Carpathian region (Sadova et al., 2020). The Republic of Poland is currently the main destination of these migration flows. Thus, to support convergence in development of the Carpathian region's oblasts in Ukraine and voivodships in Poland, it is particularly relevant to develop and practically test the method for empirically analysing migration's impact on regional socio-economic development (on the example of the Carpathian region in Ukraine) with further modelling and calculation of structural changes in external migration flows.

The potential of the proposed methodological approach is not limited to the migration system of the regions of Ukraine and Poland but also provides an opportunity to model the impact of migration processes on the territorial social and economic balances in European countries in general. Moreover, the analysis of the relationship between migration and social and economic development is crucial for elaborating an efficient regional and local migration policy. The policy is considered in terms of: the highly developed vs. less-developed regions (Kanbur & Venables, 2007; Ruiz-Tagle, 2013; Enflo & Henning, 2016); urban agglomerations vs. rural areas (Labriani & Sykas, 2009; Rye, 2017; Woods, 2016; Aure et al., 2018; Kuropka & Krupowicz, 2021); professions in high demand evolving along with economic growth (Lewis, 1954; Ryan & Mulholland, 2015; Boschma et al., 2014; Vasylytsiv & Hrynkevych, 2015); and migration of individuals vs. migration of business and business networks (Vasylytsiv, 2015; Ilyash et al. 2021).

The *aim* of the research is to model and visualize the impact of population migration on the social and economic development of the Carpathian region of Ukraine. To fulfil the goal, an optimal value and critical range of external migration for the region are to be determined based on a reasonable level of divergence in social and economic development of the Carpathian region and border territories (on the example of Poland).

Thus, the research *hypothesis* is that there are strong, discrete relationships (both positive and negative) between the parameters of migration and socio-economic development in the Carpathian region that vary depending on the specificity of migration, the level and dynamics of the core social and economic indicators of the region and that are subject to state regulation. Such relationships influence the convergence between the regions with different levels of social and economic development and the creation of a common migration system (for example, based on the western regions of Ukraine and the eastern regions of the EU).

2. Methodology

The statistical basis for calculating the level of external population migration in the region is the data from

territorial departments of the Western Regional Directorate of the State Border Guard Service of Ukraine on the number of departures of Ukrainian citizens abroad (through the crossing points in each oblast of the region). The empirical indicator of the intensity of departures from the region is calculated as a ratio of the number of citizens in the region going abroad to the total population in the region. Given that external movements through the region are made not only by residents of the region, but also by representatives of other regions of Ukraine (transit migrants), to construct an empirical indicator of external migration intensity (formula 1), it is proposed to use the approach of weighting the coefficients of intensity of departures from the region and transit migration (formula 2). The correction coefficient (transit migration) will eliminate the error in calculating the intensity of external population migration (departures) from the region, which experiences transit migration.

$$MIGR_t^{reg} = \frac{DEP_t^{reg}}{NP_t^{reg}} \times k_t^{reg}, \quad (1)$$

$$k_t^{reg} = \frac{DEP_t^{UA} - DEP_t^{reg}}{NP_t^{UA} - NP_t^{reg}}, \quad (2)$$

$MIGR_t^{reg}$ – the level of intensity of external population migration (departures) from the region in the t^{th} time interval; DEP_t^{reg} – population of the region who left abroad in the t^{th} time interval; NP_t^{reg} – total population in the region in the t^{th} time interval; k_t^{reg} – correction coefficient of transit migration in the t^{th} time interval; DEP_t^{UA} – population of Ukraine who left abroad in the t^{th} time interval; NP_t^{UA} – total population in Ukraine in the t^{th} time interval.

The method of an integral assessment of the level of social and economic development of the Carpathian region (by constructing integral coefficients for Lviv, Ivano-Frankivsk, Zakarpattya and Chernivtsi oblasts) involves the use of a multiplicative approach based on principal component analysis decomposing the data to project it onto a lower dimensional space. The information and analytical support for assessing the social and economic development of the region and the selection of indicators were provided on the principles of validity, universality and comparability.

The authors' methodology allows to standardize indicators of social and economic development of the regions, to identify the structure of relationships between partial indicators and groups of indicators, and to calculate the significance of each indicator within the group and the weight coefficients of groups of indicators. The calculation of integral coefficients of the social and economic development consists of the following stages:

1. *Standardization of indicator–stimulators according to equation (3) and indicator–de-stimulators according to equation (4):*

$$z_{ij}^s = x_{ij} / x_{maxj} \quad (3)$$

$$z_{ij}^d = x_{minj} / x_{ij}, \quad (4)$$

Where z_{ij}^s is normalized values of the i^{th} stimulator in the j^{th} time interval ($i = \overline{1, n}; j = \overline{1, m}$); z_{ij}^d is normalized values of the i^{th} de-stimulator in the j^{th} time interval ($i = \overline{1, n}; j = \overline{1, m}$); x_{ij} is initial indicator values ($i = \overline{1, n}; j = \overline{1, m}$); and x_{maxj} , x_{minj} are maximum and minimum values of the i^{th} indicator in the j^{th} time interval ($i = \overline{1, n}; j = \overline{1, m}$).

2. *Determination of indicator weights within the v -group based on principal component assessment by equation (5):*

$$w_{iv} = |F_{iv}| / \sum_i^n |F_{in}| \quad (5)$$

where w_{iv} is the weight of the i^{th} indicator in v -group; F_{iv} is the value of the principal component of the i^{th} indicator in v -group; n is the number of indicators in the v -group.

3. *Calculation of weight coefficients of indicators within each group (eq. 6):*

$$y_{ijv} = z_{ij}^{w_i} \quad (6)$$

where y_{ijv} is a partial weight coefficient of the i^{th} indicator in the j^{th} time interval of the v -group; z_{ij} is normalized values of the i^{th} indicator in the j^{th} time interval.

4. *Construction of integral coefficients of social and economic development (eq. 7):*

$$Y_j^{SED} = \prod_j^v \widetilde{K}_{vj} \quad (7)$$

where Y_j^{SED} is an integral coefficient of social and economic development in the j^{th} time interval; and \widetilde{K}_{vj} is the weight coefficient of the v -group in the j^{th}

time interval calculated based on a multiplicative approach with the determination of the weights of the group of indicators (w^i).

The impact of population migration on the social and economic development of the Carpathian region is described in Table 3 by the following functions: for Lviv region by Dose Response Multistage-3 Model (eq. 8), Ivano-Frankivsk by Saturation Growth Rate Model (eq. 9), Chernivtsi by Sinusoidal Model (eq. 10) and for Zakarpattya region by Sigmoidal Model (eq. 11):

$$Y_j^{SED} = 1 - e^{-\beta_1 X_j - \beta_2 X_j^2 - \beta_3 X_j^3} \quad (8)$$

$$Y_j^{SED} = \frac{aX_j}{b+X_j} \quad (9)$$

$$Y_j^{SED} = a + b \cos(cX_j + d) \quad (10)$$

$$Y_j^{SED} = \frac{ab+cX_j^d}{b+X_j^d} \quad (11)$$

where X_j is the level of intensity of external population migration in the region in the j^{th} time interval calculated as a ratio of the number of Ukrainians who left the region abroad and total population in the region adjusted by the coefficient of transit migration in the j^{th} time interval (transit migration was previously estimated by Vasylytsiv et al. 2021).

3. Results

3.1. Integral assessment of social and economic development of the Carpathian region

To assess the level of social and economic development of the Carpathian region, the 13 selected indicators were divided into two groups: (a) social development and (b) economic development. Unemployment rate of population aged 15–70, consumer price index and share of total household expenditures on food were defined as de-stimulators of social and economic development of the Carpathian region, whereas the rest of the indicators were recognized as stimulators.

In the social development group, the highest weights are assigned to the following indicators (Table 1): average monthly nominal wage (21.11%),

unemployment rate of population aged 15–70 (19.23%) for Lviv and Chernivtsi oblasts (18.95% and 18.39%, respectively), consumer price index for Lviv (19.62%) and Zakarpattya oblasts (19.58%). For Ivano-Frankivsk oblast, the most relevant are: average monthly nominal wage (22.89%), disposable income (21.73%), share of total household expenditures on food (19.10%). For Zakarpattya region, level of economic activity of the population aged 15–70 (18.01%) and average monthly nominal wage (16.63%) are significant; for Chernivtsi region, the indicators of disposable income (17.89%) and level of economic activity of the population aged 15–70 (17.86%) are of great importance.

In terms of economic development of the Zakarpattya, Ivano-Frankivsk and Chernivtsi regions, the significant indicators are capital investment (11.68%, 21.66% and 20.80%) and gross value added (12.77%, 17.04% and 16.16%, respectively). In Lviv oblast, the weight coefficient of capital investment is 2.18%, which is the lowest value among the oblasts of the Carpathian region. Thus, the region is characterized by the highest value of the indicator of foreign economic activity (20.78%), with 1.02% in Ivano-Frankivsk region, where the retail trade turnover of retail trade enterprises (21.65%) is the most important indicator. In Chernivtsi and Ivano-Frankivsk oblasts, the indicator of labour productivity has the smallest impact on economic development (2.98%, 0.41%, respectively).

The obtained results of group coefficients of social (Fig. 1) and economic development (Fig. 2) of the Carpathian region for 2008–2018 allowed the peak stages of social and economic development of the Carpathian region to be determined.

Thus, for Ivano-Frankivsk, Zakarpattya and Chernivtsi oblasts, levels of social development were highest in 2008 (0.852, 0.875 and 0.855, respectively), 2013 (0.992, 0.957 and 0.992) and 2018 (0.869, 0.805 and 0.890). The dynamics of social development level in Lviv region differ from other oblasts. There was a significant increase in 2017, when the coefficient (0.899) was highest in the studied period. In 2015–2016, the levels of social development of Ivano-Frankivsk, Chernivtsi and Zakarpattya regions decreased by approximately 33.5%, reaching the level of social development of Lviv region by 2008.

Table 1. Weights of indicators of social and economic development of the Carpathian region

Indicators	Weights, %			
	Lviv	Ivano-Frankivsk	Zakarpattya	Chernivtsi
<i>(a) social development</i>				
Unemployment rate of population aged 15–70	19.23	18.22	17.13	18.39
Level of economic activity of population aged 15–70	15.30	0.18	18.01	17.86
Average monthly nominal wage	21.11	22.89	16.63	18.95
Disposable income of population	14.34	21.73	25.90	17.89
Consumer price index	19.62	17.88	19.58	17.30
Share of total household expenditures on food	10.40	19.10	2.75	9.60
<i>(b) economic development</i>				
Foreign direct investment	15.89	21.32	15.77	14.25
Capital investment	2.18	21.66	11.68	20.80
Gross value added	18.08	17.04	12.77	16.16
Number of small enterprises	17.45	16.90	15.42	12.04
Retail turnover of retail trade enterprises	13.70	21.65	13.52	19.05
Volumes of foreign economic activity	20.78	1.02	15.87	14.73
Ratio of GRP to wage fund of full-time employees	11.92	0.41	14.97	2.98

Note: Calculations were conducted in Statistica 7.

Source: Based on data from the State Statistics Service of Ukraine using equation (3)

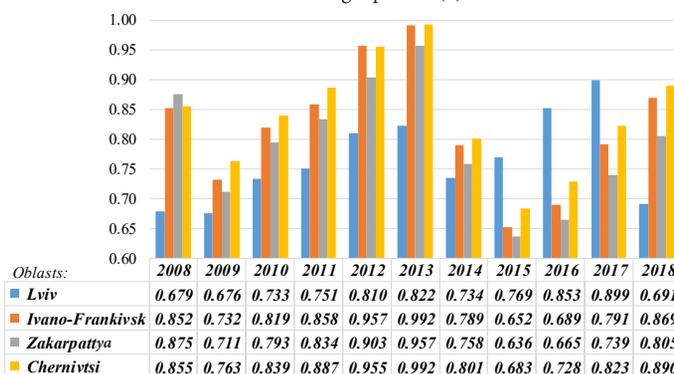


Fig. 1. Social development of the Carpathian region: integral coefficients, 2008–2018

Source: own calculations

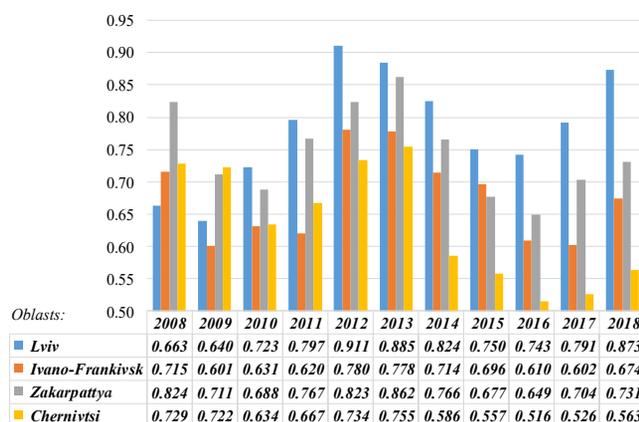


Fig. 2. Economic development of the Carpathian region: integral coefficients, 2008–2018

Source: own calculations

In terms of economic growth, Lviv oblast leads the other four oblasts. During 2008–2018, its economy grew by 31.7%, in contrast to Chernivtsi oblasts' 22.6% decrease. Meanwhile, in 2008–2009, the level of economic development of Zakarpattya oblast was the highest in the Carpathian region (0.824 and 0.711).

The levels of social and economic development in the oblasts of the Carpathian region are calculated as integral coefficients (Table 2) based on a multiplicative approach. The values of the integral coefficient range from 0 to 1. An increase in the coefficient indicates an improvement in the social and economic situation in the region, which is a factor deterring the population from labour emigration.

In 2008, the highest level of social and economic development was in Zakarpattya region (0.849), and the lowest one was in Lviv region (0.671). In 2012–2013, there was a peak period of social and economic development in the four oblasts of the Carpathian region. The beginning of the military

conflict in the east of Ukraine and the annexation of the Autonomous Republic of Crimea in 2014 had a negative impact on social and economic development in the region, which has led to an increase in labour migration. There is a significant decrease in the values of the integral coefficient of social and economic development in 2015–2017, especially in Ivano-Frankivsk and Chernivtsi oblasts. However, the level of social and economic development in Lviv region in 2017 increased to 0.843, which is 18.6% more than in 2009. Zakarpattya region had a rapid growth in the integral coefficient of social and economic development, which in 2018 was equal to the value of the coefficient in 2014.

The Carpathian region is characterized by diversity and instability of the social and economic situation. Significant gaps in the levels of the territories' development cause their social and economic disintegration. The problem is particularly critical for border areas, which are the labour donor regions for EU countries. Reducing regional disparities in the social and economic development

Table 2. Integral coefficients of social and economic development of the Carpathian region, 2008–2018

Oblasts	Years											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018/2008
Lviv	0.671	0.658	0.728	0.773	0.859	0.853	0.778	0.759	0.796	0.843	0.777	0.106
Ivano-Frankivsk	0.781	0.663	0.719	0.729	0.864	0.878	0.751	0.673	0.648	0.690	0.766	-0.015
Zakarpattya	0.849	0.711	0.739	0.800	0.862	0.908	0.762	0.656	0.657	0.721	0.767	-0.082
Chernivtsi	0.789	0.742	0.729	0.769	0.837	0.865	0.685	0.617	0.613	0.658	0.708	-0.081

Source: Own calculations

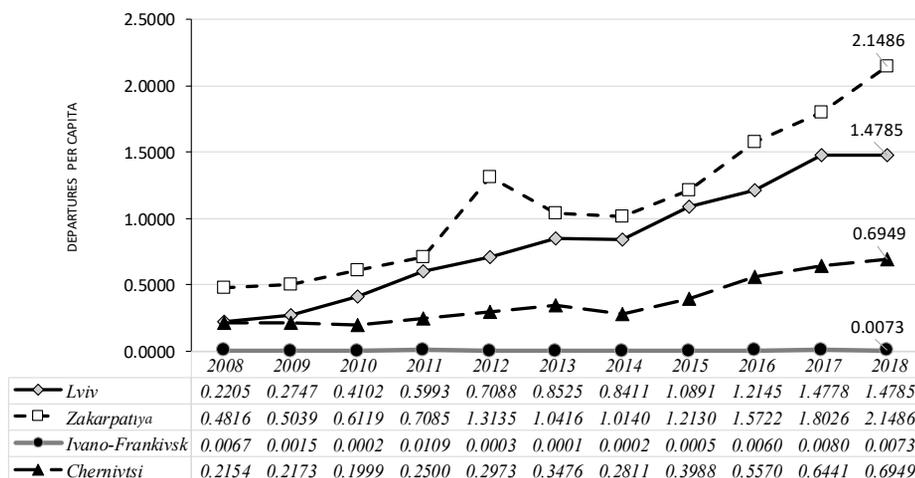


Fig. 3. The level of intensity of external population migration from the Carpathian region of Ukraine, 2008–2018

Source: Based on the data from the Western Regional Directorate of the State Border Guard Service of Ukraine (West Guard, 2018)

of the Carpathian region will contribute to intra-regional stability and prevent excessive external migration.

3.2. Modelling the impact of migration intensity on social and economic development of the Carpathian region

To identify the social and economic consequences of population migration and to confirm the hypothesis of its impact on social and economic development, the level of intensity of external migration was modelled for each oblast of the Carpathian region. Among different mathematical models, only those with the highest estimates of reliability and the lowest error were selected (eq. 6–9).

Given that external movements through the Carpathian region involve residents of that region but also other regions of Ukraine (transit migrants), the share of transit migrants through the Carpathian region was considered when calculating level of external migration (Fig. 3).

External population migration during the studied period was most intense in Zakarpattya (Fig. 3). During 2008–2018, the indicator in this region increased from 0.4816 to 2.1486. The lowest migration activity (expressed in departures of the local population abroad) was in Ivano-Frankivsk region. It is the only border region of Ukraine to have no international automobile or railway border-crossing points, despite having a 49-km border with Romania. This is mainly because Ivano-Frankivsk region is a mountainous area with problematic transport infrastructure. The intensity of external migration in the region (via pedestrian crossings) ranged from 0.0001 to 0.0109 during the analysed period.

The results of modelling the impact of intensity of external population migration on the social and economic development of the Carpathian region are presented in Table 3.

In Lviv region, the level of social and economic development decreased in the range 0.723–1.264, which can be considered critical concerning the level of intensity of external migration. The region is characterized by an increase in migration activity with growing levels of social and economic development. In this range, the unemployment and

involuntary partial employment rates significantly declined, wage arrears decreased, level of provision of population with durable goods increased, mobility of population (especially young people) intensified, and the tourism sector rapidly developed. However, with low values of the integral coefficient of social and economic development in Lviv region, there is an increase in intensity of external migration (including labour migration) against reducing quality of life in the region.

Ivano-Frankivsk region, according to mathematical modelling, is characterized by a gradual growth in social and economic development with a minimum emigration rate. This confirms the point about a labour-deficient region not being able to achieve a high level of development without sufficient labour supply. The critical level of the intensity of external migration of the region's population is estimated between 0.006 and 0.008, at which the lowest value of the level of social and economic development of the region is observed (0.653). Compared to Lviv region, where the model of the impact of migration on the social and economic parameters is described by a wave function, the model of the impact in Ivano-Frankivsk region is specific, being a straight line with a minimum angle. This is possibly due to too few border crossings by the local population, since the region has no automobile or railway border-crossings.

The decrease in the level of social and economic development of Chernivtsi region is observed at the level of intensity of external population migration of 0.286. The model of migration impact on the region is described by a sinusoidal function, which indicates the cyclical nature of the relationship between the intensity of external migration and social and economic development of the region. At low values of migration intensity, there is an increase in the level of social and economic development, and vice versa. However, it is worth emphasizing the critical volumes of migration, which bring destructive changes in the region's economy. The critical range of the intensity of external migration of the population in Chernivtsi region is 0.499–0.578, when the level of social and economic development of the region was 0.611, being the lowest value of the coefficient in 2008–2018.

Table 3. Modelling impact of intensity of external population migration (X_j) on social and economic development (Y_j^{SED}) of the Carpathian region

oblasts	Mathematical models / significance coefficients		
IVANO-FRANKIVSK oblast	$Y_j^{SED} = \frac{0.707X_j}{-0.00002 + X_j}$		
	Standard regression error		
	0.066		
	Standard errors of coefficients:	a	0.025
		b	0.000
	Correlation coefficient		
	0.584		
	Coefficient of determination		
	0.341		
Akaike Information Criterion			
-59.692			
Confidence level			
0.95			
Degrees of freedom (df)			
9			
ZAKARPATTYA oblast	$Y_j^{SED} = \frac{0.757 * (-0.287) + 0.776X_j^{-3.140}}{-0.287 + X_j^{-3.140}}$		
	Standard regression error		
	0.084		
	Standard errors of coefficients:	a	0.100
		b	2.721
		c	0.053
		d	23.875
	Correlation coefficient		
	0.511		
Coefficient of determination			
0.262			
Akaike Information Criterion			
-49.959			
Confidence level			
0.95			
Degrees of freedom (df)			
7			
LVIV oblast	$Y_j^{SED} = 1 - e^{-5.742X_j + 6.308X_j^2 - 2.154X_j^3}$		
	Standard regression error		
	0.041		
	Standard errors of coefficients:	β_1	0.488
		β_2	1.028
		β_3	0.507
	Correlation coefficient		
	0.837		
	Coefficient of determination		
0.701			
Akaike Information Criterion			
-68.229			
Confidence level			
0.95			
Degrees of freedom (df)			
8			
CHERNIVTSI oblast	$Y_j^{SED} = 0.687 + 0.098\cos(12.335X_j - 3.512)$		
	Standard regression error		
	0.070		
	Standard errors of coefficients:	a	0.029
		b	0.040
		c	1.696
		d	0.764
	Correlation coefficient		
	0.711		
Coefficient of determination			
0.506			
Akaike Information Criterion			
-54.083			
Confidence level			
0.95			
Degrees of freedom (df)			
8			

Note: construction of models and calculation of significance coefficients were performed in the CurveExpert Professional 2.6.3 software.

Source: Own calculations

The model of migration impact on the social and economic development in Zakarpattia region differs from the models of the other three regions and is described by the sigmoidal function. The critical range of the intensity of external migration of the region's population is 0.479–0.769, at which the level of social and economic development of the region is equal to the minimum value (0.777). The constructed mathematical model for the region confirms the hypothesis that, with increasing levels of external migration, the region's economy will suffer significant losses, the level of social and economic development will be minimal, and the migration capital will be spent mainly on consumption or household needs rather than on starting businesses and investing. Money transfers are important for the well-being of households, but their investment use is insignificant. Even with the increase in the level of external migration intensity and the simultaneous increase in remittances, the model does not show the intensive development of Zakarpattia region.

The modelled impact of the level of external population migration intensity on the social and economic development of four oblasts of the Carpathian region of Ukraine is visualized in Fig. 4.

To identify the optimal level of intensity of external migration under improving social and economic development, it is simulated that the level of social and economic development of the Carpathian region goes to the level of social and economic development of Poland in 2018 (as a country with the largest volumes of labour migrants from Ukraine). Using a multiplicative approach to calculating the integral coefficients of social and economic development of Lviv, Ivano-Frankivsk, Chernivtsi and Zakarpattia regions, the integral coefficient for Poland in 2008–2018 was constructed. To ensure the validity and comparability of the obtained results, as well as their reproducibility in time, all indicator–stimulators and de-stimulators for the Carpathian region and Poland were harmonized. To avoid double effects, the indicators were checked for the absence of multicollinear relation and autocorrelation. The level of social and economic development of Poland in 2008–2018 is presented in Fig. 5.

Modelling the situation in which the levels of social and economic development of the oblasts of

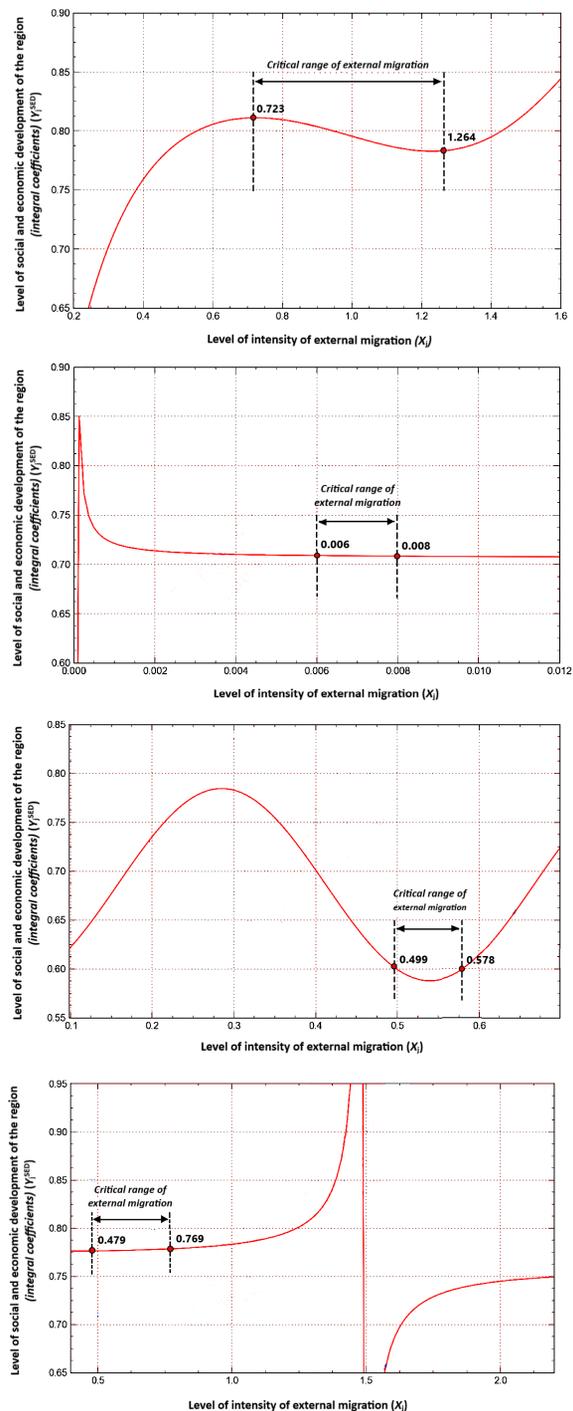


Fig. 4. Visualization of the impact of external population migration on social and economic development of the Carpathian region

Source: models were constructed in CurveExpert Professional 2.6.3 software.

the Carpathian region are equal to 0.98715, which is an integral coefficient of social and economic development of Poland in 2018, allowed us to

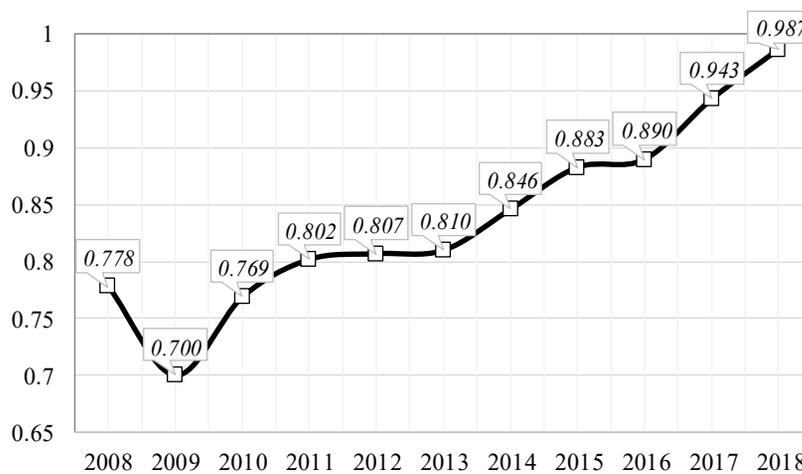


Fig. 5. Integral coefficients of social and economic development of Poland, 2008–2018

Source: own Calculations

identify the optimal level of external population migration in the Carpathian region:

- for Lviv region, it is 0.850, which is 42% less than the level of intensity of external migration of the region's population in 2018;
- for Chernivtsi region, it is 0.653, which is 6.05% less than the level of intensity of external migration of the region's population in 2018;
- for Zakarpattia region, it is 1.488, which is 44.4% less than the level of intensity of external migration of the region's population in 2018.

When modelling the level of intensity of external migration in Ivano-Frankivsk region, the results have a large statistical error. The reasons for this are, firstly, the very low number of border crossings by the local population according to the statistics of the State Border Guard Service of Ukraine, and, secondly, the lack of information on border crossings by the population of this region through other regions.

It has also been found that, when the coefficient of external migration (departures from the region) of the population increases by 1%, the level of social and economic development decreases by 0.06% in Lviv region, by 1.099% in Chernivtsi region and by 0.471% in Ivano-Frankivsk region, while it increases by 0.29% in Zakarpattia region. This data indicates a high dependence of social and economic development of oblasts of the Carpathian

region of Ukraine on the level of intensity of external migration, which mainly consists of labour emigration. The smallest impact of this dependence is observed in Lviv region, which demonstrates both a high level of social and economic development and high intensity of population migration.

4. Discussion and conclusion

External migration of the population is, on the one hand, the result of globalization and social and economic policy of Ukraine, and on the other, it is a socio-economic phenomenon affecting all spheres of public life. The level of regional social and economic development is a significant factor in migration processes in the Carpathian region, but population migration itself is an important factor influencing the social and economic development of oblasts, especially the level of formal employment, disposable income, capital investment and gross value added.

The volume of external labour migration from the Carpathian region of Ukraine is significant and has a growing trend. In 2016–2019, the biggest part of the local population left the Carpathian region for Hungary, Poland and the Czech Republic, as well as Western European countries such as Germany, Italy and Spain. The results of structural analysis confirmed the close migration relations between the oblasts of the region with neighbouring countries,

particularly Zakarpattya region with Hungary, the Lviv and Ivano-Frankivsk regions with Poland, and Chernivtsi region with Moldova.

The actual number of migrants from the Carpathian region of Ukraine significantly exceeds the official statistics. According to some European countries, every year, Ukrainians receive the right to work and/or permanent residence in their territory in numbers tens of times greater than domestic statistics show. The key recipient countries of labour from the region are Poland, Italy and the Czech Republic. The role of migration attractiveness of European countries is growing every year, especially in the case of Poland, which is actively attracting Ukrainian workers to the domestic labour market. The location of the region and the simplified border crossing procedures explain the intensity and short-term (1–3 months) working trips to neighbouring countries. The local population prefers employment in the construction sector and seasonal work in agriculture.

During the study, the hypothesis set was confirmed. The obtained results allowed us to calculate the optimal levels of external migration in the Carpathian region at which there is reason to expect migration to contribute to the parameters and rates of social and economic development of the Carpathian region converging with the averages for Poland.

Based on the modelling, provided that the social and economic development of the Carpathian region corresponds to the level of the integral coefficient for Poland in 2018 (calculated using a multiplicative approach), the acceptable level of external migration is 0.850 for Lviv region (while the actual value was 1.479 in 2018), 0.653 (0.695) for Chernivtsi region, and 1.488 (2.149) for Zakarpattya region. The critical range of intensity of external migration was estimated in the range of 0.723–1.264 for Lviv region, 0.499–0.578 for Chernivtsi region, 0.006–0.008 for Ivano-Frankivsk region and 0.479–0.769 for Zakarpattya region. The high migration activity of the population of the Carpathian region presents a few risks, which may transform into threats. The most relevant ones are: management risks of unregulation and asymmetry of the cross-border space between the Carpathian region and neighbouring EU countries; intellectual and educational risks of migration intellectualization

and rapid growth of educational emigration; institutional risks of dual citizenship of the border population; and competitive risks of significant social and economic gaps between the Carpathian region and the EU. In addition, the network risks are important that arise from the stability of migration networks between certain regions and even settlements, which encourages more people to migrate. As a result, there are systemic threats concerning the formation of powerful migration systems, which makes it complicated to reduce the level of migration activity, since it requires much greater time, financial investment and resources.

To eliminate problems caused by migration, minimize risks and threats and increase the effectiveness of regional migration policy, a few tools and initiatives need to be implemented. They are: the development of a regional migration policy programming system; the improvement of the organizational system for regulating migration processes; the introduction of monitoring and information and analytical support of migration management; the intensification of activities related to the preparation and implementation of joint educational, research and business projects; the stimulation of economic activity of the population in the Carpathian region of Ukraine; and the improvement of the institutional infrastructure for regulating migration processes.

Note

The research was conducted within the framework of Applied Research “Mechanisms of the proactive policy for reducing social vulnerability of the population (based on the Carpathian region of Ukraine)” (M. Dolishniy Institute of Regional Research of National Academy of Sciences of Ukraine, Reg. No. 0121U112014, period: 2021–2023).

References

- Arango, J. (2000). Explaining migration: a critical view. *International Social Science Journal*, 52(165): 283-296.
- Arthur, P.L., Ensor, J., van Faassen, M., Hoekstra, R. & Peters, N. (2018). Migrating People, Migrating Data: Digital Approaches to Migrant Heritage. *Journal of the*

- Japanese Association for Digital Humanities*, 3(1): 98-113. DOI: https://doi.org/10.17928/jjadh.3.1_98.
- Aure, M., Forde, A. & Magnussen, T.** (2018). Will migrant workers rescue rural regions? Challenges of creating stability through mobility. *Journal of Rural Studies*, 60: 52-59.
- Becker, S.O. & Ferrara, A.** (2019). Consequences of forced migration: A survey of recent findings. *Labour Economics*, 59: 1-16. DOI: <https://doi.org/10.1016/j.labeco.2019.02.007>.
- Boschma, R., Eriksson, R.H. & Lindgren, U.** (2014). Labour market externalities and regional growth in Sweden: The importance of labour mobility between skill-related industries. *Regional Studies*, 48(10): 1669-1690.
- Carletto, C., Davis, B., Stampini, M. & Zezza, A.** (2006). A country on the move: international migration in post-communist Albania. *International Migration Review*, 40(4): 767-785.
- Enflo, K. & Henning, M.** (2016). The development of economic growth and inequality among the Swedish regions 1860-2010: Evidence from regional national accounts. In: Ljungberg, J. (ed.) *Structural Analysis and the Process of Economic Development. Essays in Memory of Lennart Schön*. London: Routledge, 126-148.
- Erdal, M.B. & Lewicki, A.** (2016). Polish migration within Europe: mobility, transnationalism and integration. *Social Identities*, 1(22): 1-9.
- Fischer, L.B. & Pfaffermayr, M.** (2018). The more the merrier? Migration and convergence among European regions. *Regional Science and Urban Economics*, 72: 103-114. DOI: <https://doi.org/10.1016/j.regsciurbeco.2017.04.007>.
- Gómez, M.G. & Giráldez, M.S.O.** (2017). The causality between economic growth and immigration in EU/EFTA member states. Documentos de trabajo do Departamento de Economía Aplicada (No. 1701). Available at: <http://webx06.webs4.uvigo.es/wp-content/uploads/2019/05/wp1701.pdf> (Accessed 20 November 2020).
- Halkiv, L., Karyy, O., Kulyniak, I. & Ohinok, S.** (2020). Modeling and Forecasting of Innovative, Scientific and Technical Activity Indicators under Unstable Economic Situation in the Country: Case of Ukraine. In: *International Conference on Data Stream Mining and Processing*, 79-97, Springer, Cham. DOI: https://doi.org/10.1007/978-3-030-61656-4_5.
- Hear, N.V., Bakewell, O. & Long, K.** (2017). Push-pull plus: reconsidering the drivers of migration. *Journal of Ethnic and Migration Studies*, 44(1): 1-18. DOI: <https://doi.org/10.1080/1369183X.2017.1384135>.
- Ilyash, O., Vasylytsiv, T., Lupak, R. & Get'manskiy, V.** (2021). Models of efficiency of functioning in trading enterprises under conditions of economic growth. *Bulletin of Geography. Socio-economic Series*, 51(51): 7-24. DOI: <http://doi.org/10.2478/bog-2021-0001>.
- Kanbur, R. & Venables, A.** (2007). Spatial Disparities and Economic Development, In D. Heldand, A. Kaya (eds.) *Global Inequality*. London: Polity Press.
- Katsarski, N.** (2019). Factors determining migration of the population. *International Journal of Knowledge Management*, 30(6): 1729-1733.
- Keijzer, N., Héraud, J. & Frankenhaeuser, M.** (2016). Theory and practice? A comparative analysis of migration and development policies in eleven European countries and the European Commission. *International Migration*, 54(2): 69-81. DOI: <https://doi.org/10.1111/imig.12191>.
- Kravtsiv, V.S.** (2013). The Carpathian region: problems and prospects of development: in 8 vols. Lviv: NAS of Ukraine. Institute of Regional Research. (In Ukrainian). Available at: <http://ird.gov.ua/irdp/p20130001.pdf> (Accessed 15 November 2020).
- Kuropka, I. & Krupowicz J.** (2021). Spatial convergence of mortality in Poland. *Bulletin of Geography. Socio-economic Series*, 54(54): 7-20. DOI: <https://doi.org/10.2478/bog-2021-0029>.
- Labriani dis, L. & Sykas, T.** (2009). Migrants, Economic Mobility and Socio-economic Change in Rural Areas: the Case of Greece. *European Urban and Regional Studies*, 16(3): 237-256.
- Levytska, O.O.** (2016). Migration factor for the development asymmetry of border regions of Ukraine and Poland (In Ukrainian). *Regional Economy*, 4: 56-65. Available at: http://re.gov.ua/re201604/re201604_056_LevytskaOO.pdf (Accessed at 01 December 2020).
- Levytska, O., Mulska, O., Ivaniuk, U., Kunytska-Iliash, M., Vasylytsiv, T. & Lupak, R.** (2020). Modelling the Conditions Affecting Population Migration Activity in the Eastern European Region: The Case of Ukraine. *TEM Journal*, 9(2): 507-514. DOI: <https://doi.org/10.18421/TEM92-12>.
- Lewis, A.** (1954). Economic Development with Unlimited Supplies of Labor. *The Manchester School*, 22(2): 139-149.
- Mulska, O.P., Baraniak, I.Ye., Ivaniuk, U.V. & Kolosinska, M.I.** (2019). Social and demographic factors and migration processes of the population in the Carpathian region. *Efficient Economy*, 11. (In Ukrainian). DOI: <https://doi.org/10.32702/2307-2105-2019.11.66>.
- Pitkänen, P., Hayakawa, T., Schmidt, K., Aksakal, M. & Rajan, S.I.** (2019). Temporary Migration, Transformation and

- Development: Evidence from Europe and Asia. London: Routledge. DOI: <https://doi.org/10.4324/9780429244346>.
- Rahman, M.M.** (2013). Estimation of internal migration by the national growth rate method: an alternative approach. *The Bangladesh Development Studies*, 79-87. DOI: <https://doi.org/10.2307/44730021>.
- Ruiz-Tagle, J.** (2013). A theory of socio-spatial integration: Problems, policies, and concepts from a US perspective. *International Journal of Urban and Regional Research*, 37(2): 388-408.
- Ryan, L. & Mulholland, J.** (2015). Embedding in motion: Analysing relational, spatial and temporal dynamics among highly skilled migrants. In: Ryan, L., Erel, U. & D'Angelo, A. (eds) *Migrant Capital: Networks, Identities and Strategies*. Basingstoke: Palgrave Macmillan, 135-154.
- Ryan, L.** (2018). Differentiated embedding: Polish migrants in London negotiating belonging over time. *Journal of Ethnic and Migration Studies*, 44(2): 233-251.
- Rye, J.F.** (2017). Labour migrants and rural change: The "mobility transformation" of Hitra/Frøya, Norway, 2005-2015. *Journal of Rural Studies*, 64: 189-199.
- Sadova, U.Ya. et al.** (2011). Regional migration policy and mechanisms for its implementation. Lviv: Dolishnyi Institute of Regional Research of NAS of Ukraine. (In Ukrainian). Retrieved on 10 December 2020, from: <http://ird.gov.ua/irdp/p20110802f.pdf>
- Sadova, U. Ya. (Ed.)** (2020). Ukrainian labour migration and the future of labour market: social-economic, geographic and institutional dimensions / U. Ya. Sadova (Ed.); Dolishnyi Institute of Regional Research of the National Academy of Sciences of Ukraine. Lviv. Available at: <http://ird.gov.ua/irdp/p20200037.pdf> (Accessed 22 December 2020).
- Skeldon, R.** (2008). International migration as a tool in development policy: a passing phase? *Population and development review*, 34(1): 1-18. DOI: <https://doi.org/10.1111/j.1728-4457.2008.00203.x>.
- Storonyanskiy, I.Z.** (2018). Decentralization in Ukraine and its Impact on the Socio-Economic Development of Territories: Methodological Approaches and Evaluation Results. Scientific Report. Lviv: IRD of NASU. (In Ukrainian).
- Valentine, G.** (2008). Living with difference: Reflections on geographies of encounter. *Progress in Human Geography*, 32(3), 323-337.
- Vasylytsiv, T.** (2015). Directions for improvement of the institutional basis of transaction costs minimization of business entities in Ukraine. *Actual Problems of Economics*, 172(10): 160-168.
- Vasylytsiv, T. & Hrynckevych, S.** (2015). Systemic transformation of national labor potential. *Actual Problems of Economics*, 167(5): 356-364.
- Vasylytsiv, T., Mulska, O., Levytska, O., Kalyta, O., Kohut, M. & Biletska, I.** (2021). External migration and endogenous development nexus: challenges for the sustainable macroeconomic policy. *Studies of Applied Economics*, 39(8). DOI: <https://doi.org/10.25115/eea.v39i8.4770>.
- Vollmer, B. & Malynovska, O.** (2016). Ukrainian migration research before and since 1991. In: *Ukrainian Migration to the European Union*, 17-33. Springer, Cham. DOI: https://doi.org/10.1007/978-3-319-41776-9_2.
- West Guard** (2018). Western Regional Directorate of the State Border Guard Service of Ukraine. Statistical Information. (In Ukrainian). Available at: <https://dpsu.gov.ua/en/structure/western-regional-directorate-of-the-state-border-service-of-ukraine> (Accessed 25 November 2020).
- Williams, A.M.** (2009). International Migration, Uneven Regional Development and Polarization. *European Urban and Regional Studies*, 16(3): 309-322.
- Wills, J., May, J., Datta, K., Evans, Y., Herbert, J. & McIlwaine, C.** (2009). London's Migrant Division of Labour. *European Urban and Regional Studies*, 16(3): 257-271. DOI: <https://doi.org/10.1177/0969776409104692>.
- Woods, M.** (2016). International migration, agency and regional development in rural Europe. *Documents d'Ana`lisi Geogra`fica*, 3(62): 569-593.

