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RESEARCH ARTICLE OPEN ACCESS

Migration's Role in Shaping Socio-Demographic Structure in the Peripheral Rural Regions: A Case Study of Lithuania

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ABSTRACT

This paper aims to deepen our understanding of how migration shapes the socio-demographic structure of the peripheral rural regions. We bridge the fields of peripherality and migration research to address the gap in understanding their interplay. We use Lithuania as a case study, exemplifying the metropolization-peripheralization trend and selective migration patterns. Our analysis uses a unique longitudinal, geocoded data set covering the entire population, including inner and international migrants, allowing for a detailed examination of migration patterns across spatial and temporal dimensions from 2001 to 2021. The results show significant variations in the characteristics of individuals migrating to and from peripheral rural regions across different directions, with two-way migration flows playing an important role in shaping the socio-demographic structure of these regions. Furthermore, migration—particularly inner migration—has become an increasingly important factor influencing population dynamics and contributing to further peripheralization.

1 | Introduction

Over the past few decades, many countries have experienced uneven regional development, leading to polarisation¹ into central and peripheral regions (Lang et al. 2022; Iammarino, Rodriguez-Pose, and Storper 2019; Kühn 2015). As country's demographic and economic resources increasingly concentrate in a few central areas, peripheral regions—excluded from these development trajectories—face declining infrastructure, reduced investment, and population loss. Peripheralization, therefore, refers to a region becoming less important, less visible, and less influential compared to more central locations. While peripherality affects both rural and urban areas, it is more pronounced in rural regions, where poor connectivity,

limited access to economic and social networks, low population density, and sparse services exacerbate disadvantages and deepen the gap with central regions (Bernard and Keim-Klärner 2023).

In this paper, we specifically focus on peripheral rural regions (PRRs). Living in PRR typically means experiencing exclusion from economic, social, and political opportunities, facing increasingly difficult and limited access to services and amenities, and being located relatively far from main centres of population and activity. It is not surprising that the efforts are being made to 'rescue' such regions (MacKinnon et al. 2022; Rossi 2022; Plüschke-Altof 2019; Eder and Trippl 2019). However, it is well-established that once the process of peripheralization begins,

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altering its trajectory becomes challenging (Leibert and Golinski 2016; Fratesi and Percoco 2014; Myrdal 1957). This process is characterised by a vicious circle, wherein population decline and aging play a central role in self-reinforcing effects (Elshof, van Wissen, and Mulder 2014; Li, Westlund, and Liu 2019). Unsurprisingly, when there is a lack of education and job opportunities, or a decline in the quality of life, individuals tend to migrate away from these regions. The outmigration of young individuals, who tend to leave first, results in an aging population and declining birth rates. Consequently, declining population triggers a decrease in economic and social activities, further limiting educational and job opportunities and perpetuating peripheralization. However, in theory (e.g., neo-classical theory), labour migration should lead to a new economic equilibrium as declining areas become more attractive to employers due to lower labour costs (Sjaastad 1962). Economic crises, pandemics, global warming, conflicts and wars may also encourage individuals to choose a rural location. Additionally, despite the longstanding trend of urbanisation, rural areas have persistently attracted residents. Thus, various push and pull factors shape the socio-demographic structure of PRRs, making it crucial to examine migration flows to and from these regions to understand population changes.

With this study we aim to deepen our understanding of how migration influences the socio-demographic structure of PRRs, using Lithuania as a case study. Focusing on PRRs, the study examines the extent and composition of incoming and outgoing migration flows from 2001 to 2021. The paper addresses the following research questions:

1. What is the contribution of different factors, such as natural change, international migration, and inner migration, to population change in peripheral rural regions?
2. How do the characteristics of individuals and their migration directions influence the socio-demographic structure of peripheral rural regions?
3. What changes in migration patterns can be identified when comparing the periods 2001–2011 and 2011–2021?

In this study, we use a unique data set that links Lithuanian register-based data with population census data at the individual level, creating a longitudinal, geocoded data set for the entire population. This methodological approach enables a detailed analysis of migration patterns across both spatial and temporal dimensions, while also revealing the underlying drivers and impacts of migration on regional development and socio-economic change over time. Although this study focuses on Lithuania, its methodological approach can be widely applied, inspiring similar studies elsewhere to better understand migration's far-reaching effects.

2 | Literature Review

2.1 | Conceptualising Peripheralization

As demographic and economic resources increasingly concentrate in large cities and their surrounding regions, many other

areas—particularly in central and eastern Europe, though not exclusively—experience reduced investment, declining infrastructure, and population loss (Musil 1993; Lang 2011). According to Kühn (2015), 'peripheralization' is a process that creates peripheries through social relations and their spatial consequences. It refers to regions that are losing importance and influence compared to central areas, often simultaneously experiencing economic, demographic, infrastructural, and social decline. Globalisation, technological advancements, and shifts in national or international policies, among other factors, can exacerbate these challenges, pushing some regions further into peripherality (Lang et al. 2022; Nagy and Timár 2018). Thus, peripheralization implies exclusion from broader development. While peripheralization may affect both urban and rural areas, it tends to be more severe in rural regions due to their remoteness, weaker connectivity, infrastructure lags, and limited economic and demographic potential, all of which worsen existing disadvantages and widen the 'distance' from urban centres (Bernard and Keim-Klärner 2023). It is important to note that rurality and peripherality are not synonymous; while rural areas are often perceived as peripheral due to their geography, not all rural regions undergo peripheralization. Some thrive through tourism, agriculture, or regional policy support, while others face exclusion and limited opportunities, thus experiencing peripheralization (see Eder and Trippel 2019).

2.2 | Migration Dynamics in Peripheral Context

Migration and peripheralization are closely intertwined processes that shape socio-demographic structure of peripheral regions (Török 2017; Rowe et al. 2019). Since most migration studies focus on specific types of migration, particular migrant groups, or certain destinations, they often fail to provide a comprehensive understanding of how migration impacts socio-demographic changes in specific regions, such as peripheral areas. Against this backdrop, this section reviews the literature on migration from and to peripheral rural regions. Meanwhile, the empirical part of the paper fills the literature gap by analysing internal and international migration flows, both incoming and outgoing, and examining how migration shapes the socio-demographic structure of peripheral rural regions, using data that represents the entire population.

Migration from peripheral rural regions to urban centres within countries is one of the most quantitatively significant and well-documented migration phenomena. It is explained through the frameworks of rural-urban migration and stages of migration (Mabogunje 1970). The literature suggests that migration often occurs in phases, beginning with short-distance moves and progressing to longer relocations, including international migration (King et al. 2008; Plane, Henrie, and Perry 2005). While rural-urban migration has received significant attention, international migration originating from rural areas remains underexplored. International migration is typically more prevalent in urban areas than in rural ones, leaving a gap in understanding the dynamics of rural outbound migration. Additionally, the lack of longitudinal studies linking internal and international migration, due to data limitations, creates a gap in understanding these interconnected migration patterns (Skeldon 2006; King and Skeldon 2010).

Despite considerable out-migration, there is also movement into peripheral rural areas, although migration to these regions is relatively small. Its impact, however, can be more pronounced due to smaller local populations (Hugo and Morén-Alegret 2008). People are typically drawn to rural regions by lower living costs, a quieter lifestyle, or the growing availability of remote work. The Covid-19 pandemic accelerated this trend, with more people relocating to rural areas during the crisis (Tammaru et al. 2023; González-Leonardo, Rowe, and Fresolone-Caparrós 2022; Vogiazides and Kawalerowicz 2023). Many migrants come from urban areas, a process known as counter-urbanisation. Recent studies in the Baltic states (Tammaru et al. 2023; Ubarevičienė et al. 2024) reveal that young people are increasingly participating in this migration, challenging assumptions that older individuals are the primary migrants in this direction, as suggested by cyclical urbanisation models and the life-course approach (see Geyer and Kontuly 1993). Plane, Henrie, and Perry (2005) similarly found that migration patterns vary across life stages, with different determinants at each stage. While less common, foreign countries are also a source of migrants for rural areas (Fromentin 2022; Jentsch and Simard 2016; Hugo and Morén-Alegret 2008), with return migrants often playing a significant role, especially in emigration countries like Lithuania (Farrell et al. 2014). Transnationalism (Schiller, Basch, and Blanc-Szanton 1992; Török 2017) is relevant here, manifesting in various ways, such as returnees maintaining ties across borders. These migrants bring new knowledge, ideas, and financial flows, known as remittances, positively influencing rural development (see Faist 2008). Lastly, migration between rural regions, though quantitatively substantial, has received little attention. Stockdale (2016) compares counter-urban and lateral rural migration, arguing that the latter is often neglected while counter-urbanisation is overly generalised.

2.3 | Data Approaches in Migration Studies

Various data sources and methodologies offer insights into migration flows, migrant characteristics, and socio-economic impacts on both origin and destination areas. This section overviews data sources commonly used in migration studies.

Longitudinal panel datasets are invaluable for tracking individuals over time, enabling researchers to examine migration behaviours and their effects on well-being throughout the life course (Vidal and Lersch 2021). In-depth interviews provide specific insights into the experiences of particular groups, such as return migrants (see Farrell et al. 2014). Surveys like the Labour Force Survey, Household Survey, Living Standards Measurement Survey, and European Social Survey capture factors influencing migration decisions and outcomes, including employment and housing (see Martí and Ródenas 2007; Portes and Springford 2023). However, surveys and interviews often have a limited set of observations and inadequate regional coverage. Thus, migration behaviours and their impacts on both origin and destination areas are best analysed using census and register-based datasets. Advances in linking individual-level data sources and digitalisation further enhance the adaptability and scope of these datasets for addressing diverse research questions (Ernsten et al. 2018; Tjaden 2021).

Despite numerous studies, a significant gap remains in understanding the interplay between peripheralization and migration, particularly the impact of inner and international migration flows. There is limited knowledge of how migrant characteristics vary across destinations and how these variations influence socio-demographic structures in both origin and destination. This paper addresses this gap, using Lithuania as a case study, to examine migration's role in shaping population dynamics in peripheral rural regions. A similar study by Ubarevičienė and van Ham (2017) highlighted the selective nature of migration from declining areas but was based on 2011 census data that captured migration patterns over a single year (2010). In contrast, this study offers a comprehensive analysis of migration patterns to and from peripheral rural regions over 20 years, examining both inner and international migration. It examines the drivers of population change and provides new insights into the socio-demographic dynamics of these regions.

3 | Peripheral Rural Regions in Lithuania

Although Lithuania is a small country with 3 million people and a territory of 65,000 km², it faces significant polarization between metropolitan and peripheral areas, resulting in pronounced regional disparities (Pociūtė-Sereikienė 2019). This trend began after the Soviet Union's collapse in the 1990s, as new economic sectors concentrated in the largest cities, particularly the capital, Vilnius (Lang et al. 2022). Meanwhile, the rest of the country struggled with reduced labour demand in agriculture and outdated Soviet-era industries (Dudzevičiūtė, Mačiulis, and Tvaronavičienė 2014). During the soviet period (1944–1990), the centrally planned economy integrated regional planning policies promoting socio-spatial equality. The communist doctrine sought to evenly distribute the population and resources (Stanilov 2007; Bertaud and Renaud 1997), aiming to eliminate social, economic and regional disparities and push for homogenisation (Gentile, Tammaru, and van Kempen 2012). Strict controls on population movement within and between communist states were used to maintain this equality (Clayton and Richardson 1989; Klüsener et al. 2015). In Lithuania, these measures were implemented more rigorously than elsewhere (Ubarevičienė 2018), laying the groundwork for today's more pronounced shifts in population organisation. Thus, the transition from a Soviet-style planned economy to a market-driven system profoundly impacted not only Lithuania's political and economic systems but also its socio-spatial organisation.

Among the most pressing consequences of these changes was a significant population decline. Between 1989 and 2021, Lithuania's population fell by 25%, driven by both natural population change and emigration (Eurostat 2023), with emigration accelerating significantly after its accession to the EU in 2004 and the Schengen Zone in 2007. This positioned Lithuania among the fastest-shrinking countries in the world. Notably, since 2019, Lithuania's population has begun to stabilise, driven by a shift to positive net international migration primarily linked to return migration due to Brexit and the pandemic, as well as an influx of refugees from Ukraine.² However, this shift has not necessarily translated into positive effects for rural regions, due to ongoing nationwide spatial polarisation.

Contrary, we can expect that long-term population decline, combined with growing regional inequalities, leads to further shrinkage of rural regions, likely making them among the most severely affected by peripheralization in Europe. In Lithuania, areas classified as PRRs are continually increasing in size while experiencing a decrease in population. Presently, PRRs cover about half of Lithuania's territory and house around 20% of the country's population (see Figure 1). Located further from urban centres and often near the country's borders, these sparsely populated areas face challenges due to remoteness and limited resources, resulting in minimal influence from the largest cities on their development, and leading to a lack of economic growth and job opportunities.

Based on the centre-periphery model and previous studies conducted in Lithuania (Lang et al. 2022; Pociūtė-Sereikienė 2019; Ščerbinskaitė 2022), this study identifies PRRs in Lithuania using two key criteria: (i) geographical proximity to cities (within 30, 45, or 60 min by car) and (ii) population change from 2011 to 2021, categorising the territory into five relatively homogeneous groups: cities, metropolitan regions, peri-urban regions, transition areas and peripheral rural regions, as depicted in Figure 1.

1. *Cities* represent centres in the centre-periphery hierarchy; their population trends varied—some grew, while others shrank.
2. *Metropolitan regions*³ consist of cities and suburbs, but also cover less urbanised areas with the mix of suburban and rural settlements, their population either increased or remained stable.
3. *Peri-urban* regions are semi-urban and semi-rural areas closely connected to cities, they experienced depopulation of up to 15%, and are located within a 45-min drive from the largest cities and up to 30 min from the regional cities.

4. *Transition areas* predominantly rural areas with depopulation ranging from 15% to 20% or more, located within a 45–60-min drive from the largest cities and 30–45 min from the regional cities.
5. *Peripheral (rural) regions*⁴ are primarily rural regions experiencing significant depopulation, often exceeding 20%, they are located further than 60-min drive from the largest cities and 45 min from the regional cities. Peripheral regions have local centres (villages) which, depending on their size and geographical position, have a local influence on the peripheral regions.

4 | Data and Methods

4.1 | Data

One of the novelties of this study is its use of the newly established Lithuanian data infrastructure.⁶ This enabled the creation of a unique data set linking individual-level register-based and census data, resulting in a comprehensive longitudinal, geocoded data set for the entire population. This allows for detailed analysis of migration patterns across both spatial and temporal dimensions. Regarding register-based data, we use the address register and the population register. By linking these registers, we can associate individuals' place of residence and migration histories (including where they lived at any given time) with key demographic characteristics such as age, gender, and ethnicity. Since this is the first time these specific datasets have been linked for migration study in Lithuania, considerable attention was given to potential errors or inconsistencies. Our investigation revealed instances where individuals lacked a registered place of residence or were listed with incorrect or incomplete demographic information. To address these

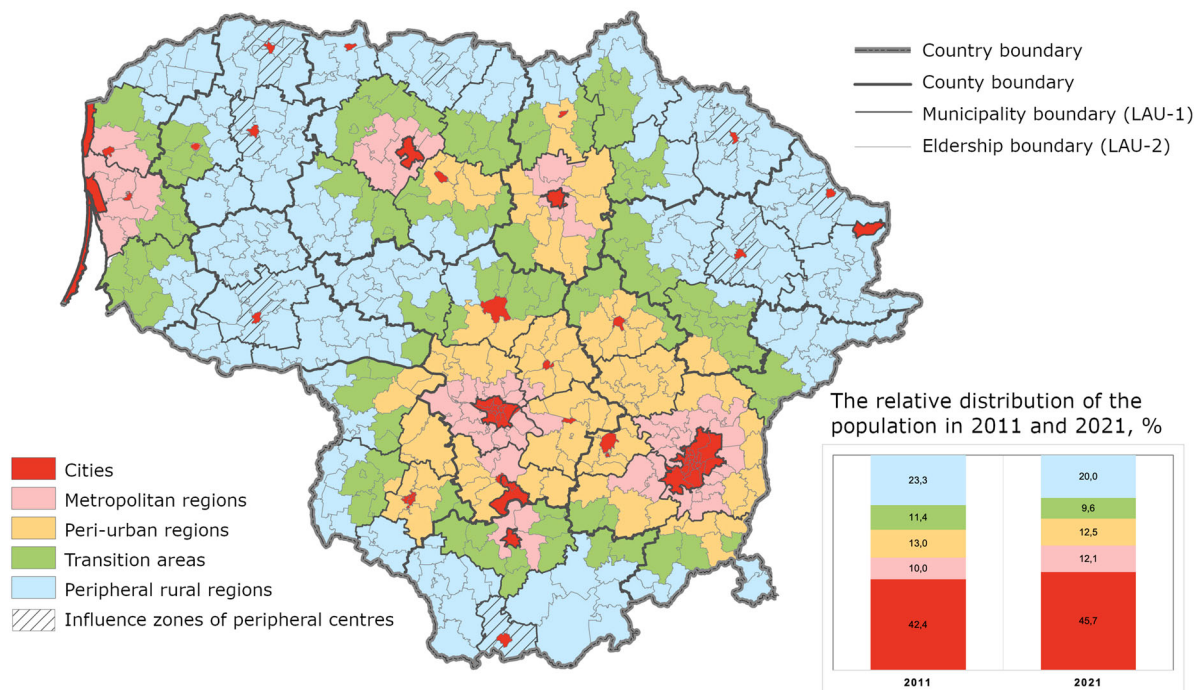


FIGURE 1 | The categorisation of Lithuanian territory according to the centre-periphery hierarchy; at the level of LAU-2 regions, 2021 (authors).

challenges, we employed logical assumptions to eliminate systemic errors and, when necessary, edited the records to indicate missing information. Remarkably, some entries in the address register date back to the 19th century (sparking new research ideas!); however, upon closer examination, it became evident that the accuracy of older records was unsatisfactory, with the most reliable data available from 1990 to the present day.

This study also uses data from the 2011 and 2021 Lithuanian censuses. By linking register-based data with census data at the individual level, we enriched the data set with valuable information on family status, education, employment, and more (see Table A1 for variables included). However, due to the nature of census data, time-varying characteristics are recorded only on the census date, leaving us uncertain whether migration occurs before or after individuals achieve certain attributes such as education level or marital status. Thus, caution is needed when interpreting the effects of time-varying characteristics. The population census includes residence details, but migration information is limited (for more details see Ubarevičienė and van Ham 2017). Therefore, we rely on individual's addresses from the address register, which records all changes of address and provides a full migration history for each person. By linking different data sources, we overcome challenges faced by migration studies relying solely on census data (as showcased in Ubarevičienė and van Ham 2017), and significantly advance migration research (see Ernsten et al. 2018).

Although the data used for this study is extensive and detailed, it does have shortcomings. A common challenge in migration studies, including this one, is that not all individuals accurately report or promptly update their residential addresses (see Sjöberg and Tammaru 1999; Raymer, Smith, and Giulietti 2011; Vogiazides and Kawalerowicz 2023). This problem affects both inner migrants—particularly students or those with multilocal living arrangements—and international migrants, especially those migrating seasonally or temporarily within EU countries. Currently, there are no reliable studies estimating the extent of this issue in Lithuania. Additionally, our data spans two decades—from 2001 to 2021—during which several events influenced migration patterns and overall demographics. Specifically, the 2011 census was conducted in a post-crisis context, while the 2021 census took place during the pandemic. These events impacted population dynamics, affecting both natural change and migration patterns. While we do not explore the specific effects of these events, we assume they likely had mixed impacts on the socio-demographic structure of PRRs. Additionally, migration is influenced by numerous factors (Fafchamps and Shilpi 2013). This paper focuses on the characteristics of individuals rather than the exact magnitude of migration flows. We believe the extensive population coverage of our data mitigates the impact of these limitations on our findings.

4.2 | Methods

Our empirical analysis is organised as follows. First, we use aggregated-level data to examine population change trends in Lithuania's PRRs over two decades, assessing how natural change, international migration, and inner migration each contribute to population dynamics. Second, we use individual-level data and run a set of regression models to examine the characteristics of (i) those who live in the PRR, (ii) those who

leave the PRR and their destination, and (iii) those who come to the PRR and their origin. By comparing the results of different models, we address the central question of this paper—How migration influences the socio-demographic structure of PRRs?

The regression models in our study include individual characteristics that are commonly analysed in migration research (see Table A1). Notably, we intentionally exclude regional-level variables like depopulation rates and distance to the administrative centre, as PRRs are already distinguished by these characteristics and demonstrate significant homogeneity (see Section 3). Additionally, administrative borders often do not serve as barriers to accessing jobs or education.

Although we analyse individual-level data, our study's results are organised to compare migration patterns over two decades: 2001–2011 and 2011–2021 (censuses selected as threshold years). This approach allows us to observe the main trends and avoid random fluctuations and confidentiality issues that could arise from annual data analysis. It also helps mitigate the temporary effects resulting from specific circumstances, such as financial crises, Brexit, and the pandemic, which may have influenced migration patterns.

All data preparation procedures and statistical analyses were conducted in a safe online Palantir environment, using Python and R languages. Data confidentiality requirements were strictly followed to ensure the protection of personal information and maintain the anonymity of research participants. Results are presented in aggregated form only.

5 | Results

5.1 | Descriptive Results of Population Change in the Peripheral Rural Regions

Natural population change, inner migration, and international migration are all important factors that contribute differently to population dynamics and peripheralization processes. Figure 2 illustrates the extent to which these factors influence population change in Lithuania's PRRs. In other words, it shows the changes in population resulting from births and deaths, and the inflows and outflows of inner and international migration. In Figure 2, 'inner immigration' refers to people moving into PRRs from other areas of the country, while 'inner emigration' refers to those leaving PRRs for other parts of the country. Similarly, 'international immigration' involves people coming from abroad to settle in PRRs, and 'international emigration' refers to residents leaving these regions to move abroad. It should be noted that the graph reports migration flows—counting migration events rather than the number of individuals moving to or from PRRs—meaning one person may have migrated multiple times. This way, it highlights population dynamics rather than the final distribution of individuals in PRRs. We examine natural change and migration flows over two decades: 2001–2011 and 2011–2021, providing cumulative figures for each period to shed light on the direction of changes between decades. Population-increasing factors (births and in-migration) are indicated with pattern fill, while population-decreasing factors are shown with solid fill.

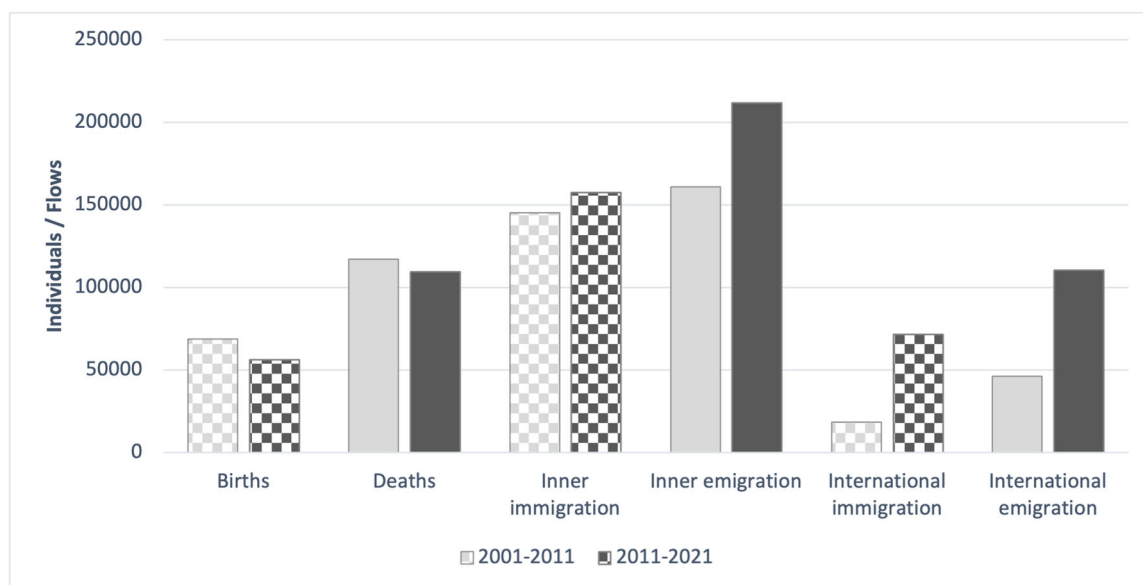


FIGURE 2 | The contribution of different factors (natural change, inner and international migration) to population change in peripheral rural regions, during 2001–2011 and 2011–2021 (based on the 2011 and 2021 censuses, demographic and address register).

As shown in Figure 2, the columns for births and deaths have shortened in the second decade, indicating a reduced impact of natural change on population dynamics in PRRs. In contrast, migration flows in all directions have increased, demonstrating their growing significance. International migration flows in both directions were relatively small in the first decade but increased significantly in the second, becoming as important as natural population change in shaping overall population dynamics. However, in quantitative terms, inner migration was the primary contributor to population change in both decades, highlighting its importance in shaping population dynamics within PRRs. Importantly, the flows of inner emigration were the highest in both decades, particularly in the second, indicating the trend of peripherization discussed in the literature review—population redistribution away from PRRs toward more central areas.

When comparing the two decades, it is important to consider significant events: the period from 2001 to 2011 was marked by the effects of the financial crisis, while the years 2011 to 2021 experienced the impacts of Brexit and the pandemic. Interestingly, regarding the potential impact of the pandemic, we do not observe an increase in death numbers during the second decade, possibly due to a decline in the overall population in the PRRs. In contrast, the notable rise in international immigration can be linked to global factors such as Brexit and the pandemic, which prompted many Lithuanians to return in search of safety, stability, and better economic opportunities. Lastly, the implications of these events for inner migration are more nuanced and will be better understood as this study unfolds.

5.2 | Models

While aggregated-level data (see Table A1 and Figure 2) provides insights into population composition and migration flows between PRRs and the rest of Lithuania, it may hide actual differences in population structure and migration-driven

changes. Therefore, we employ a series of binary logistic regression models to examine the nuanced impact of migration flows on population composition.

5.2.1 | Who Lives in the Peripheries?

First, we estimate the probabilities of living in the PRR and living in the city (Table 1). We compare these two groups, as they are contrasting spaces in terms of the centre-periphery division as well as expected migration flows (Bernard and Keim-Klärner 2023). The dependent variable distinguishes individuals living in PRRs (1) from those who do not (0), and in the same way, individuals residing in cities (1) from those who do not (0). Using data from the 2011 and 2021 censuses, we examine how population composition changed in PRRs and cities over the decade. The models include a range of individual characteristics and cover the entire population. It is important to note that these models are descriptive rather than causal, indicating the role of each variable while controlling for others.

First, the models that include gender and age show that there were almost no gender differences in the likelihood of residing in PRRs or cities; both in 2011 and 2021, $Exp(B)$ was close to 1. No gender differences were observed in the following models either, thus gender only serves as a control variable, ensuring its influence is accounted for while examining other factors. Next, we examine age, using individuals under 18 as the reference category. We would expect young people to be more likely to reside in urban areas and less likely in rural ones. However, our models yield mixed results: while the trend in 2011 was contrary to our expectations, the findings for 2021 align with them.

After adding more individual characteristics in Model 2, the age effect began to align with expectations across all models. Young people showed a lower probability of living in PRRs and a higher probability of living in cities, while older individuals showed the opposite trend. Over time, the age composition gap between cities

TABLE 1 | Logistic regression models of living in the peripheral rural regions (PRRs) and cities.

	2011						2021					
	Peripheral regions			Cities			Peripheral regions			Cities		
	Model 1	Model 2		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2	
	Exp (B)	SE	Exp (B)	SE	Exp (B)	SE	Exp (B)	SE	Exp (B)	SE	Exp (B)	SE
Gender (ref. male)												
Female	0.935	0.003	0.972	0.003	1.133	0.003	1.085	0.003	0.958	0.003	1.081	0.002
Age (ref. < 18)												
18–34	0.736	0.008	1.154	0.011	1.500	0.008	0.767	0.010	1.146	0.005	0.897	0.004
35–49	0.843	0.008	1.368	0.012	1.235	0.008	0.655	0.011	0.998	0.005	1.159	0.014
50–64	0.869	0.009	1.338	0.012	1.254	0.008	0.738	0.011	1.326	0.005	0.789	0.004
> 65	0.974	0.009	1.012	0.012	1.116	0.008	1.220	0.011	1.319	0.005	0.868	0.004
Ethnicity (ref. non-Lithuanian)												
Lithuanian			2.269	0.005			0.486	0.004			2.216	0.005
Family status (ref. single)												
Married			0.974	0.005			0.892	0.004			0.910	0.005
Divorced			0.871	0.007			1.154	0.006			0.890	0.006
Widowed			1.001	0.007			0.853	0.006			0.989	0.007
Education (ref. primary) ^a												
Secondary			0.681	0.006			2.045	0.006			0.720	0.007
Tertiary			0.366	0.007			4.564	0.006			0.414	0.008
Labour market position (ref. low-ranking occupation)												
Middle-ranking occupation			0.878	0.008			1.240	0.007			1.052	0.007
High-ranking occupation			0.759	0.009			1.432	0.008			0.744	0.008
Students			0.904	0.010			1.290	0.008			0.843	0.011
Unemployed			1.210	0.008			0.841	0.008			1.178	0.008
Non-participating ^b			1.213	0.008			0.766	0.008			1.128	0.008

Note: Models compare individuals living in PRRs or cities (1) with those who do not (0). Not provided are significance levels because the complete sample of population is analysed.

^aTogether with unfinished primary.

^bOver 65, housewives, disabled, missing information.

and peripheries has grown. Furthermore, in both years, ethnic Lithuanians⁷ were 2.2 times more likely to live in PRRs than in other areas, while non-Lithuanians were twice as likely to live in cities rather than other regions. This disparity between peripheral and central locations has slightly reduced from 2011 to 2021, indicating a trend towards a more balanced ethnic distribution across Lithuania. The concentration of ethnic minorities in urban areas is a world-wide phenomenon, driven by access to education, social networks, and job opportunities that support the use of their native language (Massey and Denton 1993). In Lithuania, the pronounced ethnic contrast arises from a low overall minority population (around 15% in 2021), with its significant concentration in the Vilnius region (Ubarevičienė 2018).

The results show no significant differences in residential location based on family status for both 2011 and 2021, suggesting it is not a key factor in determining where people live. In contrast, education level emerges as an important predictor; higher education is positively associated with living in the city and negatively with living in the periphery. For example, without controlling for other factors, individuals with higher education are nearly 10 times more likely to be found in cities than in PRRs (this calculation is not shown here). Notably, over the past decade, the education gap between central and peripheral regions has narrowed, marked by slight improvements in education levels in the periphery and small declines in urban ones. In terms of labour market differences, city residents tend to hold better positions, especially in high-ranking occupations, while those in PRRs face higher unemployment or non-participation rates. These findings highlight the contrasting labour market conditions between central and peripheral areas. Over the decade, there have been no clear signs of labour market improvements in PRRs. In cities, however, contradictory trends have emerged, with workers experiencing an increased likelihood of high-ranking occupations alongside higher rates of unemployment and non-participation.

In summary, while there have been no major shifts in the distribution of people based on their socio-demographic characteristics over the analysed decade, there is a noticeable trend of diminishing disparity between peripheral and central locations. The following sections will explore this trend by examining migration patterns, particularly focusing on individuals moving to and from PRRs.

5.2.2 | Who Leaves the Peripheral Rural Regions and Where do They Move to?

In this section, we focus on the characteristics of individuals most likely to migrate from PRRs. The models in Table 2 include persons who lived in PRRs in 2001 and either remained there or moved away at any point between 2001 and 2011; applying the same criteria for the 2011–2021 period. The dependent variable indicates whether a person stayed in the same PRR (0) or moved (1) to another PRR, a city or abroad during the analysed periods. We exclude migrations within LAU-2 regions and individuals below 18 years of age in the census years.

The results show that, in both periods, the likelihood of migration from PRRs decreases with age. Young adults (18–34) were most likely to leave peripheral regions, while the elderly

(> 65) were the least likely to move, especially abroad. This trend is consistent across all three migration destinations, though those moving to cities and abroad tend to be younger than those relocating within PRRs. When comparing the first decade to the second, the differences in migration likelihood between age groups have narrowed (except for those moving abroad), suggesting a shift in the perception that only young individuals leave PRRs, as older groups are increasingly doing so. The models also show that Lithuanians were more likely to move to other peripheries, while non-Lithuanians were slightly more inclined to migrate abroad. Interestingly, the results indicate a shift in rural-urban migration, with non-Lithuanians increasingly relocating to cities in the second decade, while Lithuanians were more likely to do so in the first.

We next analyse time-varying characteristics, recognising that data from the 2011 and 2021 censuses reflects individuals' post-migration status. The models reveal that single individuals had a higher likelihood of emigrating abroad but were less likely to move to cities or peripheries in both decades. Notably, widows were the most mobile group (except in the direction of abroad), but some may have transitioned to single or widowed status after the migration. Indeed, literature Bradsher et al. 1992; Zilincikova et al. 2024) suggests that the migration patterns of widows often reflect a desire to be closer to family, social support, community engagement, downsizing, and better access to healthcare and services. Next, as education levels rise, the likelihood of migrating from PRRs to cities or abroad significantly increases, while those with lower education tend to remain in or move to other PRRs. Regarding labour market positions, individuals migrating between PRRs do not differ significantly from those who stay. The probability of moving from the periphery to the city rises with occupational rank. In 2011, low-skilled workers were more likely to emigrate abroad, whereas in 2021, this emigration was more closely associated with unemployment and non-participation. Emigration abroad and holding high-ranking positions was unlikely in both decades. Paradoxically, emigration is linked to higher educational attainment but lower occupational status, which could potentially shed light on individuals' motivation to choose to emigrate.

The models also consider individuals' migration history, specifically the number of prior moves recorded in the address register. Those with no prior migration or only one move had the lowest likelihood of migrating, indicating a tendency for sedentary individuals to remain in peripheries. In the first decade, those experiencing their fourth to ninth migration had the highest probability of moving, while in the second decade, individuals with 10 or more migrations were more likely to leave PRRs. Notably, emigrants abroad exhibited high mobility, evidenced by repeated emigrations. Additionally, the models include a variable indicating whether a person died after migrating and before the next census, allowing us to examine the relationship between migration direction and mortality. Comparing the three migration destinations, individuals who stayed in place, followed by those migrating to cities, had a higher probability of death in both decades.

In conclusion, the results reveal some interesting trends in migration patterns. First, individuals' characteristics vary depending on their migration destination. Those moving to

TABLE 2 | Logistic regression models of moving from the peripheral rural regions (PRRs).

	2001–2011						2011–2021					
	Moved to peripheral regions			Moved to cities			Moved to peripheral regions			Moved to cities		
	Exp (B)	SE		Exp (B)	SE		Exp (B)	SE		Exp (B)	SE	
Gender (ref. male)												
Female	1.056	0.012		1.111	0.016		1.060	0.012		1.033	0.013	
Age (ref. 18–34)												
35–49	0.512	0.016		0.290	0.020		0.561	0.016		0.411	0.015	
50–64	0.372	0.020		0.103	0.032		0.379	0.018		0.120	0.022	
> 65	0.286	0.027		0.195	0.043		0.354	0.025		0.168	0.030	
Ethnicity (ref. non-Lithuanian)												
Lithuanian	1.458	0.022		1.404	0.029		1.422	0.021		0.839	0.019	
Family status (ref. single)												
Married	1.588	0.018		2.135	0.021		1.370	0.016		1.615	0.015	
Divorced	1.722	0.023		1.791	0.033		1.446	0.021		1.513	0.024	
Widowed	1.846	0.028		3.001	0.042		1.534	0.028		1.969	0.036	
Education (ref. primary)												
Secondary	0.948	0.024		1.062	0.042		0.809	0.025		1.138	0.037	
Tertiary	0.868	0.029		2.935	0.044		0.773	0.028		2.683	0.038	
Labour market posit. (ref. low-ranking occup.)												
Middle-ranking occup.	1.053	0.028		1.732	0.046		1.071	0.025		1.260	0.029	
High-ranking occup.	0.911	0.033		2.124	0.049		0.968	0.029		1.956	0.031	
Students	0.877	0.035		0.874	0.056		1.049	0.036		0.739	0.043	
Unemployed	1.027	0.030		0.893	0.051		0.996	0.028		0.850	0.034	
Non-participating ^a	1.132	0.030		0.955	0.052		1.157	0.027		1.052	0.033	
Migration history (ref. 2nd or 3rd migration)												
0 or 1st migration	0.099	0.013		0.122	0.017		0.107	0.013		0.140	0.014	
4–9th migration	1.262	0.025		1.365	0.032		1.151	0.016		1.403	0.017	
≥ 10th migration	1.165	0.208		1.166	0.330		1.265	0.062		1.566	0.071	

(Continues)

TABLE 3 | Logistic regression models of moving to the peripheral rural regions (PRRs).

	2001–2011						2011–2021					
	Moved from peripheral regions			Moved from cities			Moved from peripheral regions			Moved from cities		
	Exp (B)	SE		Exp (B)	SE		Exp (B)	SE		Exp (B)	SE	
Gender (ref. male)												
Female	1.047	0.012		0.818	0.021		0.777	0.064		0.804	0.023	
Age (ref. 18–34)												
35–49	0.488	0.017		0.674	0.029		0.587	0.088		1.002	0.036	
50–64	0.347	0.020		0.870	0.033		0.292	0.104		0.899	0.039	
> 65	0.271	0.028		0.916	0.045		0.326	0.134		1.033	0.047	
Ethnicity (ref. non-Lithuanian)												
Lithuanian	1.353	0.022		0.826	0.031		0.035	0.071		0.881	0.035	
Family status (ref. single)												
Married	1.681	0.018		0.740	0.029		2.641	0.102		0.943	0.032	
Divorced	1.725	0.024		1.298	0.035		2.106	0.135		1.374	0.038	
Widowed	1.930	0.029		0.722	0.049		2.838	0.150		0.943	0.054	
Education (ref. primary)												
Secondary	0.948	0.025		1.775	0.049		0.969	0.128		1.196	0.055	
Tertiary	0.909	0.030		3.021	0.054		2.148	0.140		2.623	0.059	
Labour market posit. (ref. low-ranking occup.)												
Middle-ranking occup.	1.051	0.029		1.107	0.056		0.909	0.153		1.191	0.062	
High-ranking occup.	0.929	0.034		1.095	0.062		0.465	0.184		1.542	0.066	
Students	0.867	0.036		0.985	0.070		0.530	0.231		1.794	0.087	
Unemployed	0.988	0.030		1.401	0.057		1.058	0.161		1.385	0.066	
Non-participating ^a	1.099	0.031		1.532	0.058		1.340	0.162		1.967	0.062	
Migration history (ref. 2nd or 3rd migration)												
0 or 1st migration	0.096	0.013		0.046	0.022		0.170	0.074		0.096	0.028	
4–9th migration	1.307	0.026		1.728	0.032		1.980	0.119		1.628	0.029	
≥ 10th migration	1.045	0.205		1.169	0.262		N/A	N/A		2.163	0.094	

(Continues)

outgoing migration. King and Skeldon (2010) emphasised that focusing on only one migration type provides an incomplete view, while Stockdale (2016) argued that neglecting intra-rural migration distorts the understanding of rural migratory processes. This study aimed to deepen understanding of how inner and international migration—both incoming and outgoing—shapes the socio-demographic structure of peripheral rural regions. Lithuania offers a compelling context for examining migration dynamics. The country's transition from a Soviet-style planned economy to a market-driven system has significantly influenced socio-spatial organization, reinforcing the metropolization-peripheralization trend and leading to selective migration patterns. Peripheral rural regions now cover half of Lithuania's territory—a proportion that continues to grow and reflects a broader European trend of peripheralization—underscoring the need to identify emerging threats and inform effective regional policy. Additionally, recent advancements in Lithuanian data infrastructure have enabled the creation of a unique data set that allows for detailed analysis of migration patterns across spatial and temporal dimensions.

By examining migration flows to and from peripheral regions, this paper uncovers how these movements reshape the socio-demographic structure of rural peripheries. We find that migration from peripheral rural regions to cities primarily involves younger, working-age individuals, accelerating depopulation, aging, and weakening local labour markets and social structures. Conversely, migration to peripheral regions, including urban-to-rural relocations and cross-border migrants, introduces new demographic profiles and benefits local demographics and economies. However, most migrations occur between peripheral rural regions (consistent with Stockdale (2016) observation), with minimal differences between movers and non-movers, thus it has little impact on the overall socio-demographic composition. Therefore, the key drivers of population changes are rural-urban and urban-rural migrations. Interestingly, over the past two decades, migration out of peripheral rural regions has become less selective, with individuals of all ages and various educational and occupational backgrounds leaving. In contrast, migration into these regions has grown more selective, increasingly attracting individuals with higher education and better occupational status. Lastly, a key finding is the diminishing impact of natural change and the growing influence of migration in shaping the population composition of peripheral rural regions. This highlights the increasing need to better understand migration trends and their consequences.

This study deepens our understanding of migration dynamics and presents a model for future research. The methodological approach lays the foundation for further exploration of critical issues, including the challenges faced by 'left-behind' populations, return migrants, and the impacts of uneven development. Understanding the interplay between peripheralization and migration is important, as it illustrates how migration patterns both shape and reinforce regional inequalities, exacerbating socio-economic divides and influencing future migration trends.

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Use of AI-Assisted Writing Tools

During the preparation of this work the authors used ChatGPT-4.0 in order to refine the language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

¹In this paper, 'polarisation' refers to the socio-spatial divide that grows between 'winning' and 'losing' regions, or central and peripheral regions. 'Peripheralization' refers to the process through which certain regions or areas become peripheral or less central in terms of economic, political or social influence compared to more dominant or central regions.

²This study analyzes data up to 2021, and thus does not include the impacts of the recent influx of refugees from Ukraine, which occurred after this period.

⁵Lithuania is divided into around 550 LAU-2 regions, with average population size 2000 in rural areas and 25,000 in urban areas.

³See Burneika and Ubarevičienė (2016) for more details on how the boundaries of the three largest metropolitan regions were delimited.

⁴We use the terms *Peripheral regions* and *Peripheral rural regions* interchangeably in the rest of the paper.

⁶See more about the Lithuanian data infrastructure (State Data Governance Information System 2022).

⁷We distinguish only between "Lithuanians" and "non-Lithuanians" due to Lithuanians making up over 90% of the research population (see Table A1). We did not break down smaller ethnic groups, as their effects become statistically insignificant in the models due to their small sample sizes.

⁸Tables 2 and 3 have some overlap, because both include periphery-periphery migration, for which the results are close, yet not entirely identical due to slight variations in the samples of individuals analysed.

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Appendix

TABLE A1 | Composition of the population of Lithuania and the peripheral rural regions (PRRs), and composition of people who have moved from and moved to the PRRs (based on the 2011 and 2021 censuses and address register).

	2011			2001–2011			2021			2011–2021		
	Total in Lithuania	Total in Lithuania, %	PRR, %	Moved from PRR, %	Moved to PRR, %	Total in Lithuania	Total in Lithuania, %	PRR, %	Moved from PRR, %	Moved to PRR, %	Total in Lithuania	Total in Lithuania, %
Gender	3,052,588	100	22.2	13.8	11.9	2,810,761	100	20.1	23.3	15.8		
Male	1,407,223	46.1	46.7	45.3	47.8	1,304,965	46.4	46.8	47.5	49.7		
Female	1,645,365	53.9	53.3	54.7	52.2	1,505,796	53.6	53.2	52.5	50.3		
Age (years)												
≤ 17	532,228	17.6	17.6	2.9	2.9	494,942	17.6	15.4	12.6	15.6		
18–34	690,036	22.9	20.3	45.4	34.9	559,239	19.9	19.7	39.4	27.8		
35–49	640,355	21.2	21.0	28.9	31.0	562,006	20.0	17.5	26.1	25.2		
50–64	595,434	19.7	20.0	12.4	18.6	634,634	22.6	25.1	13.1	19.0		
≥ 65	561,361	18.6	21.0	10.3	12.7	559,940	19.9	22.3	8.7	12.4		
Mean age	41.5	41.5	42.9	39.5 (2011)	42.7 (2011)	43.1	43.1	45.2	37.2 (2021)	39.9 (2021)		
Ethnicity												
Lithuanian	2,516,314	82.4	90.8	92.6	91.0	2,378,118	84.6	90.7	91.3	90.8		
Non-Lithuanian	503,296	16.5	7.1	2.9	4.7	383,010	13.61	7.7	5.0	5.7		
Not indicated	32,978	1.1	2.1	4.5	4.3	49,633	1.8	1.6	3.7	3.6		
Education (> 10 years old)												
Primary	448,865	16.4	20.9	8.8	9.2	308,809	12.2	14.0	13.7	16.9		
Secondary	1,701,804	62.2	66.6	66.1	73.6	1,541,813	60.8	68.5	55.9	65.0		
Tertiary	584,807	21.4	12.5	25.1	17.2	684,844	27.0	17.5	30.4	18.1		
Family status (≥ 15 years old)												
Married	1,291,143	50.3	49.1	50.0	46.8	1,184,531	49.5	46.3	48.3	42.8		
Divorced	281,254	10.9	10.2	13.1	17.8	297,745	12.4	12.3	13.8	18.1		
Widowed	297,279	11.6	13.7	7.7	8.6	219,444	9.2	10.9	5.1	6.5		
Single	699,349	27.2	27.0	29.2	26.8	691,970	28.9	30.5	32.8	32.6		
Employment status (≥ 15 years old)												
Low-ranking occup.	103,808	4.0	4.3	4.4	4.5	133,110	5.6	6.0	5.9	6.2		

(Continues)

TABLE A1 | (Continued)

	2011			2001–2011			2021			2011–2021		
	Total in Lithuania	Total in Lithuania, %	PRR, %	Moved from PRR, %	Moved to PRR, %	Total in Lithuania	Total in Lithuania, %	PRR, %	Moved from PRR, %	Moved to PRR, %		
Middle-ranking occup.	673,219	26.2	23.9	31.4	28.4	667,321	27.9	28.8	33.1	30.1		
High-ranking occup.	397,929	15.5	9.7	16.7	11.2	465,099	19.4	12.2	21.0	12.4		
Unemployed	290,735	11.3	13.4	15.8	18.8	211,269	8.8	10.3	11.5	13.9		
Students	282,953	11.0	11.1	9.8	8.8	171,573	7.2	7.4	7.2	8.4		
Non-participating ^a	820,205	31.9	37.6	22.0	28.3	745,312	31.1	35.4	21.2	29.0		
Migration												
To/From abroad				4.8	1.4				1.5	5.4		
To/From another peripheral region (PRR)				41.9	49.0				35.9	52.9		
To/From city (CCM)				26.3	16.9				34.0	12.2		
To/From periurban region (C)				5.3	5.7				6.1	4.2		
To/From transition area (T)				10.3	11.0				8.9	12.6		
To/From suburbs (CPR)				5.6	3.2				9.0	4.2		
To/From unknown				5.8	12.9				4.5	8.5		

^aOver 65, housewives, disabled, missing information.