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MODELING THE RELATIONSHIP OF THE MIGRATION PHENOMENON AND THE FACTORS OF SUSTAINABLE DEVELOPMENT

Abstract. *The migration phenomenon is often perceived as a threat to social cohesion, due to the emergence of new groups of people from different backgrounds and cultures, which unbalance the communities in the host countries, exposing their values and culture, which can lead to alter the identity of the community. The economic and social transition has affected the population and demographic phenomena. The aging of the population also has effects on social security systems by putting pressure on public budgets. Immigration can be considered a potential solution to the aging population, but many other issues need to be considered here as well.*

In Romania, the structure of migratory flows can support economic growth through the inflow of financial capital following the transfer of remittances and the increase of domestic consumption, while contributing to reducing economic and social inequalities among the population and reducing the unemployment rate nationwide. Thus, in order to represent the impact of the migration phenomenon in Romania, the connection between the number of migrants and the elements related to the welfare level of the population were analyzed from an econometric point of view.

Keywords*: Migration, Remittances, Sustainable Development, GDP, Econometric Modeling.*

JEL Classification: F22, F24, Q01, E40, C51

DOI: 10.24818/18423264/56.3.22.03

1. Introduction

Researchers approach the field of migration as a phenomenon that is currently encountered and must be viewed and analyzed from a structural point of view, in order to have an overview of it.

A fundamental characteristic of the population is the right to move from one place to another, this being a right implemented and recognized worldwide, since 1948, by adopting the Universal Declaration of Human Rights, after the formation of the United Nations in 1945. One of the main principles of the UN is to promote and encourage "respect for human rights and fundamental freedoms, regardless of race, gender, language or religion."

The World Commission on Environment and Development presents in the Brundtland Report of 1987 the concept of sustainable development as "development aimed at meeting the needs of the present, without making changes in the future of future generations, to meet their own needs" .

Directly linked to the concept of sustainable development is both the concept of “needs” (especially focusing on the subsistence needs of the low-income population) and the technological concept, which is the key element in supporting the field of research and development on the environment, which seeks to ensure the present and the future (Brundtland Report, 1987).

Therefore, this concept is widely encountered and covers all processes and methods of economic and social development that are based mainly on ensuring the balance between the elements of social, economic and ecological nature and environmental issues.

The mobility of people is essentially a serious challenge for states and communities to determine the level of well-being. The reasoning of the migration phenomenon presupposes the existence of divergent premises that have to do both with the free movement of persons and with the protection measures of the states through migration policies, in order to reduce the flows of migrants. There are global uncertainties about migration implications and their impact on state identities, and measures to prevent immigrants from entering foreign markets are causing a labor crisis and stagnation in the economic sector. The European Union wants to introduce uniform migration policies that support the integration of migrants into developed markets through effective welfare mechanisms and thus the integration of immigrants into host societies, without social conflicts between the two existing communities.

Increasing labor flows can lead to high economic progress in the countries of origin, with a high return on other policies involved in the process of globalization. In Romania, the structure of migratory flows can support economic growth through the inflow of financial capital following the transfer of remittances and the increase of domestic consumption, contributes to reducing economic and

social inequalities among the population and reducing the unemployment rate nationwide.

Migration is usually associated with the place of origin and destination, obstacles and characteristics that occur, so the volume of migration differs depending on all these factors. These changes in the volume of migration are also linked to the diversity of regions and populations, but also to economic difficulties and fluctuations. (Enache, 2019).

Although the level of international migration and remittances continues to rise, data on international migration remain uncertain. This topic has been intensely debated in the literature, migration is a phenomenon that requires ongoing study, due to the dynamics of economic developments.

Given the strong impact of the economic crisis of 2007-2008 on all socio-economic phenomena, the following analysis aims to establish a link between the most complex category of migration for Romania, namely emigration and several relevant socio-economic variables , in the period 2008-2020, representing factors influencing them. The analytical approach will follow the dynamics of the number of emigrants, depending on the real GDP per capita, research and development expenditures from GDP and people exposed to the risk of poverty, through an econometric approach.

2. Literature review

The literature knows a lot of research on the link between unemployment and emigration. Such a paper (Kumpikaite and Zickute, 2012) analyzes the phenomenon of migration from the perspective of several theories. Most of these theories support the hypothesis of a direct link between unemployment and emigration. For example, in Slovakia (Barbone, Kahanec et al., 2013) it is shown that "the decision to emigrate was stronger among the unemployed population and underdeveloped regions." Using regression analysis (Kumpikaite and Zickute, 2013), unemployment represents a major factor influencing emigration to other developed countries, in the case of Slovaks, mainly to Lithuania.

For Central and Eastern European countries that joined the European Union in 2004 (Pryymachenko, Fregert and Andersson, 2013), it has been found that "emigration has a strong positive impact on unemployment", so that the unemployment rate will decrease as the unemployment rate increases. emigration, being an inversely proportional relationship between the two economic actions. For the same group of countries (Barrell, Fitzgerald and Riley 2010) it was analyzed and observed the existence of a negative correlation between emigration and GDP per capita and also another positive correlation between emigration and unemployment rate.

Analyzing the 28 countries of the European Union in the period 2000-2010, (Mihi-Ramírez, Rudžionis and Kumpikaite, 2014) shows that emigration will increase during periods of economic recession, while "during periods of growth

and economic development, immigrants they could return to their countries of origin ”and this explains why there is a strong link between unemployment and emigration. Therefore, the higher the unemployment rate, the more intense the desire to emigrate among the population and vice versa. In the case of immigration, research has shown that there is a negative correlation between this variable and the unemployment rate, which shows that when unemployment increases, immigration decreases and vice versa (Begu et all, 2022). Another researcher claims that by the accession of the states to the EU, the aspects related to the emigration process of the people will be made more efficient, by simplifying the transit measures, thus resulting in an increase in job demand, which will lead to a decrease in unemployment. in the host country. "(Zaiceva, 2014)

There have also been studies which have shown that the economic decision is not always based on the migration decision, in some cases being other factors that contribute to the adoption of the emigration decision. In this regard, a study on the migratory flows of Ireland, in the period 2013-2014, shows that only a quarter of the country's migrant population had decisive considerations the loss of employment in the country, the rest of the emigrants leaving the state for other reasons. (MacGuill, 2014)

In a regional analysis for Romania (Moraru and Muntele, 2015,) it was found that in Bacău County, "the emigration of low-skilled workers could result in a so-called relaxation of the local labor market", while the emigration of skilled workers produces negative effects locally and nationally. Following the brain drain, the state is facing significantly higher losses than gains, caused by the lack of specialists in sensitive areas of society, resulting in stagnation of socio-economic development in the medium and long term (Begu et all, 2019).

In the vision of Romanian specialists, the economic factor is the one that underlies the decision of emigration of our compatriots (Vasilescu et all, 2020). The social impact that migration has on the lives of migrant families is far-reaching, producing long-term psycho-emotional effects and other changes in behavior and character in the evolution of children and young people (Roman and Voicu, 2010).

In Romania, the migration phenomenon has helped to alleviate the pressure on the labor market, to reduce unemployment and to reduce the budget deficit, due to the inflows of financial capital, following the remittances sent by Romanian emigrants from the adopted countries. (Ailenei, Badea and Dima, 2015)

3. Data and methodology

For the analysis were established as variables: emigration, dependent variable and socio-economic factors previously presented as independent variables. Data on these variables were collected for Romania in the period 2007-2020, using the Eurostat online database (Table 1).

Table 1. Data on emigrants and variables of influence

Years	Emigrants (people) ($EMIGR_t$)	GDP per capita (€2010)(GDP_t)	R&D expenditure, % in GDP (RD_t)	People at risk of poverty (thousands) ($People_t$)
2007	–	6050	51	9940
2008	302796	6730	55	9115
2009	246626	6410	44	8795
2010	197985	6200	46	8425
2011	195551	6350	50	8265
2012	170186	6500	49	8673
2013	161755	6770	39	8392
2014	172871	7040	38	8043
2015	194718	7290	49	7435
2016	207578	7670	48	7694
2017	242193	8280	50	7040
2018	231661	8700	50	6360
2019	233736	9110	48	6073
2020	–	8780	–	5873

Source: *Eurostat*: Emigrants – table [migr_emi2]
GDP per capita (€2010) – table [nama_10pc]
R&D expenditure, % in GDP – table [rd_e_gerdtot]
People at risk of poverty (thousands) – table [T2020_50]

In order to achieve the purpose of the article, we used the model validity method by testing the stationarity of the variables, which involves the application of several econometric analysis techniques, together with the application of the DF, ADF, KPSS tests, described below.

Stationarity tests, or unit root tests evaluate the probability that $\alpha = 1$ in the regression $y_t = \alpha y_{t-1} + XA + e_t$, where X represents the set of other factors that determine the evolution of the y_t series, A is the vector of the parameters attached to the respective variables, and e_t is an independent and identically distributed random variable. Usually $XA \equiv 0$, $XA = \beta$, or $XA = \beta + \gamma_t$ (Jula and Jula, 2019).

Dickey-Fuller test

The Dickey-Fuller test starts with three types of models:

(1) autoregressive process: $y_t = \alpha y_{t-1} + \varepsilon_t$, $|\alpha| \leq 1$

(2) autoregressive process with non-zero mean: $y_t = \alpha y_{t-1} + \beta + \varepsilon_t$, $|\alpha| \leq 1$ and $\beta \neq 0$

(3) autoregressive process with tendency: $y_t = \alpha y_{t-1} + \beta + \gamma_t + \varepsilon_t$, $|\alpha| \leq 1$ and $\gamma \neq 0$.

In all models, the random variable ε_t is considered to be independent and identically distributed. If we admit that the null hypothesis $H_0 : \alpha = 1$ is true, then, under the null hypothesis, the first model is reduced to a random process ($y_t = y_{t-1} + \varepsilon_t$), the second model is reduced to a process of random drift type ($y_t = y_{t-1} + \beta + \varepsilon_t$, cu $\beta \neq 0$), and the third model is reduced to a trend-type random process ($y_t = y_{t-1} + \beta + \gamma_t + \varepsilon_t$, cu $\gamma \neq 0$).

The Dickey-Fuller test verifies the null hypothesis (H_0), $\phi = 0$ (non-stationary) against the alternative hypothesis, $\phi < 0$ (stationary). We reject the null hypothesis H_0: $\phi = 0$ (the series is non-stationary), against the alternative hypothesis H_1: $\phi < 0$, if $\phi \hat{} t < \tau\phi$, where $\tau\phi$ is one of the critical (negative) values in the Dickey-Fuller distribution table.

The Dickey-Fuller test assumes that ε_t errors are generated by a white noise stochastic process. In reality, the errors can be autocorrelated and / or heteroskedastic.

Augmented Dickey-Fuller test

The ADF test (Augmented Dickey-Fuller, Dickey & Fuller, 1981) is designed to eliminate possible self-correlation of errors by introducing lag variables. As with the simple DF test, three models are considered:

[1] $\Delta y_t = \phi y_{t-1} + \sum = \Delta - \delta\ p\ j\ 1\ j\ yt\ j + \varepsilon_t$

[2] $\Delta y_t = \phi y_{t-1} + \beta + \sum = \Delta - \delta\ p\ j\ 1\ j\ yt\ j + \varepsilon_t$

[3] $\Delta y_t = \phi y_{t-1} + \beta + \gamma_t + \sum = \Delta - \delta\ p\ j\ 1\ j\ yt\ j + \varepsilon_t$

where we admit that the variable ε_t is white noise (zero mean, constant dispersion, uncorrelated with y_{t-i}, whatever j = 1, 2,…, p).

Testing the null hypothesis (existence of the unit root) means, as in the case of the simple DF test, testing $\phi = 0$. Thus, H_0: $\phi = 0$ is tested, against H_0: $\phi < 0$.

KPSS test

The null hypothesis of the KPSS test (Kwiatkowski, Phillips, Schmidt & Shin, 1992) is that the analyzed time series is stationary, around a constant (β), or a linear deterministic trend ($\beta + \gamma_t$). KPSS writes the time series y_t as a sum between a deterministic trend, a random process (r_t) and the error (ε_t), which is assumed to be stationary: $y_t = \gamma_t + r_t + \varepsilon_t$, where $r_t = r_{t-1} + e_t$ and $e_t \sim ZA\ (0, \sigma_e^2)$. If y_t is stationary, then the scatter of the random process is zero, 0, $\sigma_e^2 = 0$ and $r_t = r_{t-1} = \ldots = r_0$. KPSS tests the null hypothesis of stationarity, $\sigma_e^2 = 0$. Under the null hypothesis, y_t is a stationary process around a trend, and if $\gamma = 0$, y_t is stationary around a constant, r_0.

4. Results

Data series are short (13-14 records), so unit root tests are of low relevance. However, for safety, we tested the stationary of the series in the previous table. The results (subject to the small number of records are as follows:

Table 2. Unit root tests for the Emigrants and Gross Domestic Product series

Test		Exogenous	Emigrants		GDP/cap. (€2010)	
			t-stat.	critical value	t-stat.	critical value
ADF	series in level	free	-1.1771	-1.977	2.2702	-1.971
		constant	-2.8811	-3.175 -2.73(10%)	0.1235	-3.145
		trend	–	–	-1.5343	-3.829
	The first difference series	free	–	–	-2.5701	-1.974
	conclusion		I (0) at the 10% threshold		I(1)	
KPSS	series in level	constant	0.1507	0.463	0.5206	0.463 0.739(1%)
	conclusion		I(0)		I (0) at the 1% threshold	

Legend: ADF – "Augmented Dickey-Fuller test"
KPSS – "Kwiatkowski-Phillips-Schmidt-Shin test"
The critical value is for the 5% threshold, where no other bracket threshold is specified.
Source: Calculations in EViews based on the data in Table 1.

Table 3. Unit root tests for series Share of R&D expenditure in GDP and number of people at risk of poverty

Test		Exogenous	Share of R&D expenditures in GDP		Number of people at risk of poverty	
			t-stat.	critical value	t-stat.	critical value
ADF	series in level	free	-0.3771	-1.971	-3.3211	-1.971
		constant	-2.6297	-3.120		
		trend	-2.4808	-3.829		
	series in level	constant	-4.2799	-3.175		
	conclusion		I(1)		I(0)	

Test		Exogenous	Share of R&D expenditures in GDP		Number of people at risk of poverty	
KPSS	series in level	constant	0.1291	0.463	0.5689	0.463 0.739(1%)
	conclusion		I(0)		I (0) at the 1% threshold	

Legend: ADF – "Augmented Dickey-Fuller test"
KPSS – "Kwiatkowski-Phillips-Schmidt-Shin test"
The critical value is for the 5% threshold, where no other bracket threshold is specified.
Source: Calculations in EViews based on the data in Table 1.

Subject to the small number of available data (records), we accept the hypothesis that the series are stationary in level, so that for econometric analysis we used the multifactor linear regression method, resulting in the following equation:

Table 4. Regression equation for emigration

Dependent variable EMIGRt	Coefficient	Std. Error	t-Statistics	Prob.
$EMIGR_{t-1}$	1.161767	0.264330	4.395139	0.0046
GDP_t	118.4875	41.96698	2.823350	0.0302
GDP_{t-1}	-119.5703	48.83551	-2.448430	0.0499
RD_{t-1}	-2515.081	1256.616	-2.001471	0.0922
$PEOPLE_t$	7.751553	4.349881	1.782015	0.1250

Source: Calculations in EViews based on the data in Table 1.

Based on the above output, the following specification results:

$$EMIGR_t = 1.1618 \cdot EMIGR_{t-1} + 118.4875 \cdot GDP_t - 119.5703 \cdot GDP_{t-1} - 2515.081 \cdot RDt\text{-}1 + 7.7516 \cdot PEOPLE_t + u_t$$

The coefficient of determination is $R^2 = 0.9153$, the probability calculated in the Breusch-Godfrey Serial Correlation test for the hypothesis of the lack of autocorrelation of the errors is 0.3655, higher than the standard threshold of 0.05, and the Breusch-Pagan-Godfrey test does not reject the homoscedasticity hypothesis, at the threshold of 0.5319. Also, the errors are normally distributed (Jarque-Bera statistics = 1,033, a value much lower than the threshold of 5,991 in the distribution $\chi 2$ with 2 degrees of freedom). The first three parameters in the model are significantly different from zero at the threshold of 5%, the coefficient of

the variable CD_{t-1}, at 10%, and for the parameter of the variable PEOPLE the risk is 12.5%.

Given the fact that the number of degrees of freedom is low (12 observations - 5 estimated coefficients), for the robustness test we applied the bootstrapping estimate with 10,000 replicates. The estimation results are as follows:

Table 5. Bootstrap estimation for the regression equation

Dependent variable EMIGRt	Coefficient	Std. Error	t-StatisticS	Prob.
$EMIGR_{t-1}$	1.1599	0.1960	5.9178	0.0010
GDP_t	118.1502	30.9099	3.8224	0.0087
GDP_{t-1}	-119.1856	35.9952	-3.3112	0.0162
RD_{t-1}	-2507.3600	921.0306	-2.7223	0.0345
$PEOPLE_t$	7.7170	3.1884	2.4204	0.0518

Source: Calculations in EViews based on the data in Table 1.

The results do not differ much from those obtained by simple multifactorial linear regression. The model parameters are significant at 5%. If we simulate 10,000 replicates by bootstrapping on the residues from the regression equation, the distribution of the coefficients is the one shown in figures 1.

Figure 1. Bootstrapping distribution of parameters in the regression equation

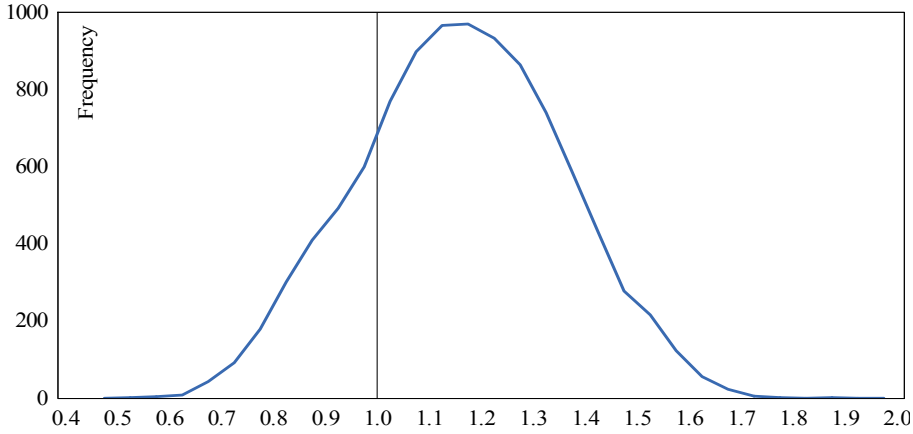

Figure 1a. Variable $EMIGR_{t-1}$

The distribution of the impact coefficient attached to the variable $EMIGR_{t-1}$, (inertial dynamics) is concentrated at superunit values, with a maximum frequency

between 1.13 and 1.17 (with an average of 1.16), which confirms the hypothesis of an explosive evolution of emigration phenomenon in the period 2007 - 2020.

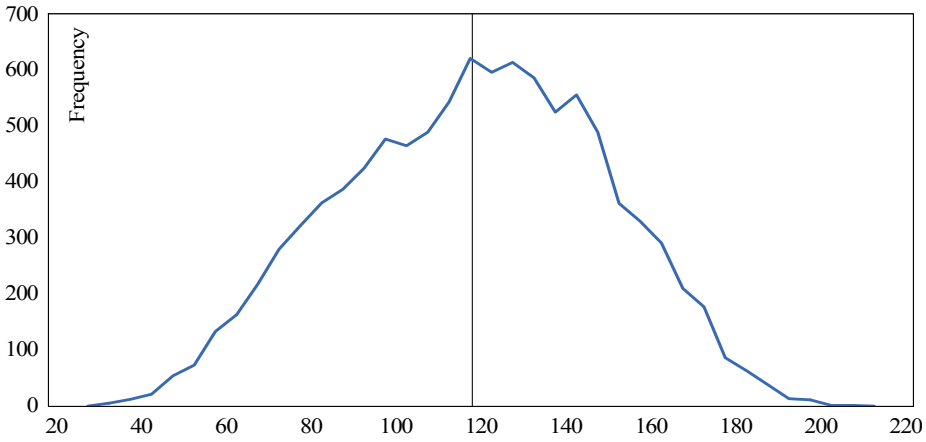

Figure 1b: Variable GDP_t

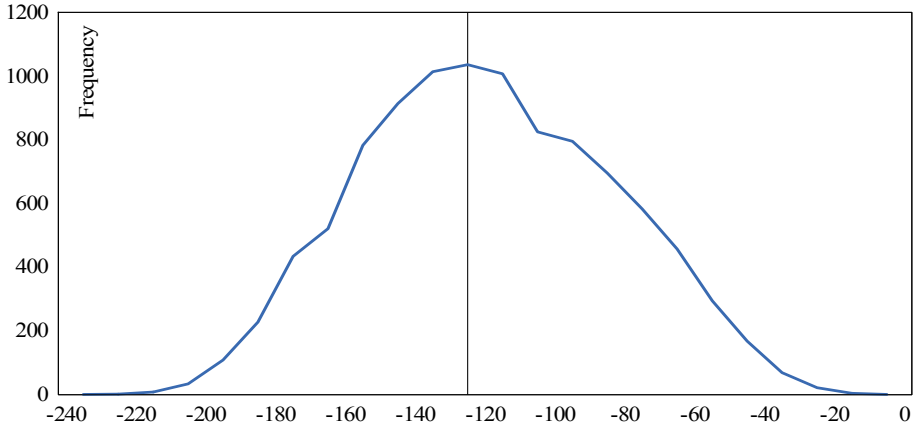

Figure 1c: Variable GDP_{t-1}

The impact of gross domestic product / capita, in real terms, can be explained by the combined analysis of the distribution of coefficients attached to the variables GDP_t and GDP_{t-1}.

The coefficient attached to the variable of GDP in level has the average +118.1594 and appears in the distribution with the highest frequency in the range [118, 128]. The coefficient calculated for the variable PIB_{t-1} has an average value of -119.1856 and is found with the highest frequency in the range [-135, -115] (maximum frequency is -125).

As we have shown, in the equilibrium situation (steady state), the impact of the increase in gross domestic product per capita (in Euro, 2010 prices) on

emigration is negative: the value simulated by bootstrapping is 118.1502 - 119.1856 = - 1.0354, close to the value obtained in initial model, –1.0828.

Almost all the values in the distribution of the coefficient attached to the variable, the share of research and development expenditures in GDP (with a lag of one year) are negative, with a maximum frequency of -2375 and an average value of -2514. This confirms the results obtained in the initial model: the increase of the share of research and development expenditures in GDP attenuates the phenomenon of emigration.

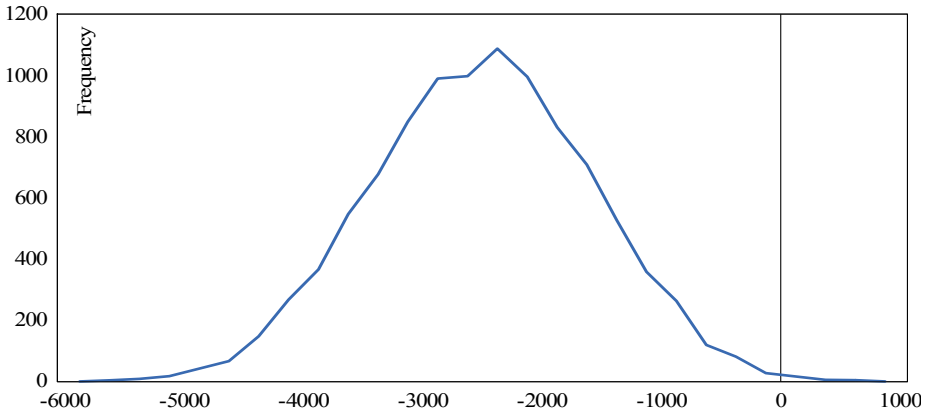

Figure 1d: Variable RD_{t-1}

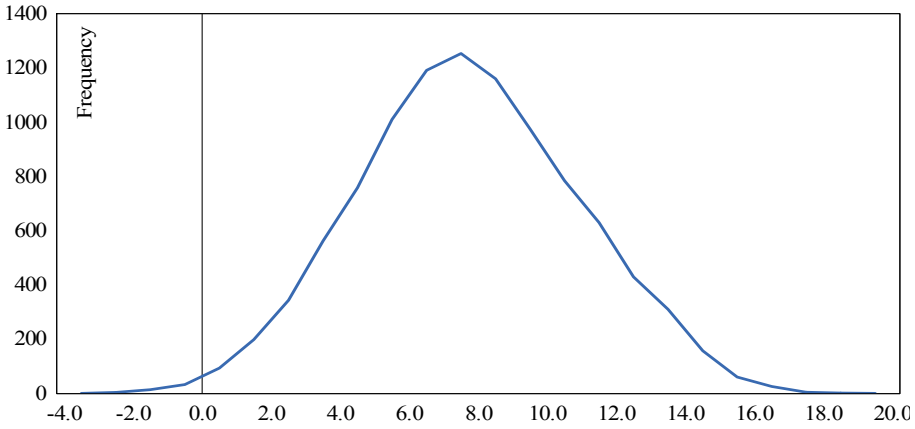

Figure 1e: Variable $PEOPLE_t$

Source: Calculations in EViews based on the model described in the data table in Table 3.

The values simulated by bootstrapping for the coefficient of the variable *number of people exposed to the risk of poverty* in the emigration equation are almost entirely positive. The maximum frequency is recorded for 7.7 and the distribution is symmetrical. The average value is 7,717. These simulations confirm

the hypothesis deduced from the initial model: the increase in the number of people at risk of poverty is positively associated with emigration.

Overall, the bootstrapping results confirm the robustness of the least squares estimators applied to the linear multifactorial model.

The variables involved in the regression equation are expressed in different units of measure. Because of this, the impact coefficients cannot be compared directly. To ensure comparability, we construct a model in logarithms so that the coefficients calculated by scaling, starting from the standard deviation, can be interpreted as elasticities.

The model is presented in the following table:

Table 6. Bootstrap estimation for the regression equation

Dependent variable ln(EMIGRt)	Coefficient	Std. Error	t-Statistics	Prob.
$\ln(EMIGR_{t-1})$	1.202038	0.262262	4.583354	0.0038
$\ln(GDP_{t-1})$	-1.041499	0.538188	-1.935195	0.1011
$\ln(RD_{t-1})$	-0.573470	0.143036	-4.009283	0.0070
$\ln(PEOPLE_t)$	0.920622	0.296696	3.102911	0.0210
t	0.097964	0.033472	2.926744	0.0264

Source: Calculations in EViews based on the data in Table 1

In the table, ln means natural logarithm, and t indexes time. To attenuate the phenomenon of heteroskedasticity we have unified the method of least weighted squares: the series used for weighting is t, and the shape is the inverse of the standard deviation. The elements in the covariance matrix are calculated as HAC Nevey-West (Heteroskedasticity and Autocorrelation Consistent Covariances), with the Bartlett kernel option, bandwidch method: Andrews Automatic. The standardized coefficients are presented in the following table:

Table 7. Standardized coefficients

Variable	Coefficient in the equation	Standardized coefficient	Average elasticity
$\ln(EMIGR_{t-1})$	1.202038	1.323314	1.200718
$\ln(GDP_{t-1})$	-1.041499	-0.846838	-0.757456
$\ln(RD_{t-1})$	-0.573470	-0.426247	-0.180119
$\ln(PEOPLE_t)$	0.920622	0.828156	0.669206

Source: Calculations in EViews based on the equation described in Table 6

The relative importance of the influencing factors is approximately equal and of opposite signs for GDP and the number of people at risk of poverty: at a change with a standard deviation of the influencing factors, migration changes on average by -0.84 standard deviations to GDP growth and by +0.83 as the number of people at risk of poverty increases. The increase of the share of research and development activities in GDP, offers a perspective of economic growth and attenuates the emigration phenomenon, but with more moderate values than the other two factors. The strongest influence is given by the inertial processes registered during emigration (+1.32). The size and intensity ratio of the effects are also preserved in terms of elasticity.

5. Conclusions

Regarding sustainable development in relation to the migration phenomenon, we can say that this concept of sustainable development is found throughout the world and outlines all processes and methods of socio-economic development that focus mainly on ensuring the balance between social, economic and ecological elements. and aspects of natural capital. The term sustainable development envisages both the design of long-term goals and the correlation with short- and medium-term goals, as well as the implementation of a set of internationally adopted criteria.

Given that migration is the movement of labor, and this movement has increased flows, often with changes in meaning and intensity, we can say that migration is a phenomenon of increasing interest, due to or due to the effects on which produces them for sustainable development.

In this regard, opportunities are considered for a better job, which is joined by a number of other conditions, such as socio-cultural environment, relief and climate, development and career prospects, infrastructure, education conditions. for the children.

In the relationship between migration and sustainable development, the effects of migration, both internal and external, related to the components of sustainable development, are the most complex challenges of globalization processes, both now and in the future, due to the fact that human beings, through this process gain confidence and experience, which opens up new perspectives for international cooperation in various fields.

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