DO PEOPLE MIGRATE DUE TO CLIMATE CHANGE? A COMPARATIVE ANALYSIS FOR ROMANIA AND POLAND

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Abstract: *Nowadays people from all over the world have to face climate change. This issue can take different forms like changes in temperatures, sea level increases or natural disasters (floods, droughts, earthquakes, hurricanes, tsunami, heat waves). Throughout this paper we test the impact of climate change (proxied by the level of precipitations) on international migration from Romania and Poland to the main destinations from the European Union by testing the gravity model of migration. Due to the fact that both countries taken into consideration are exposed to extreme weather events like floods, it is important to find out how people deal with these problems. They adapt locally or migrate abroad? Policymakers need to know how people react to climate change because they have to develop specific adaptation policies. One significant novelty in our study is that we consider new and up-to-date reasons for migrating abroad from Romania and Poland. In this way we fill the gap on this topic related to Romania and Poland as origin countries. By applying a Poisson Pseudo Maximum Likelihood Estimator on a balanced panel database for the 2001-2018 time period we have found that Romanian people are more prone to emigrate because of climate reasons rather than Polish people.*

Keywords: international migration, climate change, Romania, Poland, gravity model.

JEL classification: F22, Q59, C23.

1. Introduction

Climate change is one of the most major problems that people have to face nowadays. Emissions of carbon dioxide make temperatures hotter, increase the level of sea and oceans or intensify the number of natural disasters (floods, droughts, earthquakes, hurricanes, tsunami, heat waves). Every country will have to face climate change and in some cases will exist voluntary or forced migration due to climate issues (Burzyński et al., 2022).

Moreover, people displaced by climate change can move internally or internationally (Kaczan & Orgill-Meyer, 2020). According to United Nations Development for Economic and Social Affairs (2017), 750 million people across the globe have been displaced at internal level; at international level approximately 250 million people were registered. Across time studies exist which take into consideration one country or more to see if climate change affects migration of people and results of internal or international migration because of this reason were obtained. To offer only a few examples, people migrate internally due to rainfall in Sub-Saharan Africa (Barrios, et al., 2006), interregional migration is induced by environmental changes on short distances in Italy (Biagi, et al., 2011), in Vietnam internal migration on the short-term is influenced by natural disasters (Gröger & Zylberberg, 2016)

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and in South America climate variability increases the chance of migration between provinces in the region (Thiede, et al., 2016). On the other hand, international migration from 142 sending countries influenced by increases in temperature in the origin country was obtained by Backhaus, et al. (2015), unusual temperature and precipitation patterns contribute to an increase in urbanization, which leads to more international migration between 222 countries (Maurel & Tuccio, 2016), and the intensity of hazards in the origin location leads to increases in bilateral migration from 162 countries (Gröschl & Steinwachs, 2017).

In this research, we take as origin countries Romania and Poland. Our motivation for choosing them is that they are relatively similar countries from economic and geographical aspects. Over time, Romania and Poland were in the attention of researchers for testing the migration behavior using the gravity model (Iancu et al. (2017), Stancu & Popescu, (2018), Iordache & Matei (2020), Pietrzak et al. (2012)). In these studies, Romania and Poland were taken as origin countries. As control variables we have used economics and geographical factors and the results show that emigration is negatively influenced by the distance between the two locations and by the growth of GDP from the origin country and the growth of unemployment from destination country. On the other hand, emigration is positively influenced by the growth of unemployment in the origin country and the growth of GDP from the destination country.

With this study, we want to test the following hypothesis: climate change induces international migration. We have used an extended version of gravitational model of migration which catches both economic and climate reasons (Khamis & Li, 2020). Migration is induced by more reasons like economic ones, political factors, spatial related reasons and climate change factors (Radel et al., 2018). Sas such, our paper contributes to the existing literature by including more reasons which induce labor migration from Romania and Poland to countries from the European Union. For Romanian emigrants we have the following destinations: Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden. And the following destinations countries for Polish emigrants: Austria, Belgium, Czechia, Denmark, Finland, Germany, Hungary, Italy, Luxemburg, Netherlands, Slovakia, Spain, Sweden.

The relevance of the study comes from the fact that the results inform policymakers about specific challenges faced by Romania and Poland. To be more specific, policymakers can develop adaptation policies in accordance with people's needs. Also, the results of this work can help countries which have similar problems to develop strategies for facing the phenomenon of climate migration.

The paper is structured in five sections, including this one with some introductory notions. It is followed by section 2 where we make a brief overview of the current literature on the climate migration topic. Section 3 describes the model and in the next section are information about the data used and results obtained. The last section (section 5) comprises conclusions based on the results of the study.

2. Literature review

In 2050 it is predicted that the number of people which migrate due to climate change will be between 200 million and 1 billion. The number of migrants will be higher because of storms, floods, heat waves, rises in temperature, precipitations and sea level (Tacoli, 2009).

In Europe people migrate mostly because of economic reasons and not because of the quality of life. For example, a study was conducted taking into account the interregional migration from Italy. The migration phenomenon can be split in two categories: migration on long distances and migration on short distances. This was done in order to obtain clearer results about the migration behavior. The results indicate that on long distances the

economic variables play an important role in the decision of migration. People go in areas with higher values of GDP per capita and small unemployment rate. The vulnerable category is that of age between 20 and 39 years (they migrate for higher salaries). Of course, areas which ensure a better education is preferred by immigrants and for migration on long distances the climate factors are not taken in consideration. On the other hand, as concerns migration on short distances people go in small areas, with a better quality of life. Economic variables don't play an important role in the decision of migration. As robustness check, we have applied the instrumental variable approach and two-stage GMM estimator. In this regard other control variables are included: the performance of football players, industry mix employment rate and number of ATM machines per 10000 inhabitants in 1996. The results are unchanged: migration on longer distances is correlated with high income and small unemployment rate and on short distances migration is influenced by environmental changes (Biagi et al., 2011).

Another research was made on the interregional migration from Italy, and it was obtained that emission of gases have a positive impact on migration. Moreover, criminality has a negative impact on migration. The study started form Harris-Todaro model of migration and with some improvements like including the costs involved by the moving of a person from a region to another; climatic changes (following the suggestion of Greenwood (1985, 1997), Knapp and Graves (1989)) measured by CO2 emissions and criminality. A dynamic panel two-step difference generalized method of moments (GMM) estimator was implemented. The period included in the study was 1985-2006 and for the empirical testing it was split in two sub-periods: 1985-1995 and 1996-2006. As dependent variable we have taken into account the net migration flow (calculated as outflows-inflows) of region "l" with individuals with the same qualifications and with the same educational level. Following this, the control variables were included: EM-employment rate; W and H - relative wage and price houses; A1 and A2-CO2 emissions and delinquency, and GDP per capita. The Harris-Todaro model was not enough to explain migration in the case both sub-groups. In the first case, when the prices of houses were taken in consideration the results were more conclusive about migration. Due to data availability the CO2 emissions and criminality wasn't included in the first sub-group, but for the second one was taken in consideration. So, the conclusions reached were the ones stated at the beginning (Bonasia & Napolitano, 2012).

In 2020, Sedova & Kalkuhl have researched rural India to see how climate change influence migration and, moreover, to find out the destination for these kinds of migrants. The panel data used in the study was a combination on data from the European Centre for Medium Range Weather Forecasts and from the India Human Development Survey for the following time intervals: 2004-2005 and 2011-2012. Climate change was proxied by temperature level and precipitations. The empirical estimation consisted in applying a linear probability model and, also, a multinomial logit model. We have obtained that extreme weather events lead to migration from rural to urban areas in the same state and, at the same time, to a decreasing in rural-to-rural migration and international migration. A possible explanation can be that people don't go to closer rural zones due to the fact that they are similar when it comes to weather shocks. Moreover, Indian people from rural areas don't migrate internationally because of liquidity constraints. However, we have found that high level of precipitation can lead to international migration and, also, to urban areas from the same country. In addition, we have found that people who migrate because of climate change are more likely to be unskilled migrants and to come from a household which depends on agriculture.

Mikula and Pytlikova (2021) have studied the case of Czech Republic as concerns migration influenced by air pollution. They have constructed an unbalanced panel database for the intervals of time 1971-1989 and 1990-2003. The empirical estimations were made by using a difference-in-difference estimator and it was obtained that exists a positive relationship between air pollution and migration.

Migration induced by climate change was also studied by Helbling & Meierrieks (2021). The dataset included 121 origin countries and 20 OECD destination countries for the interval of time 1980-2010. By using a long-difference approach was found that increases in temperature and precipitations levels affect the migration process. More precisely, low-skilled migration is influenced by increases in temperature and precipitation levels. Precipitation levels leads to migration of low-skilled labor force on both short and long-run, and in the case of the effect of temperature on international migration of low-skilled labor it is present only on the long-run.

On a global scale Burzyński et al. (2022) studied the impact of climate change on labor migration. Climate change was proxied by temperature changes, sea level rise and the number of natural disasters. The authors followed a micro model, which is the Random Utility Maximization Model, for modelling the decision of migration. Results show that climate change affects more rural areas. So, both internal and international migration will exist due to climate change at global level, even though this kind of migration is very costly.

Azumah & Ahmed (2023) conducted a study in Ghana to see if in the case of maize farmers climate change influenced them to migrate. The data were collected through questionnaires and focus group discussions. The analysis consisted of of two parts: the first one with qualitative data analyzed by Qualitative Content Analysis and the second one with quantitative data analyzed by a Heckit probit regression model. The results obtained are the following: migration is not influenced by floods and soil fertility, but droughts and decreases in rainfall are push factors of migration.

Another research was made by Duijndam et al. (2023) in Netherlands to find out how people adapted to severe floods from the year of 2021. Usually, people use in situ adaptation or migration when are dealing with extreme floods. The data were collected through questionnaires. By using regression analysis, it was found that people prefer to adapt locally rather than to migrate. Nevertheless, it is predicted that migration will increase in time due to the increasing number of floods.

Bannor et al. (2023) took in consideration 35 countries from sub-Saharan Africa to study the phenomenon of migration induced by climate change. The study consisted in analyzing a panel dataset for the 1990-2017-time interval through a country-pair fixed effects estimator and a Generalised Method of Moment. The results indicate that temperature positively influences emigration from regions in sub-Saharan Africa that are dependent on agriculture. The robustness check was made by changing the proxy for climate change, instead of the mean monthly temperature was used the long-run variability of temperature. Robust results that indicate that temperature variability increase emigration have thus been obtained.

Considering the existing literature, we can say that countries from all over the world have to face with climate change and with migration of people due to this reason. Along with the phenomenon of climate migration comes some implications. The first one is of economic nature. The displacement of people impacts both the origin and destination countries. The origin country is affected by the loss of labor force and the destination country gains through the fact that increase the demand for local services and resources. The second one is the pressure on urban areas, people have the tendency to go in cities because there they have more job opportunities and resources. Another implication can be the decrease of agricultural productivity in the origin country, due to the migration of people from rural zones affected by climate change.

3. The Gravity Model

The gravity model is used to study the labor migration. Both economic and geographical reasons are included in this model in order to explain labor migration (Beine et al., 2021). The basic gravity model of migration is represented in the following mathematical expression (Cseres-Gergely, 2005):

$$M_{ij}=C*\frac{P_i^{\beta 1}*P_j^{\beta 2}}{d_{ij}^{\beta 3}} \quad (1),$$

where
M_{ij} is the number of migrants from origin country "i" to destination country "j", C is a constant, $P_i^{\beta 1}$ is the total population from origin country "i", $P_j^{\beta 2}$ is the total population from destination country and $d_{ij}^{\beta 3}$ is the distance between origin and destination countries.

In the linear form, equation 1 has the following expression:

$$\ln M_{ij} = \alpha + \beta_1 \ln P_i + \beta_2 \ln P_j - \beta_3 \ln d_{ij} \quad (2)$$

We use an extension of this model which include besides the factors mentioned above, also the climate factors as affecting labor migration (Khamis & Li, 2020; Abel et al., 2019).

4. Data Description and Empirical Results

The present research consists in the comparative analysis of Romania and Poland, both from the perspective of generators of emigrants. The reason for choosing these countries is that are two similar countries from more perspectives. From the economic point of view, in both countries are registered very closely values of GDP per capita (see *Figure 1*). Other similarities come from the perspective of climate. Both countries have temperate climate and are exposed to floods, the most frequently natural disaster in these countries according to EMDAT (The international disasters database).

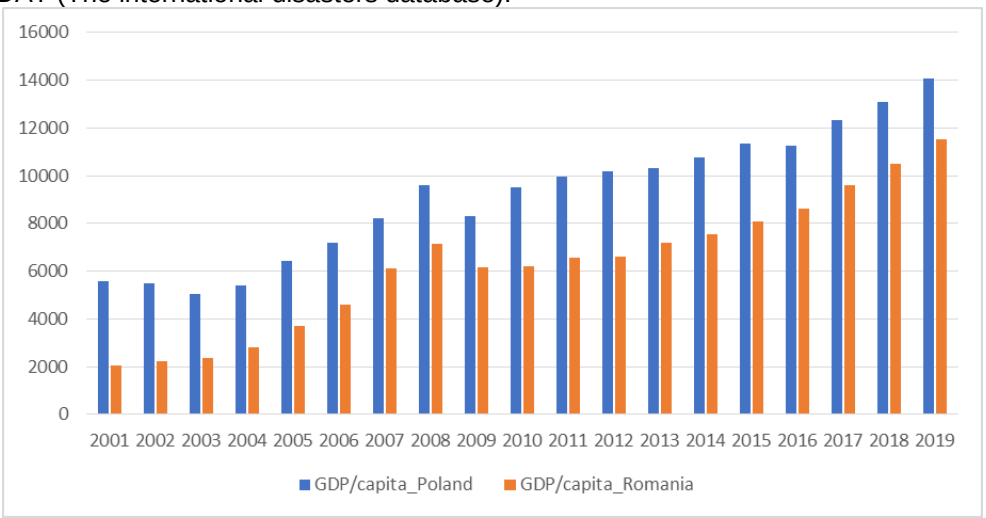

Figure 1. GDP per capita from Romania and Poland.
Source: Figure made by the author based on Eurostat data.

In order to test the impact of climate change on labor migration in Romania and Poland we follow the extended version of the gravity model. In the first case we take Romania as origin country and as destinations we include countries from European Union which receive the most Romanian emigrants (Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden). For the second case we take as origin country Poland and the following countries from European Union as destinations for Polish emigrants: Austria, Belgium, Czechia, Denmark, Finland, Germany, Hungary, Italy, Luxemburg, Netherlands, Slovakia, Spain, Sweden.

We have constructed a balanced panel database for the interval of time 2001-2018 which contain the migration level measured here by the emigration level from origin country to every destination country, population from origin and destination countries, transport costs measured by distance between origin country and every destination country, climate change proxied by precipitation level in origin and destination countries and some economic variables such as gross domestic product per capita and unemployment level from origin and destination countries. All data were extracted from Eurostat, INSSE (Romanian National Institute of Statistics), OECD (The Organization for Economic Co-operation and Development) and POWER (The Prediction of Worldwide Energy Resources). According to Khamis & Li (2020) a Poisson Pseudo-Maximum Likelihood estimator (PPLM) is suitable to be applied on these data to avoid the heteroscedasticity problems and the presence of null values for labor migration.

$$Migration_{ij}=\beta_0+\beta_1 lnpop_i+\beta_2 lnpop_j+\beta_3 lndistance_{ij}+\beta_4 lnclimate\_change_i + \beta_5 lnclimate\_change_j+\beta_6 X \quad (3),$$

where $Migration_{ij}$ – measured by number of emigrants from origin country to destination country.

$lnpop_i$ – logarithm of population from origin country “i”

$lnpop_j$ - logarithm of population from destination country “j”

$lndistance_{ij}$ – logarithm of the distance between origin country “i” and destination country “j”

$lnclimate\_change_i$ – logarithm of the climate change proxied by precipitation registered in the origin country “i”

$lnclimate\_change_j$ – logarithm of the climate change proxied by precipitation registered in the destination country “j”

X – logarithm of economic variables: GDP per capita from origin and destination countries, number of total unemployed people from origin and destination country and geographical variable proxied by the percent of agricultural land from origin and destination countries

Firstly, we test the general form of gravitational model. So, emigration is the dependent variable, and the independent variables are population from both origin country and destination country, distance from origin country to the destination country and the level of precipitation from origin and destination countries. The results show that the level of precipitations from Romania has a positive and significant impact on emigration and the sign from the perspective of Poland is negative. This means that Polish people are not influenced by climate change when they decide to migrate. So, our hypotheses tested is accepted only in the case of Romania. When it comes about the distance, both in Romania and Poland we obtain that remoteness matter. That means that they will migrate abroad if the destination country is relatively closer to the origin country.

Table 10. Results of general form of the gravitational model

Variable/Country	Romania	Poland
lnpopulation_origin	-5.332769 (0.0000)	-98.72887 (0.0000)
lnpopulation_partner	1.508523 (0.0000)	1.830590 (0.0000)
Lndistance	-0.153739 (0.0000)	-2.038943 (0.0000)
lnprecipitation_origin	0.421011 (0.0000)	-0.388676 (0.0000)
lnprecipitation_partner	-0.430273 (0.0000)	0.404151 (0.000)
Constant	74.79349 (0.0000)	1585.351 (0.0000)
Variables	306	234
R-squared	0.424153	0.965281

Source: Author's own calculation in EViews.

Secondly, to the basic model tested we add some economic variables for the robustness check according to Agliardi et al. (2019): gross domestic product and unemployment level from origin country and destination country. In Table 2 we can see the results are robust in the case of Romania. When we control for other reasons besides climate ones the coefficient obtained for precipitation level (1.054443) is higher than the one from the basic model (0.421011). Also, in the case of Poland results are better. That means the Polish people can be influenced by climatic reasons. However, the value obtained is higher in the case of Romania (1.054443) rather than Poland (0.540035), which means that Romanians are more exposed to climate migration.

Table 2. Results for the extended gravitational model

Variable/Country	Romania	Poland
lnpopulation_origin	8.943691 (0.0000)	140.6519 (0.0000)
lnpopulation_partner	2.562743 (0.0000)	0.106960 (0.0000)
Lndistance	-0.320948 (0.0000)	-2.375299 (0.0000)
lnprecipitation_origin	1.054443 (0.0000)	0.540035 (0.0000)
lnprecipitation_partner	-1.073712 (0.0000)	-0.547936 (0.0000)
lnunemployment_origin	0.838483 (0.0000)	0.528605 (0.0000)
lnunemployment_partner	-1.108696 (0.0000)	1.320785 (0.0000)
lnGDP_origin	1.255973 (0.0000)	0.618005 (0.0000)
lnGDP_partner	0.721214 (0.0000)	3.951691 (0.0000)
Constant	-196.1813 (0.0000)	-2502.978 (0.0000)
Variables	306	234
R-squared	0.625164	0.987788

Source: Author's own calculation in EViews.

5. Conclusions

Through this paper we have contributed to the existing literature with a new perspective to international migration when it comes about two countries from Europe: Romania and Poland. In general, developing countries are faced with migration induced by climate change. Moreover, both countries are dealing with the same climate issues, and it is important to test if people move due to this reason.

The migration decision is influenced by climate change in the case of Romanians rather than Polish people. Particularly, it is determined by the precipitation level. The higher the level of precipitation is, more people will emigrate. This was obtained by applying a Poisson Pseudo Maximum Likelihood Estimator.

So, the government should take into account the climate reasons when considering labor migration. For example, a possible solution for having control on floods can be to implement a system that incorporate the storage of water from precipitation and to make use of it.

This analysis should be interpreted by taking into account its limit. We didn't proxy climate change with other relevant variables for Romania and Poland. As further research an analysis which takes into consideration also internal migration because of climate change in these countries could be employed.

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Bio-note

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