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The empirical evidence of digital trends in more disadvantaged European Union regions in terms of income and population density

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Abstract

Remote rural and postindustrial regions are much more vulnerable to population drain in comparison with industrialized centers and capitals, due to obvious reasons such as meager job opportunities, difficulties in accessing public services in education, healthcare and transport, housing, entertainment, lack of integration with other territories and, finally, less advanced levels of digitalization. This represents an open challenge for the European Union within the framework of its Cohesion Policy. This paper analyzes the impact of digital trends, represented by the percentage of the population with access to internet and broadband and the percentage of individuals who buy goods and internet services (percentages provided by Eurostat) in less populated EU NUTS2 regions with lower income, on the crude population growth rate composed of natural changes in population and migratory flows and on the unemployment rate by applying panel data analysis. It has been possible to confirm that digitalization has a positive impact on natural changes in population in EU regions with lower economic development. On the contrary, the unemployment rate does not affect natural changes in population, but it does have a negative impact on migratory flows. The findings show that digitalization may contribute to reversing negative demographic trends in more disadvantaged EU regions in terms of income and population density.

KEYWORDS

depopulation, digitalization, EU regions, European Union, panel data analysis

1 | INTRODUCTION

Digital technologies dramatically transformed the way people lived in the past decade and they will continue to do so in the future. The importance of striving towards an equal and parallel deployment of these technologies is particularly evident in isolated rural regions and regions in the process of industrial transition, inasmuch as it reduces the gap of attractiveness and digital divide and thus contributes to reversing negative demographic trends. This gap between capital/metropolitan regions and more peripheral areas not benefiting from quality services in energy, transport and digital connectivity was highlighted in the Report of the European Parliament (2021).

Although the problem of basic access to internet and broadband, for example, is almost solved owing to the EU's efforts to accelerate the roll-out of broadband infrastructure, very high-speed connections are only available to two out of three city residents and one in six rural residents. In this regard, the investment for the digitalization of EU regions is a top priority for the European Union's Regional Policy, since it has the potential to reduce distances between users and to attract highly skilled workers to avoid the digital divide and ensure digital cohesion.

The EU cohesion policy aims to correct imbalances between countries and regions. The policy is implemented by national and regional bodies in partnership with the European Commission. The EU cohesion policy has set a shorter, more modern menu of five policy objectives supporting growth for the period 2021–2027.[1] The political priorities are specially focused on the green and digital transition. Not only does the digitalization of EU regions aim to make Europe more connected but may also contribute to achieving its other main objectives within the framework of the Cohesion Policy, such as making Europe more social and competitive, smarter and closer to citizens by fostering the sustainable and integrated development of all regions.

It is worth mentioning that remote rural and postindustrial regions are much more vulnerable to population drain in comparison with industrialized centers and capitals, due to obvious reasons such as meagre job opportunities, difficulties in accessing public services in education, healthcare and transport, housing, entertainment, lack of integration with other territories and, finally, less advanced levels of digitalization. With regard to the latter reason, this article analyzes the impact of digital trends, represented by the percentage of the population with access to internet and broadband and the percentage of individuals who buy goods and internet services (percentages provided by Eurostat) in less populated EU NUTS2 regions with lower income, on the crude population growth rate composed of natural changes in population and migratory flows.

The paper is organized as follows: after the introduction, we provide a literature review with respect to depopulation and digital trends, including their impact on labor market. We then present the selection of the data sample, including the Covid 2019 period, in terms of population and population density supported by description statistics. The next section describes the model and provides empirical evidence that digitalization may contribute

[1]See Economic, social and territorial cohesion available at: https://www.europarl.europa.eu/factsheets/es/sheet/93/la-cohesion-economica-social-y-territorial.

to reversing negative demographic trends in more disadvantaged EU regions in terms of income and population density. The final section provides the conclusions.

2 | LITERATURE REVIEW

There is no doubt about the exponential growth experienced by the rates of access to and use of information and communication technologies (ICT) throughout the world during the last decade (ITU, 2019; World Bank, 2019). However, this growth has been heterogeneous among the population and in the territory, taking into account elements such as training or ability to use or access to ICTs according to places of residence; that is, taking into account the educational, socioeconomic and geographical perspectives (UN, 2019). This is what gives rise to what is known as digital inequalities or the digital gap (Anderson et al., 2001; Castells, 2005; Kularski & Moller, 2012; Norris, 2001; Van Dijk & Hacke, 2003). In this regard, Glass and Stefanova (2010) argued that studies on the digital divide generally find a correlation between adoption and socioeconomic factors such as age, race, income and education as the most significant. However, if in the past social exclusion was mainly related with unemployment, poor job skills, low income and poor housing and neighborhoods (Social Exclusion Unit, 1998), nowadays digital inclusion is a key issue across several Sustainable Development Goals (SDGs). On this point, digital inclusion as a human right (United Nations Secretary General's High-Level Panel on Digital Cooperation, 2019) has been proclaimed in the United Nations' "Declaration of Digital Interdependence."

The report published by the International Telecommunication Union (ITU) (2017) underlines that the provision of telecommunication/ICT services is generally not lucrative in sparsely populated rural areas, and low-income regions network operators are not keen to invest in low-income regions, mainly due to high capital expenditure and operational expenditure costs (Chiaraviglio et al., 2017). Therefore, its development requires the implementation of special policies, initiatives, and government subsidies. In this regard, the institutional component of the aforementioned digital inequalities should not be forgotten involving the capacities of the different competent administrative levels to supervise, support and regulate, in a coordinated manner, the telecommunications market, stimulating the formulation of public policies in favor of the most vulnerable elements (population sectors, certain territories or production sectors) and that cause a change in the trends of depopulation in lower-income depopulated areas. Thus, for instance, in Italy within National Strategy for Inner Areas (Strategia Nazionale per le Aree Interne), partly financed by the regional operational programs and partly co-financed at national level, the reduction of depopulation was combined with a local development policy based on territorial specificity while being implemented on small groupings of municipalities (Barca et al., 2014; Lucatelli and Monaco, 2018).

It is reasonable to expect digitalization to significantly generate and provide multiple services: teaching, work, leisure, commerce, health care, attention and care for citizens, as well as offering the opportunity to optimize existing services and create new business models (Guerrero, 2019). These possibilities exist for the entire population, but it is true, however, that some are much more important for depopulated areas.

Depopulation is a demographic and territorial phenomenon by which a reduction in the number of inhabitants occurs with respect to a previous period of time. This reduction could have occurred as a consequence of negative natural growth, negative net migration, or both causes at the same time. On the other hand, Navarro et al. (2023) highlight that depopulation mostly reflects a particular situation of rural municipalities, in terms of settlement, so that these areas reach extremely low population densities and a high degree of population aging. In this regard, Zavratnik et al. (2018) analyze how in Smart Villages traditional and new networks and services are enhanced through digital technologies, telecommunications, innovations, and better use of knowledge for the benefit of residents and companies. This impact is precisely what can cause a population effect on the population's permanence and reverse the migratory phenomenon of rural areas or zones with greater exposure to depopulation, with the consequent process of regional demographic rebalancing. However, it must be admitted that this process is not free of difficulties, related to the insufficiencies in broadband infrastructure, the availability of digital services and digital literacy, together with the poor diversification of the economy, the low incomes added to a greater risk of poverty and social exclusion the abandonment of agricultural land or the high number of people who leave education and training prematurely (Martínez & McEldowney, 2021). This theoretical framework of Smart Villages is closely related to the Cork Declaration 2.0 (Unión Europea, 2016) of the European Parliament on a better life in rural areas (which includes a series of objectives with the aim of the revitalization and prosperity of rural areas) within the framework of a broader theme referring to "smart and competitive rural areas."

It is worth mentioning that digitalization processes have a sociodemographic impact, with spatial repercussions, a consequence of population movements (migratory flows) in search of better job opportunities and, therefore, on the gross population rate of the different territories. Speaking about the relationship between labor market and digitalization, it is worth mentioning that there is not a common point of view among scholars in this regard. Thus, some research such as Ezell (2016) and Haykal and Makki (2022) show a statistically significant negative relationship between digitalization and unemployment rates. Bertani et al. (2020) analyzed whether digital transformation significantly impacts productivity and unemployment and confirmed a significant correlation between technology investments and labor and total factor productivity while technological unemployment would enhance in the long term. Abbasabadi and Soleimani (2021) argue that there is an inverted U-shaped relationship between digital technology and unemployment rates. Başol and Yalçın (2021) pointed out that the long-term unemployment rate decreased in EU countries with the digital economy process. Bogoslov et al. (2022) confirmed the existence of a strong positive correlation between digitalization and labor market indicators such as employment rates, labor force participation and unemployment rates. Koç and İzgi-Şahpaz (2023), on the contrary, stress that their findings show no causality relationship between digitalization and unemployment rates while analyzing the case in Turkey. However, based on the literature review, it can be concluded that the majority of the authors confirm a positive correlation between digitalization and labor market indicators.

In essence, the key factor to stopping human capital flight and attracting new residents is a dynamic labor market with new job opportunities and a low unemployment rate. According to Leitner and Stehrer (2019), the employment challenges posed by the new technologies should be also analyzed from the demographic trend which is characterized by a decline in the working-age population, especially in the European countries. To combat this issue of decline in labor supply, the authors argue that higher labor productivity growth could be an alternative to sustain GDP growth. Starting from this point, the level of digitalization and digital skills are essential to increase productivity and reverse negative demographic trends. Moreover, it is important to promote a positive attitude towards digitalization among the population and to leave no one behind. In this regard, Vasilescu et al. (2020) while analyzing the EU citizens' attitude towards digitalization confirm that digitalization and automation are primarily treated as opportunities. Nevertheless, by applying cluster analysis to obtain the homogeneous groups of EU citizens in terms of their attitudes towards digitalization, the abilities to use ICT at work and the actual use of the Internet, the authors highlight the most vulnerable category in digitalization era, especially the latter citizens from countries such as Hungary, Greece, Romania and Bulgaria.

On the other hand, the concept of the digital divide was initially proposed at the beginning of 21st century with a view to describing the disproportion of people who have and do not have internet access (Blank & Lutz, 2018). However, lately the concept has become broader, and has started to cover diverse aspects of ICT within and between counties (Chen & Wellman, 2004). According to UNDESA (2016), the Digital Divide refers to the gap between individuals, households and businesses at different socioeconomic levels with regard to both their opportunities to access to ICTs, and their use of the Internet for a wide variety of activities. In this regard, Ahmad et al. (2019) proposed analytical frameworks for measuring the digital divide. More recent investigations conduct their studies on large sets of variables, performing cross-sectional analysis or time-series analysis (Gunn et al., 2019). Nevertheless, Eurostat provides a quite modest set of basic indicators related to ICT connectivity at the regional level.[2] We further focus on three main indicators provided by Eurostat: internet access, broadband access and e-commerce use.

[2]See *Digital economy and society statisticshouseholds and individuals*, available at: Digital economy and society statistics—households and individuals—Statistics Explained (europa.eu).

According to Eurostat (2021), the share of EU households with internet access had risen to 92%, some 20% points higher than in 2011 (72%). Nevertheless, it is worth mentioning the urban—rural divide that exists within the EU in terms of internet access. Whereas households in cities as well as towns and suburbs had comparatively high access rates—94% in cities and 92% in towns and suburbs—internet access was somewhat lower in rural areas (89%). In 22 EU Member States, the proportion of households in rural areas with internet access was lower than the equivalent proportions of households in cities or in towns and suburbs. In this regard, ITU (2017) suggests that the real significance of the urban-rural digital divide may lie in supporting and underpinning existing macro- and micro-economic activities, as well as the redistribution of existing activities, potentially enabling new forms of economic activity in a new digital reality and enabling personal fulfillment factors.

The divide between rural areas and the two other types of areas is particularly notable in Bulgaria, Portugal, Greece, Croatia and Romania, each of which had a lower overall level of internet access than the EU average (Eurostat, 2021). Angelovska (2018) highlights uselessness, lack of skills, high cost of access and equipment and the concerns about privacy or security as the most prevalent reasons for not having internet among Europeans.

The creation of quality jobs, or the development of new business models through digital technologies (modularity, open innovation and platforms, among others) are key factors to reinforce the potential of rural areas by creating Smart Villages, with a view to face current challenges such as, for example, climatic and environmental disasters or globalization of markets (Autio et al., 2018; Baskerville et al., 2020; Furlonger & Uzureau, 2019; Stallkamp & Schotter, 2021; Sturgeon, 2021). In this regard, internet and broadband access is a prerequisite for further ICT development of these areas.

In the last decade, an extensive range of macro-level studies has provided empirical evidence on the positive effect of broadband adoption on economic growth (see Bertschek et al., 2013; Greenstein & McDevitt, 2011; Holt & Jamison, 2009; for comprehensive literature reviews). It is widely accepted that there is a positive relation between broadband adoption, broadband availability and economic growth, especially as measured by GDP at the national and regional level. A positive relation has also been found by Gillet et al. (2006), Crandall et al. (2007) and Ford (2018), among others, between broadband availability and employment at the macro level. They find that communities with broadband experienced a more rapid growth in employment and a faster firm growth than non-broadband communities, especially in IT-intensive sectors. Gruber et al. (2014) show that the economic benefits that would be derived from achievingthe objectives of the 2020 Digital Agenda for Europe outweigh the costs of investment. They show that the economic benefits mostly spill over to users and to the national economy, highlighting the rationale for public subsidies in the roll-out of broadband networks. Canzian et al. (2015) find a positive impact of broadband diffusion on firm performance, especially in rural areas, while Briglauer et al. (2019) find a positive effect on depopulation reduction in rural areas. However, recent research points out that profit-based discrimination occurs in remote, isolated regions with a high percentage of low-income minorities in comparison to large metropolitan areas (Oyana, 2011). In this regard, Reddick et al. (2020) highlight that the inverse relationship between infrastructure costs and broadband access is more evident if we focus on factors such as population density, availability of similar services, and the level of broadband speed and performance.

Regarding geographical coverage with respect to broadband access in Europe, there are research studies that focus on one particular country (see, for instance, papers about the UK, by Choudrie & Dwivedi, 2006; about Germany, by Czernich, 2014; about Netherland, by Salemink et al., 2017; about Spain, by Ruiz and Esparcia, 2020; and about Sweden, by Hasbi & Bohlin, 2022). Barbero and Rodriguez-Crespo (2018) focused on the EU NUTS- 2 regions to analyze the effect of broadband on EU trade, while Garashchuk et al. (2023) provide empirical evidence, that digitalization of EU NUTS-2 regions with lower incomes via broadband access may contribute to reversing negative demographic trends.

Likewise, e-commerce is one of the sectors directly influenced by technological change (Jaković et al., 2021). According to Eurostat, more than half of the EU population (60%) ordered merchandise or a service online in 2019, almost double from 2009 (32%). This percentage is even higher among younger groups. In 2021 the proportion of individuals aged 16–74 in the EU who ordered or bought goods or services over the internet for private use stood at 66%, an increase of 15 percentage points when compared with 2016. The highest results were seen in Sweden and Ireland (both 87%), the Netherlands (89%) and Denmark (91%) at the top, while this proportion was the lowest in Romania (38%) and Bulgaria (33%) (Eurostat, 2021). Although sales in the EU still predominantly take place offline and purchases are still predominantly made with cash, both online shopping and cashless electronic payments are booming and are among the key drivers of the digital transformation taking place in the EU economy and society (Negreiro, 2020). As e-commerce provides various benefits such as overcoming geographical barriers by the use of ICTs and consolidates dispersed markets, which results in a much greater supply of products and services offered by e-commerce enterprises (Jaković et al., 2021), we argue that e-commerce, together with other main factors mentioned above, such as internet and broadband access, may contribute to reversing negative demographic trends. In other words, in line with our research, we analyze the impact that the aforementioned digital trends may produce on the crude rate of total population change, composed of natural changes in population and migratory flows in EU NUTS-2 regions with lower incomes and lower population density. However, we have not found a literature review, especially with empirical evidence, related to the estimations of the impact of digitalization on the crude rate of total population change besides our previous research (Garashchuk et al., 2023), where it was analyzed only one digital variable "Broadband Access." In this sense, our research aims to continue contributing to fill this gap.

The data sample and the methodology are described in the next section.

3 | DEPOPULATION AND LEVEL OF ECONOMIC DEVELOPMENT IN THE EU REGIONS

In more unfavorable regions in terms of the level of economic development and population, digitalization measured through an Internet connection can be decisive, or at least more significant or relevant when explaining migratory flows or natural population change. In less developed regions and with a lower population density, the average levels of digitalization are below those achieved in the more developed regions. This idea could justify that greater growth in the digitalization process could increase their population favoring certain migratory flows and slowing down the phenomenon of depopulation in the most affected municipalities.

Depopulation is a more typical phenomenon in rural areas,[3] which according to Eurostat represents about 30% of the NUTS-3[4] in contrast to urban areas, which constitutes about 26% (see Figure 1).

According to Eurostat data, in the year 2021, rural regions have an average population density of 84.9 persons/km^2, with a minimum of 1.3 persons/km^2 and a maximum of 1109.7 persons/km^2. Urban areas, representing 26.3% of the regions, have an average population density of 1279.5 persons/km^2, with a minimum value of 49 persons/km^2 and a maximum of 20897.1 persons/km^2.

Focusing on NUTS2 regions (see Figure 2 on the left), the median population density stands at 119.1 persons/km^2, with a minimum value of 3.4 persons/km^2 and a maximum of 7560.8 persons/km^2.

Speaking about levels of economic development,[5] according to the official EU Eurostat classification, between 2006 and 2021, the number of more developed regions gradually decreased from 138 to 115, while the regions in transition and the less developed ones increased from 38 to 50 and from 66 to 77, respectively.[6] The distribution by quartiles of the regions in 2021 is shown in Figure 2 (on the right).

We are going to consider that the areas at risk of depopulation are the ones identified within those NUTS-2 regions with less economic development and a population density (see Figure 3) lower than the second quantile

[3]The classification of rural or urban areas in the 27 EU countries is only available for NUTS3 territorial units.

[4]Available at: https://ec.europa.eu/eurostat/web/regions/data/database.

[5]The regions have been differentiated by levels of economic development according to the Cohesion Policy criteria EU on the basis of NUTS-2 Eurostat classification: 0101EN.pdf (europa.eu).

[6]The shifts of some regions from the more developed regions to the group of transition or to the group of less developed regions are primarily due to the consequences of the economic crisis that began in 2008.

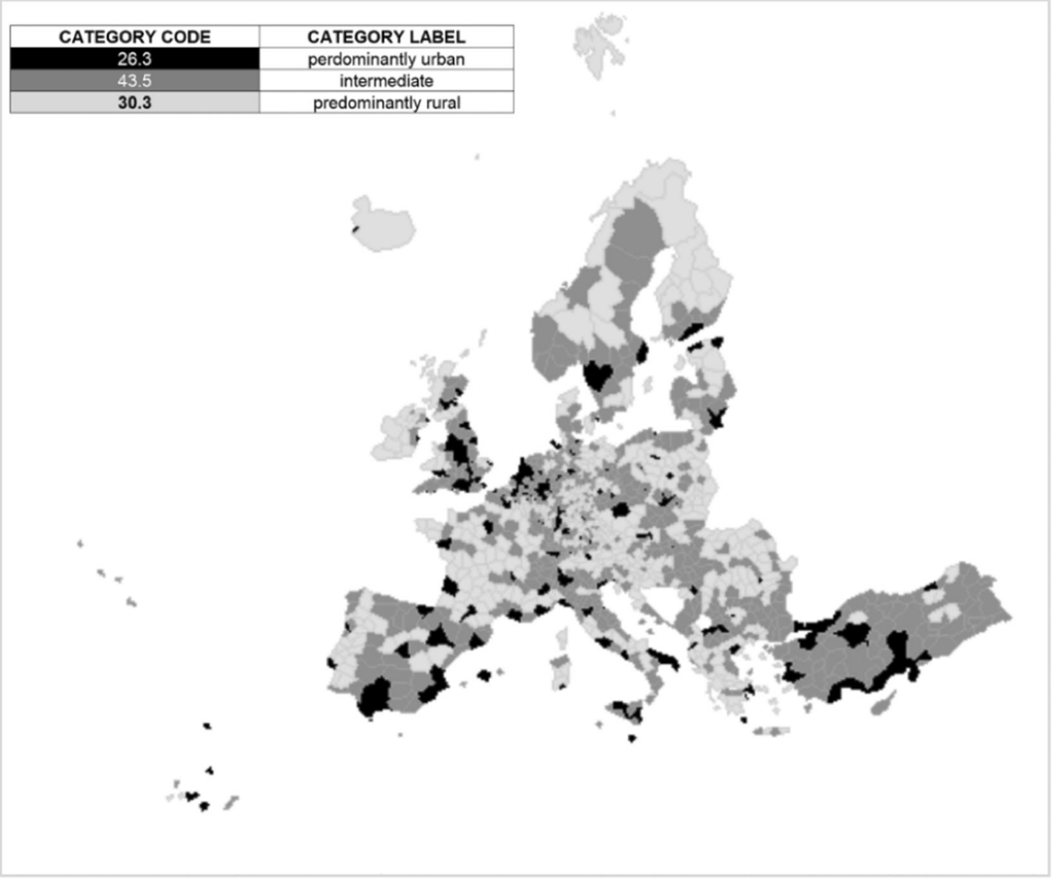

FIGURE 1 Rural Europe and Urban Areas (2021). Source: Eurostat (2021) and own elaboration.

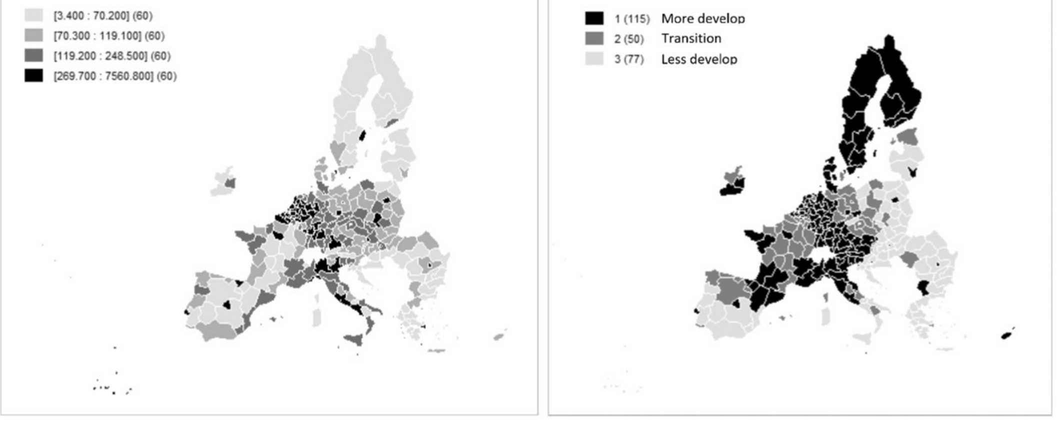

FIGURE 2 Population density and level of economic development of the EU regions. Source: Eurostat (2021) and own elaboration.

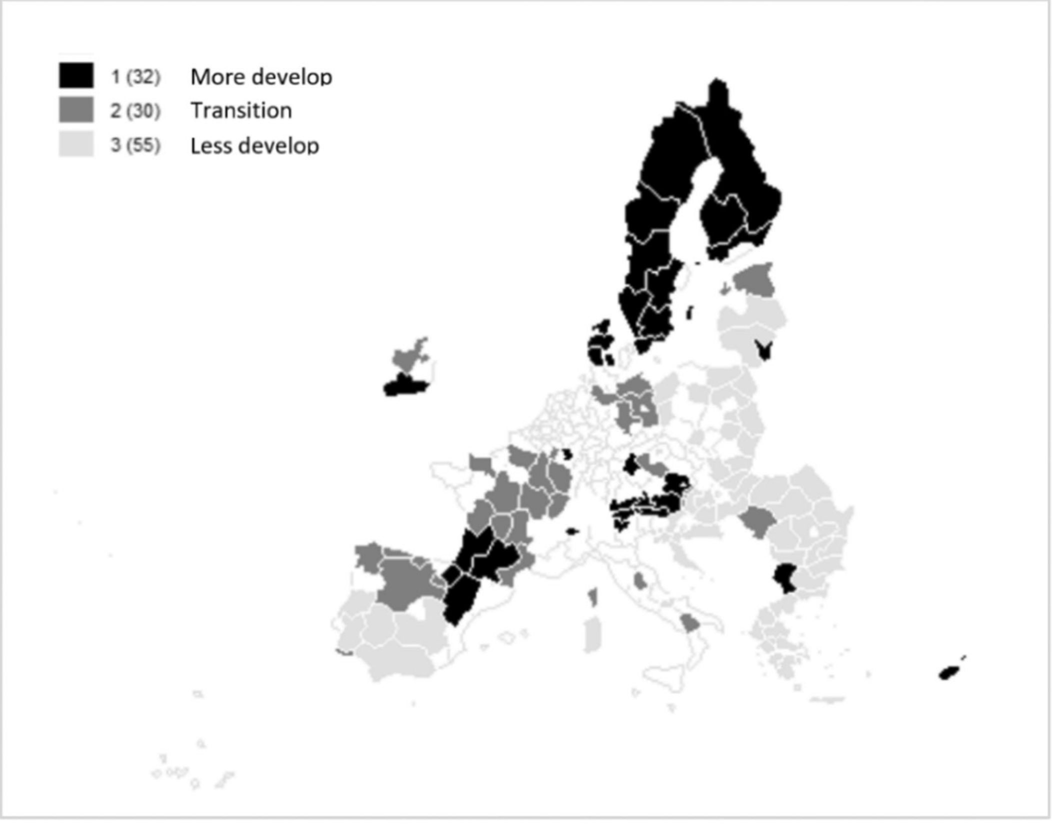

FIGURE 3 Areas at risk of depopulation of the EU regions. Source: Eurostat (2021) and own elaboration.

value in the EU (119.1 persons per square kilometer). The Figure 3 identifies 55 regions with less economic development and low population density (light gray) that are concentrated in 14 countries and 236 NUTS-3 territorial units (130 rural, 98 intermediate and eight urban regions).[7] Likewise, there are 32 regions with greater economic development and low population density (black) basically concentrated in the northern and central parts of Europe (12 countries and 112 NUTS3 territorial units). In this case, NUTS-3 territorial units are concentrated in 60 rural, 44 intermediate and eight urban regions. All in all, areas at risk are concentrated in 87 NUTS2 and 348 NUTS3 (23% and 30% respectively).

4 | DATA PANEL: DESCRIPTIVE ANALYSIS

The data panel[8] of the areas at risk of depopulation for the 2006–2021 period is made up of two groups of variables for the econometric model: population movement flows that constitute the dependent variables, and digitalization and the labor market that represent the independent variables.[9] Dependent variables are the crude

[7]See Table A1 of the Appendix A. There are 242 NUTS2 and 1166 NUTS3 territorial units according to Eurostat.

[8]The information regarding all indicators at the NUTS2 level (242 regions) used in this research is available at https://ec.europa.eu/eurostat/web/regions/data/database. Most of the information about these indicators covers the period from 2006 to 2021.

[9]See Table A2 of the Appendix A (dependent variables) and Table A3 of the Appendix A (independent variables) for the means values in the data panel.

rate of natural change of population (NATGROWRT),[10] the crude rate of net migration plus statistical adjustment (CNMIGRATRT)[11] and finally the crude rate of total population change (GROWRT), being the sum of the two rates mentioned above. Independent variables are the percentage of the population with access to broadband internet (BROADBAND), the percentage of families with access to the Internet (INTERNET) and the percentage of individuals who buy goods and services online (E-COMMERCE). Finally, the unemployment rate (UNEMPLOY) has been included, which controls population movements associated with labor market conditions.

Figure 4 shows the temporal evolution of population movements. Until 2014, there had been a reduction in natural and migratory flows. As of that year, population flows begin to increase thanks to migrations until the arrival of COVID-19. With the pandemic, the drop in the gross rate of population change was critical (reaching the figure of −2.9 people per 1000 inhabitants). If we differentiate by levels of development (see Figure 4) the drop in the less developed regions has been almost five times more. On the other hand, in the more developed regions the gross rate of population change has remained at positive values (around an average of 4.3 people per 1000 inhabitants) thanks to migratory flows.

The digitalization process has maintained a clear trend of convergence between regions (see Figure 5). This is not the case in terms of unemployment, where although a convergence process can also be seen, although there is a significant differential, despite greater job destruction in the more developed regions, caused by the pandemic of Covid-2019.

In the areas at risk of depopulation, a positive relationship is expected between digitization and population flows, while the relationship between unemployment and population movements should be negative. Table 1 shows cases of positive and significant correlation at 1%, 5%, and 10% levels between digitization (ΔBROADBAND)[12] and NATGROWRT. On the left are regions with lower development, and on the right are those with higher development. Out of a total of 29 regions,[13] only 12 showed a direct and significant relationship. In the case of the most developed regions with low population density, half of them[14] showed a positive and significant correlation. Figure 6 displays the point clouds corresponding to Portugal (Centro) and Spain (Comunidad Foral de Navarra). Table 2 and Figure 7 show cases of negative and significant correlation between the unemployment rate and migratory flows. Additionally, two particular cases are highlighted, corresponding to the region Közép-Dunántúl (Hungary) and Southern (Irland).[15]

5 | HYPOTHESIS, ECONOMETRIC MODEL, AND RESULTS

The hypotheses are the following hypotheses:

H1. Digitalization has a positive influence on natural change of population.

H2. In the most disadvantaged regions in terms of level of economic development and population density, the impact of digitization on migratory flows is more relevant.

H3. Unemployment does not have influence on natural change of population.

[10]The crude rate of natural change is the ratio of the natural change during the year (live births minus deaths) to the average population in that year. The value is expressed per 1000 persons.

[11]The crude rate of net migration plus adjustment is defined as the ratio of net migration (including statistical adjustment) during the year to the average population in that year. The value is expressed per 1000 persons.

[12]Annual growth rate using logarithmic approximation: ΔLn (BROADBAND)×100

[13]The regions with a population density below the average and lower economic development consist of 55 regions. However, only 29 of them have information for all the selected indicators.

[14]The regions with a population density below the average and higher economic development consist of 32 regions, but only 24 of them have information for all the selected indicators.

[15]Table A5 of the Appendix A contains all correlations for 29 less developed regions. Table A7 of the Appendix A contains all correlations for 24 more developed regions.

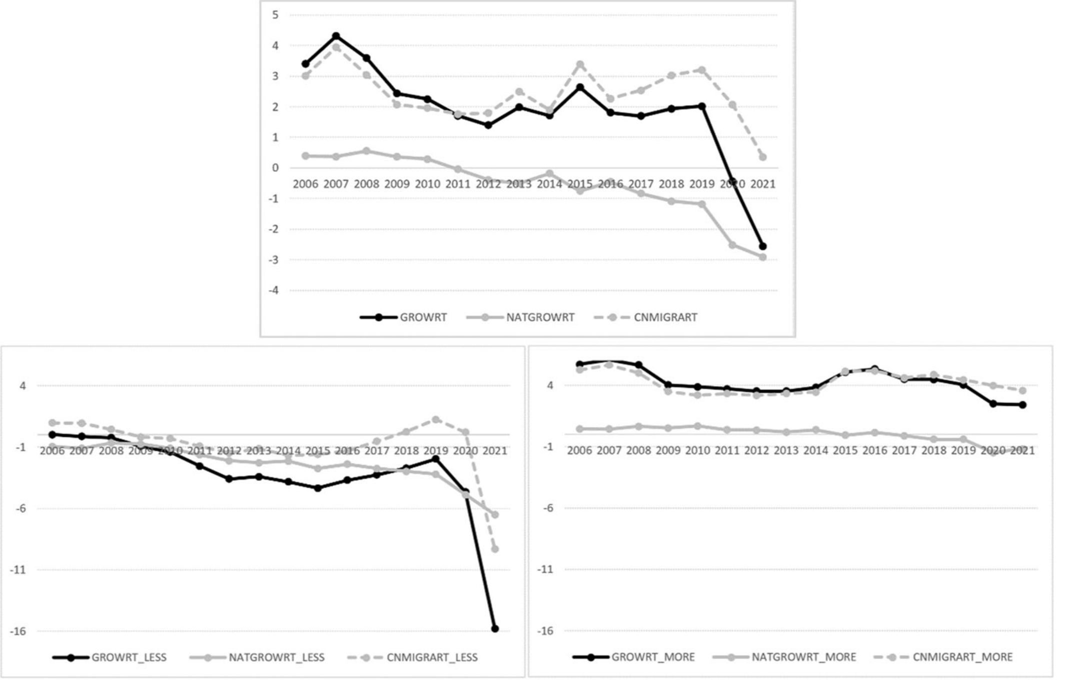

FIGURE 4 Mean population flows of EU regions with less population density. Source: Own elaboration based on Eurostat data.

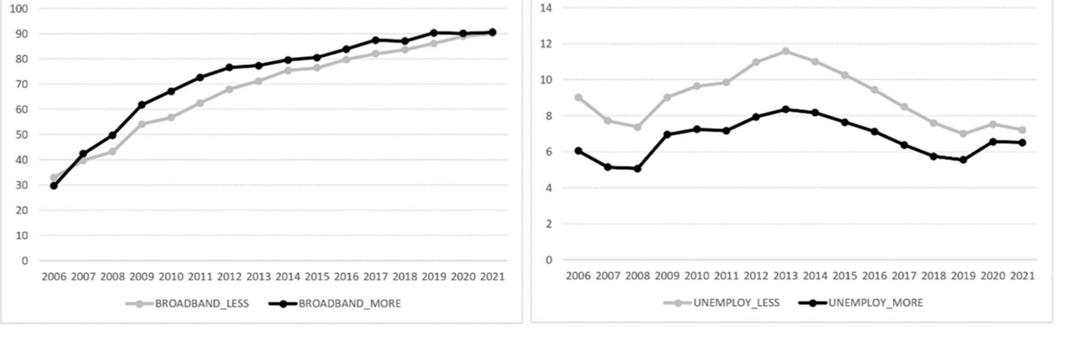

FIGURE 5 Mean of digital and unemployment rate variables of EU regions. Source: Own elaboration based on Eurostat data.

H4. Unemployment has a negative influence on migratory flows.

To test the above hypotheses, the following econometric model applied to a static panel is formulated[16]:

[16]The fixed and random effects models are the usual specifications for analyzing the heterogeneity between the units observed when working with a data panel (see, e.g., Baltagi, 2008 and Wooldridge, 2010). Depending on the type of "unobservable" heterogeneity in the static panel, the consistency of the

TABLE 1 Analysis of correlations between variables NATGROWRT and BROADBAND.

	Less developed					More developed			
	Country	NUTS2	BROADBAND	*p*-value		Country	NUTS2	BROADBAND	*p*-value
1	Bulgaria	BG31	0.36	0.10*	1	Austria	AT12	0.54	0.02**
2	Spain	ES42	0.67	0.00***	2	Austria	AT21	0.64	0.00***
3	Spain	ES43	0.63	0.00***	3	Austria	AT33	0.38	0.09*
4	Spain	ES61	0.76	0.00***	4	Denmark	DK03	0.57	0.01**
5	Croatia	HR03	0.65	0.00***	5	Denmark	DK04	0.50	0.03**
6	Italy	ITF2	0.62	0.00***	6	Spain	ES22	0.75	0.00***
7	Italy	ITG2	0.63	0.00***	7	Spain	ES24	0.67	0.00***
8	Portugal	PT16	0.73	0.00***	8	Finland	FI1D	0.74	0.00***
9	Portugal	PT18	0.50	0.02**	9	Ireland	IE05	0.94	0.00***
10	Romania	RO31	0.41	0.09*	10	Italy	ITH1	0.68	0.00***
11	Romania	RO41	0.40	0.09*	11	Italy	ITH2	0.61	0.00***
12	Slovenia	SI03	0.59	0.07*	12	Sweden	SE22	0.45	0.08*

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Source: Own elaboration based on Eurostat data.

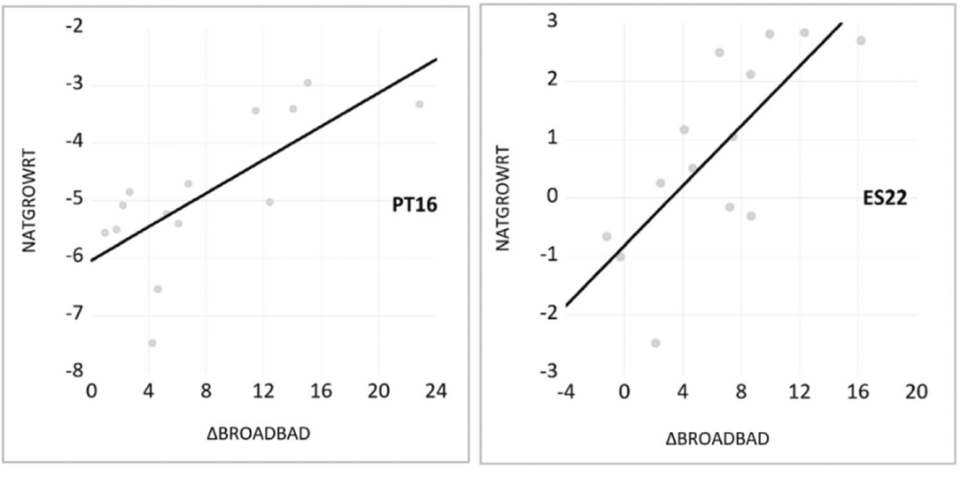

FIGURE 6 Point clouds for Portugal (Centro) and Spain (Comunidad Foral de Navarra). Source: Own elaboration based on Eurostat data.

$$GROWRT_{it} = (a + u_i) + bDIGITAL_{it} + cUNEMPLOY_{it} + \varepsilon_{it} \quad (1)$$

$$NATGROWRT_{it} = (a + u_i) + bDIGITAL_{it} + cUNEMPLOY_{it} + \varepsilon_{it} \quad (2)$$

estimator can be guaranteed either with the fixed effects estimator, also called the "within" estimator, or with the random effects estimator (Wooldridge, 2010 and Hill et al., 2018),

TABLE 2 Analysis of correlations between variables CNMIGRATRT and UNEMPLOY.

	Less economic development					More economic development			
	Country	NUTS2	UNEMPLOY	p-value		Country	NUTS2	UNEMPLOY	p-value
1	Bulgaria	BG33	−0.44	0.03**	1	Denmark	DK03	−0.45	0.03**
2	Bulgaria	BG42	−0.48	0.02**	2	Denmark	DK04	−0.58	0.00***
3	Spain	ES42	−0.94	0.00***	3	Denmark	DK05	−0.42	0.05**
4	Spain	ES43	−0.83	0.00***	4	Spain	ES22	−0.97	0.00***
5	Spain	ES61	−0.92	0.00***	5	Spain	ES24	−0.77	0.00***
6	Hungary	HU21	−0.71	0.00***	6	Ireland	IE05	−0.88	0.00***
7	Hungary	HU22	−0.67	0.00***	7	Italy	ITH2	−0.42	0.04**
8	Hungary	HU31	−0.74	0.00***	8	Sweden	SE21	−0.43	0.04**
9	Portugal	PT16	−0.68	0.00***	9	Sweden	SE22	−0.58	0.00***
10	Portugal	PT18	−0.61	0.00***	10	Sweden	SE23	−0.51	0.01**
11	Romania	RO41	−0.33	0.09*	11	Sweden	SE32	−0.36	0.07*
12	Slovenia	SI03	−0.79	0.00***	12	Sweden	SE33	−0.50	0.02**

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.
Source: Own elaboration based on Eurostat data.

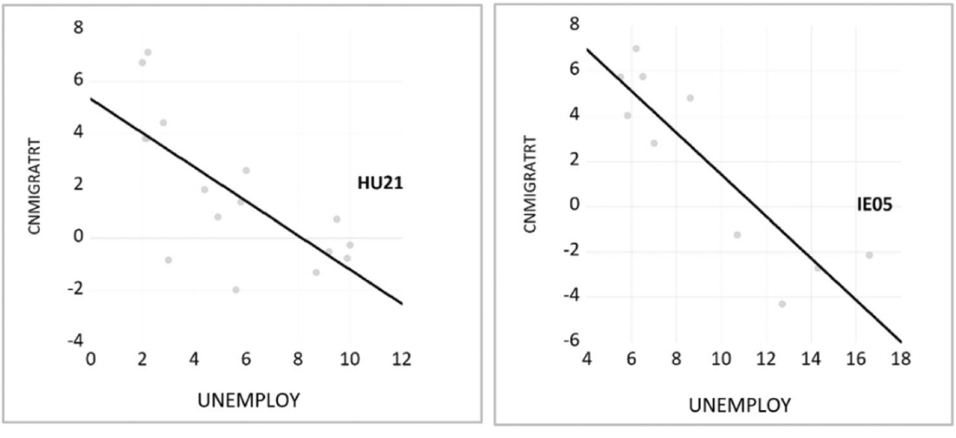

FIGURE 7 Point clouds for Közép-Dunántúl (Hungary) and Southern (Irland). Source: Own elaboration based on Eurostat data.

$$CNMIGRATRT_{it} = (a + u_i) + bDIGITAL_{it} + cUNEMPLOY_{it} + \varepsilon_{it} \quad (3)$$

The variable u_i represents the unobservable heterogeneity in the fixed character panel and ε_{it} represents which is the usual regression random error.

To address the phenomenon of depopulation and verify the hypotheses, two samples will be differentiated, on which the econometric model will be estimated. The most disadvantaged NUTS2 regions will be included in the first sample, that is, the NUTS2 regions with less economic development and population density below the median value in the panel. Using this criterion, the selected sample for the most disadvantaged NUTS2 regions includes a

TABLE 3 Tests for the endogeneity.

Less economic development			More economic development		
Dependent Variable: GROWRT			**Dependent Variable: GROWRT**		
Variable	**ΔJ-Statistic**	**Prob.**	**Variable**	**ΔJ-Statistic**	**Prob.**
ΔBROADBAND	26.8222	0.0000***	ΔBROADBAND	7.1350	0.0076***
UNEMPLOY	3.7403	0.0531*	UNEMPLOY	0.9982	0.3177
Dependent Variable: NATGROWRT			**Dependent Variable: NATGROWRT**		
Variable	**ΔJ-Statistic**	**Prob.**	**Variable**	**ΔJ-Statistic**	**Prob.**
ΔBROADBAND	33.5241	0.0000***	ΔBROADBAND	16.4338	0.0001***
UNEMPLOY	0.8605	0.3536	UNEMPLOY	0.0061	0.9390
Dependent Variable: CNMIGRAT			**Dependent Variable: CNMIGRAT**		
Variable	**ΔJ-Statistic**	**Prob.**	**Variable**	**ΔJ-Statistic**	**Prob.**
ΔBROADBAND	3.2427	0.0717*	ΔBROADBAND	1.4188	0.2336
UNEMPLOY	9.8625	0.0017***	UNEMPLOY	1.4490	0.2287

Note. Null hypothesis: exogenous variables.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.
Source: Own elaboration based on Eurostat data.

maximum of 29 regions and 14 years.[17] Alternatively, a second sample is considered, which includes the regions with more economic development and population density below the median value in the panel. This sample applied to the econometric model would allow the use of a maximum of 24 regions.[18]

Likewise, to control the possible biases derived from the endogeneity (Hill et al., 2018)[19] of the digitization and unemployment variables, the possibility of using some of the following instrumental variables is considered: the use of high technology sectors by the percentage of total employment (HIGHTECH_EMP), the percentage of level of tertiary education in the 25–64 age groups (TERTIARY_EDUC), the GDP per capita in euros at current market prices (GDP_PC) and the risk poverty rate (RISK_POVERTY) by the percentage of persons at risk of poverty or social exclusion.[20] Table A9 of the Appendix A shows the correlations between the digitalization variables and the instruments, highlighting the highest correlation with the GDP per capita and education variables.

In Table 3, the results of the endogeneity test applied to ΔBROADBAND and UNEMPLOY are shown. In less developed regions, it can be assumed that both variables are endogenous, ensuring asymptotic bias under OLS (Ordinary Less Square). In the case of more developed regions, unemployment is an exogenous variable in all cases. Therefore, it seems advisable to apply instrumental variables (IV).

Table 4a shows the results of the estimation of Equation (1) on the more disadvantaged regions in terms of level of economic development and population density (less developed) and the regions with more economic development and population density below the median value in the panel (more developed). Three models have

[17]Although the potential sample was 55 regions (see Figure 2) for the 2006–2021 period, due to data availability problems, the sample finally used represents an unbalanced panel. Depending on the variables considered, this number of observations may be more reduced. Finally, due to problems with outliers, 5 regions were removed from the sample: BG31, HR03, RO21, SK03 and SK04. The final sample includes 24 regions.
[18]Although there are 32 regions (see Figure 2) with this criterion, the data only allows working with 24 regions. Depending on the variables considered, this number of observations may be more reduced. Finally, due to problems with outliers, region LT01 was removed from the sample, so the final sample includes 23 regions.
[19]The Regressor Endogeneity Test, also known as the Durbin-Wu-Hausman Test, tests for the endogeneity of some, or all, of the equation regressors.
[20]Means values in the data panel show in Anexo 3.

TABLE 4a Fixed effects model (GROWRT).

Dependent Variable: GROWRT (Less developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
∆BROADBAND	0.3172	3.4300	0.0045
UNEMPLOY	−0.6201	−2.5687	0.0234
R^2 = 0.3691. Prob(J-statistic[a]) = 0.7244			
Obs: 244 (14 periods and 24 cross-sections).			
∆INTERNET	0.6175	3.5425	0.0036
UNEMPLOY	−0.6609	−2.8278	0.0143
R^2 = 0.3208. Prob(J-statistic[a]) = 0.2016.			
Obs: 244 (14 periods and 24 cross-sections).			
∆E-COMMERCE	0.0967	2.4916	0.0343
UNEMPLOY	−0.0450	−0.2079	0.8399
R^2 = 0.3428. Prob(J-statistic[a]) = 0.0500			
Obs: 203 (10 periods and 24 cross-sections).			
Dependent Variable: GROWTH (More Developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
∆BROADBAND	0.4537	1.9422	0.0741
UNEMPLOY	−1.2298	−2.4064	0.0317
R^2 = 0.4893. Prob(J-statistic[a]) = 0.4042			
Obs: 224 (14 periods and 23 cross-sections).			
∆INTERNET	0.7899	1.3821	0.1902
UNEMPLOY	−1.0906	−1.9462	0.0736
R^2 = 0.2525. Prob(J-statistic[a] = 0.2396			
Obs: 238 (14 periods and 23 cross-sections).			
∆E-COMMERCE	0.1266	0.1785	0.8623
UNEMPLOY	0.2720	0.4368	0.6725
R^2 = 0.5549. Prob(J-statistic[a]) = 0.1573			
Obs: 192 (10 periods and 23 cross-sections).			

Note. Instruments: gdp_pc, hightech_emp, tertiary_educ, risk_poverty. White two-way cluster standard errors & covariance (d.f. corrected). Standard error and t-statistic probabilities adjusted for clustering.
[a]Orthogonality test.

been estimated (one for each digitization variable), using a different digitization variable[21] in each case, and the fixed effects estimator or "within" estimator has been used to correct the bias due to the fixed heterogeneity by region. When working with static panels, the robustness of the estimators of the standard errors of the coefficients

[21]Due to multicollinearity problems, the three variables are not considered together.

must be guaranteed, so an estimation of the White Matrix of variances and covariances for the temporal and cross-sectional units has been used (White two-way cluster standard errors and covariance)[22] when correlations were detected in both types of units.

Instrumental variables (IV) have also been used to control the endogeneity problems present in the digitization variables. As can be seen in said table, the interannual increase in the digitization process measured by the proportion of families with access to broadband (ΔBROADBAND) is significant under a unilateral contrast. The same happens with the variables ΔINTERNET and ΔE-COMMERCE. The orthogonality of the instruments is guaranteed through contrast (*J-statistic*[23]).

In the case of regions with lower economic development, digital variables are significant: at the 1% level for ΔBROADBAND and ΔINTERNET, and at the 5% level for ΔE-COMMERCE. However, in regions with higher economic development, only ΔBROADBAND is significant at the 10% level. The influence of the unemployment rate on GROWRT is evident in two out of the three estimated models (using ΔE-COMMERCE is not relevant).

Table 4b shows the results of the estimation of Equation (2), and Table 4c gives the results of the estimation of Equation (3). When explaining the crude rate of natural change of population (NATGROWRT), ΔBROADBAND and ΔINTERNET are significant at the 5% level for less developed regions, and only the variable ΔBROADBAND is relevant in more developed regions. We can conclude that unemployment is not a relevant variable in explaining natural population movements. Finally, digitalization and unemployment affect the explanation of the crude rate of net migration plus statistical adjustment (CNMIGRATRT) in less developed regions, while the unemployment rate is a more determining factor in economically more developed regions.

6 | DISCUSSION AND CONCLUSIONS

Working with a panel of NUTS2 regions in the EU from 2006 to 2021, a total of 117 regions with a clear dominance of rural areas and, therefore, a higher risk of depopulation has been identified (32 are more developed, 30 are in a transition situation, and 55 are less developed). In these regions, a clear trend of population reduction has been observed, both in natural terms and in migratory terms. This situation is more pronounced in less developed regions and has been exacerbated by the pandemic of Covid-2019.

By carrying out econometric estimations, it has been confirmed that digitalization has a positive influence on natural population flows. Additionally, in the case of regions with lower economic development, the impact of digitalization on migratory flows is more relevant. It has also been observed that unemployment rate does not affect natural population changes but does negatively impact migratory flows. This could be explained by the fact that in less developed regions, digitalization levels have been lower than in more developed ones. This implies that regions with areas at higher risk of depopulation would be more likely to receive migratory flows under the condition that there is greater digital development and better labor market conditions. On the contrary, in regions with a higher level of development, digitalization is not a stimulus for migratory flows, while the unemployment rate being the determining factor.

The findings show that digital trends double their impact on natural population change compared to migratory flows. However, in more developed regions, digitalization does not affect migratory flows. Finally, the labor market situation can increase migratory flows, doubling the impact in more developed regions compared to less developed ones. To obtain these results, possible biases derived from endogeneity in the models have been considered, so other variables related to digitalization, such as the percentage of employment in high technology, the percentage

[22]Available at *EViews 13* (statistic and econometrics software).

[23]The Sargan–Hansen test or Sargan's *J* test is a statistical test used for testing over-identifying restrictions in a statistical model and orthogonality of the instruments (it is not correlation between instruments and residual models). See, for example, Sargan (1958), Hansen (1982) and Greene (2019).

TABLE 4b Fixed effects model (NATGROWRT).

Dependent Variable: NATGROWRT (Less developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
ΔBROADBAND	0.1852	2.8712	0.0131
UNEMPLOY	0.1188	0.5571	0.5869
R^2 = 0.4043. Prob(J-statistic) = 0.1178			
Obs: 244 (14 periods and 24 cross-sections).			
ΔINTERNET	0.3733	3.1652	0.0075
UNEMPLOY	0.0838	0.4235	0.6789
R^2 = 0.3879. Prob(J-statistic) = 0.0619			
Obs: 244 (14 periods and 24 cross-sections).			
ΔE-COMMERCE	−0.0008	−0.0196	0.9848
UNEMPLOY	0.4530	2.0446	0.0712
R^2 = 0.7103. Prob(J-statistic) = 0.1098			
Obs: 203 (10 periods and 24 cross-sections).			
Dependent Variable: NATGROWTH (More developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
ΔBROADBAND	0.2454	2.9771	0.0107
UNEMPLOY	0.0918	0.3436	0.7366
R^2 = 0.5273. Prob(J-statistic) = 0.4284			
Obs: 224 (14 periods and 23 cross-sections).			
ΔINTERNET	0.4091	1.5995	0.1337
UNEMPLOY	0.1785	0.5708	0.5779
R^2 = 0.2725. Prob(J-statistic) = 0.1726			
Obs: 238 (14 periods and 23 cross-sections).			
ΔE-COMMERCE	−0.0715	−0.1992	0.8465
UNEMPLOY	0.5195	2.3823	0.0411
R^2 = 0.7062. Prob(J-statistic) = 0.0716			
Obs: 192 (10 periods and 23 cross-sections).			

Note. Instruments: gdp_pc, hightech_emp, tertiary_educ, risk_poverty. White two-way cluster standard errors & covariance (d.f. corrected). Standard error and t-statistic probabilities adjusted for clustering.
Source: Own elaboration based on Eurostat data.

of tertiary education, and GDP per capita, have been used. These variables, along with the risk of poverty, act as instruments in the estimation methods.

In conclusion, the results of this research highlight that in the 55 most vulnerable NUTS-2 regions (with a predominance of rural areas and lower economic development), digitalization combined with a favorable labor market, could be a key factor in reversing the depopulation phenomenon as it had already been evidenced in other recent works: Briglauer et al. (2019) or Garashchuk et al. (2023). In these territories, the lack of high-quality

TABLE 4c Fixed effects model (CNMIGRATRT).

Dependent Variable: CNMIGRATRT (Less developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
∆BROADBAND	0.1320	2.6626	0.0195
UNEMPLOY	−0.7389	−3.2846	0.0059
R^2 = 0.3928 Prob(J-statistic) = 0.1809			
Obs: 244 (14 periods and 24 cross-sections).			
∆INTERNET	0.2442	2.4364	0.0300
UNEMPLOY	−0.7447	−3.1570	0.0076
R^2 = 0.3705. Prob(J-statistic) = 0.1017			
Obs: 244 (14 periods and 24 cross-sections).			
∆E-COMMERCE	0.0974	1.7982	0.1057
UNEMPLOY	−0.4981	−2.0722	0.0681
R^2 = 0.1721. Prob(J-statistic) = 0.0520			
Obs: 203 (10 periods and 24 cross-sections).			
Dependent Variable: CNMIGRATRT (More developed)			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
∆BROADBAND	0.2083	1.2360	0.2383
UNEMPLOY	−1.3216	−3.6720	0.0028
R^2 = 0.4649. Prob(J-statistic) = 0.5735			
Obs: 224 (14 periods and 23 cross-sections).			
∆INTERNET	0.3808	1.0396	0.3175
UNEMPLOY	−1.2691	−3.6148	0.0031
R^2 = 0.3467. Prob(J-statistic) = 0.4587			
Obs: 238 (14 periods and 23 cross-sections).			
∆E-COMMERCE	0.1981	0.3561	0.7300
UNEMPLOY	−0.2475	−0.5453	0.5988
R^2 = 0.1692. Prob(J-statistic) = 0.5341			
Obs: 192 (10 periods and 23 cross-sections).			

Note. Instruments: gdp_pc, hightech_emp, tertiary_educ, risk_poverty. White two-way cluster standard errors & covariance (d.f. corrected). Standard error and t-statistic probabilities adjusted for clustering.
Source: Own elaboration based on Eurostat data.

communication infrastructures in quality, capacity, and speed compared to those existing in other areas that benefit from better socioeconomic conditions and locations, entails a technological gap which makes daily life in the environment and digitalization of economic activities difficult, pushing the exodus of its population. That is why the implementation of public/private programs for territorial digitization is required.

Taking advantage of the opportunity to address digital transformation offered by the NEXT GENERATION EU, within the framework of the Recovery and Resilience Facility (RRF) and in accordance with the new Cohesion Policy

2021–2027, it is necessary and timely to consider proposals for action in this regard, such as: reinforcement of connectivity through reference centers, digital transformation and modernization of local public administrations in all sectors, including health, education, and so on, as socioeconomic engines, driving projects for digitalization and expansion of connectivity speeds (within the digital transformation, very high-capacity broadband connectivity is a key factor for the development of economic activity, the increase in productivity, the promotion of innovation and territorial and social structuring), among others, in vulnerable areas most affected by the demographic challenge.

Regarding the shortcomings of this article, it is worth mentioning that Eurostat provides a limited range of variables with respect to digital trends at the regional level. For this reason, plans for further research are to include more variables related to digitalization provided by other databases or additional surveys carried out within the EU on our own account.

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CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX A

See Tables A1–A9.

TABLE A1 UE regions with less population density.

	Less economic development		NUTS3				More economic development		NUTS3		
	Country	NUTS2	Urban	Interm.	Rural		Country	NUTS2	Urban	Interm.	Rural
1	Bulgaria	BG31	0	4	1	1	Austria	AT12	1	2	4
2	Bulgaria	BG32	0	3	2	2	Austria	AT21	0	1	2
3	Bulgaria	BG33	0	3	1	3	Austria	AT22	0	2	4
4	Bulgaria	BG34	0	4	0	4	Austria	AT32	0	1	2
5	Bulgaria	BG42	0	3	2	5	Austria	AT33	1	0	4
6	Greece	EL41	0	1	2	6	Bulgaria	BG41	1	3	1
7	Greece	EL42	0	1	1	7	Cyprus	CY00	0	1	0
8	Greece	EL43	0	2	2	8	Germany	DE23	0	4	6
9	Greece	EL51	0	3	2	9	Germany	DEB2	0	2	3
10	Greece	EL52	1	2	4	10	Denmark	DK03	0	2	0
11	Greece	EL53	0	1	2	11	Denmark	DK04	0	1	1
12	Greece	EL54	0	1	2	12	Denmark	DK05	0	0	1
13	Greece	EL61	0	2	1	13	Spain	ES22	0	1	0
14	Greece	EL62	0	0	4	14	Spain	ES24	1	1	1
15	Greece	EL63	0	1	2	15	Finland	FI19	0	1	4
16	Greece	EL64	0	0	5	16	Finland	FI1C	0	5	0
17	Greece	EL65	0	1	2	17	Finland	FI1D	0	0	7
18	Spain	ES42	0	4	1	18	Finland	FI20	0	0	1
19	Spain	ES43	0	2	0	19	France	FRI1	1	1	3
20	Spain	ES61	4	4	0	20	France	FRJ2	1	0	7
21	France	FRY3	0	1	0	21	Ireland	IE05	0	0	3
22	Croatia	HR02	0	2	6	22	Italy	ITC2	0	1	0
23	Croatia	HR03	0	4	3	23	Italy	ITH1	0	0	1

(Continues)

TABLE A1 (Continued)

	Less economic development						More economic development				
			NUTS3						NUTS3		
	Country	NUTS2	Urban	Interm.	Rural		Country	NUTS2	Urban	Interm.	Rural
24	Hungary	HU21	0	3	0	24	Italy	ITH2	0	1	0
25	Hungary	HU22	0	2	1	25	Lithuania	LT01	1	0	0
26	Hungary	HU23	0	1	2	26	Sweden	SE12	0	5	0
27	Hungary	HU31	0	1	2	27	Sweden	SE21	0	1	3
28	Hungary	HU32	0	2	1	28	Sweden	SE22	0	2	0
29	Hungary	HU33	0	3	0	29	Sweden	SE23	1	1	0
30	Italy	ITF2	0	0	2	30	Sweden	SE31	0	2	1
31	Italy	ITG2	1	1	3	31	Sweden	SE32	0	1	1
32	Lithuania	LT02	0	7	2	32	Sweden	SE33	0	2	0
33	Latvia	LV00	1	3	2		Sum		8	44	60
34	Poland	PL42	0	3	1						
35	Poland	PL43	0	2	0						
36	Poland	PL52	0	1	1						
37	Poland	PL61	1	0	4						
38	Poland	PL62	0	3	0						
39	Poland	PL72	0	1	1						
40	Poland	PL81	0	1	3						
41	Poland	PL82	0	0	4						
42	Poland	PL84	0	1	2						
43	Poland	PL92	0	1	5						
44	Portugal	PT16	0	1	7						
45	Portugal	PT18	0	0	5						
46	Portugal	PT20	0	1	0						
47	Romania	RO11	0	1	5						
48	Romania	RO12	0	2	4						
49	Romania	RO21	0	1	5						
50	Romania	RO22	0	3	3						
51	Romania	RO31	0	1	6						
52	Romania	RO41	0	1	4						
53	Slovenia	SI03	0	0	8						
54	Slovakia	SK03	0	1	1						
55	Slovakia	SK04	0	1	1						
	Sum		8	98	130						

TABLE A2 Dependent variables in areas at risk of depopulation.

	Less developed						More developed				
	Country	NUTS2	GROW	NATGROW	CNMIGRANT		Country	NUTS2	GROW	NATGROW	CNMIGRANT
1	Bulgaria	BG31	−17.666	−12.023	−5.643	1	Austria	AT12	4.523	−1.430	5.954
2	Bulgaria	BG32	−12.864	−9.257	−3.607	2	Austria	AT21	0.585	−2.083	2.668
3	Bulgaria	BG33	−5.091	−4.965	−0.126	3	Austria	AT22	2.659	−1.351	4.009
4	Bulgaria	BG34	−6.370	−5.030	−1.341	4	Austria	AT32	4.348	1.697	2.651
5	Bulgaria	BG42	−6.192	−5.637	−0.555	5	Austria	AT33	6.014	1.994	4.020
6	Greece	EL41	−0.296	−2.787	2.491	6	Bulgaria	BG41	−1.596	−4.147	2.551
7	Greece	EL42	0.666	2.025	−1.360	7	Cyprus	CY00	12.368	4.540	7.828
8	Greece	EL43	1.952	1.460	0.491	8	Germany	DE23	2.111	−2.125	4.236
9	Greece	EL51	−4.111	−3.293	−0.818	9	Germany	DEB2	2.163	−2.627	4.790
10	Greece	EL52	−3.331	−1.877	−1.455	10	Denmark	DK03	2.129	−0.023	2.152
11	Greece	EL53	−7.638	−3.884	−3.754	11	Denmark	DK04	5.961	2.336	3.625
12	Greece	EL54	−4.429	−3.667	−0.762	12	Denmark	DK05	1.688	−0.376	2.063
13	Greece	EL61	−4.809	−3.161	−1.648	13	Spain	ES22	6.750	1.029	5.720
14	Greece	EL62	−0.791	−2.915	2.124	14	Spain	ES24	2.004	−1.784	3.787
15	Greece	EL63	−4.590	−2.663	−1.926	15	Finland	FI19	2.211	−0.050	2.260
16	Greece	EL64	−5.373	−3.815	−1.558	16	Finland	FI1C	0.187	−1.956	2.144
17	Greece	EL65	−5.136	−4.409	−0.727	17	Finland	FI1D	−1.207	−0.534	−0.674
18	Spain	ES42	4.252	−0.181	4.433	18	Finland	FI20	7.876	0.580	7.296
19	Spain	ES43	−1.258	−1.998	0.740	19	France	FRI1	7.674	0.237	7.437
20	Spain	ES61	5.013	1.703	3.310	20	France	FRJ2	7.544	1.051	6.493
21	France	FRY3	23.450	24.497	−1.048	21	Ireland	IE05	7.718	5.737	1.980

(Continues)

TABLE A2 (Continued)

	Less developed						More developed				
	Country	NUTS2	GROW	NATGROW	CNMIGRANT		Country	NUTS2	GROW	NATGROW	CNMIGRANT
22	Croatia	HR02	−22.199	−8.836	−13.363	22	Italy	ITC2	−0.286	−2.457	2.171
23	Croatia	HR03	−4.707	−2.699	−2.009	23	Italy	ITH1	6.716	2.237	4.479
24	Hungary	HU21	−2.369	−4.103	1.735	24	Italy	ITH2	4.826	−0.119	4.946
25	Hungary	HU22	0.384	−4.419	4.804	25	Lithuania	LT01	1.623	−1.190	2.813
26	Hungary	HU23	−7.052	−5.519	−1.533	26	Sweden	SE12	9.012	1.571	7.441
27	Hungary	HU31	−9.358	−4.813	−4.545	27	Sweden	SE21	5.876	0.450	5.426
28	Hungary	HU32	−5.694	−2.851	−2.843	28	Sweden	SE22	10.546	2.300	8.246
29	Hungary	HU33	−6.360	−5.614	−0.746	29	Sweden	SE23	8.735	2.377	6.359
30	Italy	ITF2	−4.955	−4.809	−0.146	30	Sweden	SE31	2.555	−1.429	3.984
31	Italy	ITG2	−1.129	−2.723	1.594	31	Sweden	SE32	0.921	−1.737	2.659
32	Lithuania	LT02	−9.420	−6.007	−3.413	32	Sweden	SE33	1.802	−0.279	2.081
33	Latvia	LV00	−10.685	−4.497	−6.188		Average		4.251	0.076	4.175
34	Poland	PL42	−1.703	−0.994	−0.710						
35	Poland	PL43	−1.217	−0.352	−0.865						
36	Poland	PL52	−4.072	−1.938	−2.134						
37	Poland	PL61	−1.419	−0.456	−0.963						
38	Poland	PL62	−2.175	0.015	−2.190						
39	Poland	PL72	−5.395	−3.679	−1.716						
40	Poland	PL81	−4.447	−2.197	−2.250						
41	Poland	PL82	−0.744	−0.079	−0.665						
42	Poland	PL84	−2.966	−1.601	−1.366						

TABLE A2 (Continued)

	Less developed					More developed				
	Country	NUTS2	GROW	NATGROW	CNMIGRANT	Country	NUTS2	GROW	NATGROW	CNMIGRANT
43	Poland	PL92	−3.553	−1.624	−1.929					
44	Portugal	PT16	−3.288	−4.609	1.321					
45	Portugal	PT18	−6.284	−6.417	0.133					
46	Portugal	PT20	−0.790	0.436	−1.226					
47	Romania	RO11	−2.214	−2.043	−0.172					
48	Romania	RO12	−2.702	−1.476	−1.226					
49	Romania	RO21	−1.945	−1.391	−0.554					
50	Romania	RO22	−5.678	−3.910	−1.768					
51	Romania	RO31	−7.263	−5.258	−2.004					
52	Romania	RO41	−8.497	−5.403	−3.094					
53	Slovenia	SI03	0.590	−0.838	1.428					
54	Slovakia	SK03	−1.921	−0.332	−1.589					
55	Slovakia	SK04	0.443	2.627	−2.184					
	Average		−3.735	−2.551	−1.184					

Note. Means values in the data panel.

Source: Own elaboration based on Eurostat data.

TABLE A3 Independent and instruments variables in areas at risk of depopulation (less developed).

	Country	NUTS2	BROAD	INTERNET	E-COMM.	UNEMP	GDP	HTECH	EDUC	POVERTY
1	Bulgaria	BG31	46.6	47.5	10.2	11.2	4100.0	2.0	19.2	31.4
2	Bulgaria	BG32	52.7	54.3	9.4	10.0	4406.3	2.1	22.5	23.6
3	Bulgaria	BG33	53.3	55.2	12.0	10.9	5162.5	1.6	23.5	23.6
4	Bulgaria	BG34	51.6	54.1	8.4	8.2	5243.8	1.3	20.1	24.5
5	Bulgaria	BG42	54.2	55.9	9.0	7.9	4487.5	2.1	20.2	27.5
6	Greece	EL41				15.6	13550.0		22.6	21.4
7	Greece	EL42				15.0	19375.0	1.3	17.1	16.5
8	Greece	EL43				15.7	15281.3	1.1	23.4	16.2
9	Greece	EL51				17.7	12618.8	0.9	21.0	25.3
10	Greece	EL52				19.0	14050.0	1.9	27.9	21.7
11	Greece	EL53				22.6	16550.0		21.4	23.3
12	Greece	EL54				18.1	12687.5		25.4	19.0
13	Greece	EL61				17.5	13443.8	0.7	26.2	19.9
14	Greece	EL62				14.6	16681.3		17.6	15.3
15	Greece	EL63				20.2	13362.5	1.2	21.4	26.0
16	Greece	EL64				18.6	16331.3	1.0	19.1	20.9
17	Greece	EL65				14.2	14812.5	0.8	19.6	20.8
18	Spain	ES42	65.7	66.9	33.8	19.8	18868.8	2.2	26.3	28.3
19	Spain	ES43	63.5	65.8	31.8	23.5	16893.8	1.5	24.9	33.5
20	Spain	ES61	67.9	69.5	31.6	25.4	17756.3	2.2	27.8	30.7
21	France	FRY3	66.5	73.2	31.4	20.9	14968.8		19.6	
22	Croatia	HR02				12.8	7593.8	2.0	15.9	27.0
23	Croatia	HR03	67.8	71.5	28.3	11.6	10943.8	1.8	22.3	16.7
24	Hungary	HU21	74.5	76.4	34.2	5.5	10568.8	4.5	18.0	9.5
25	Hungary	HU22	73.5	75.2	29.5	4.9	11731.3	4.4	18.8	9.9
26	Hungary	HU23	68.5	70.7	27.9	8.5	7856.3	3.3	17.1	16.7
27	Hungary	HU31	67.0	68.5	23.7	10.3	7487.5	4.8	16.1	18.2
28	Hungary	HU32	65.9	67.7	22.9	10.7	7450.0	3.4	17.0	20.1
29	Hungary	HU33	67.1	68.6	25.3	7.5	8200.0	2.1	18.6	15.8
30	Italy	ITF2	53.1	64.2	16.5	11.6	20868.8	1.9	16.9	28.3
31	Italy	ITG2	61.9	69.4	22.9	14.6	20375.0	1.8	14.1	24.0
32	Lithuania	LT02	80.7	81.0	38.3	9.2	10437.5	1.4	35.2	23.9
33	Latvia	LV00	74.0	76.4	29.0	10.6	12131.3	3.2	30.3	
34	Poland	PL42				8.5	9175.0	1.9	24.0	12.2

TABLE A3 (Continued)

	Country	NUTS2	BROAD	INTERNET	E-COMM.	UNEMP	GDP	HTECH	EDUC	POVERTY
35	Poland	PL43				7.6	9037.5	2.2	21.0	12.0
36	Poland	PL52				7.1	8750.0	1.7	21.7	13.0
37	Poland	PL61				8.8	8868.8	2.3	20.4	19.0
38	Poland	PL62				8.4	7718.8	1.3	20.7	19.8
39	Poland	PL72				9.7	8031.3	1.0	24.6	15.9
40	Poland	PL81				8.7	7493.8	1.5	25.0	24.6
41	Poland	PL82				9.9	7612.5	1.6	23.7	18.8
42	Poland	PL84				7.0	7850.0	1.4	26.4	20.4
43	Poland	PL92				6.8	9150.0	1.8	23.6	20.7
44	Portugal	PT16	58.0	61.3	22.2	7.8	15268.8	1.7	18.6	18.1
45	Portugal	PT18	54.9	57.3	23.5	10.6	16356.3	2.0	16.4	17.2
46	Portugal	PT20	66.9	68.8	23.8	9.7	15831.3		12.3	28.5
47	Romania	RO11	62.8	68.0	12.3	4.3	7343.8	2.3	15.0	17.8
48	Romania	RO12	57.3	62.5	10.1	7.8	7718.8	2.0	14.6	19.6
49	Romania	RO21	52.2	59.1	8.3	4.3	5081.3	1.2	11.7	34.6
50	Romania	RO22	56.5	61.5	7.9	8.0	6693.8	0.9	11.7	30.1
51	Romania	RO31	56.5	60.2	8.9	8.0	6425.0	1.1	11.3	24.2
52	Romania	RO41	57.1	62.5	8.8	7.1	6093.8	0.9	14.4	32.4
53	Slovenia	SI03	83.0	83.0	38.3	8.0	15993.8	4.2	26.2	14.0
54	Slovakia	SK03	63.0	71.7	38.4	12.6	11193.8	3.2	18.5	13.7
55	Slovakia	SK04	65.7	72.4	38.3	14.7	9806.3	3.2	18.4	15.6
	Average		62.8	66.3	22.4	11.8	11159.4	2.0	20.5	21.2

Note. Means values in the data panel.

Source: Own elaboration based on Eurostat data.

TABLE A4 Independent variables in areas at risk of depopulation (more developed).

	Country	NUTS2	BROAD	INTERNET	E-COM.	UNEMP	GDP	HTECH	EDUC	POVERTY
1	Austria	AT12	71.8	77.8	48.3	4.5	32050	3.8	24.2	10.5
2	Austria	AT21	67.9	74.0	43.0	4.8	33100	4.0	23.5	12.7
3	Austria	AT22	70.3	76.1	46.1	4.3	34950	3.4	22.5	13.9
4	Austria	AT32	73.4	79.3	48.0	3.2	45831.25	2.7	25.5	11.5
5	Austria	AT33	72.1	78.1	48.2	3.1	40731.25	3.4	23.3	15.0
6	Bulgaria	BG41	62.3	63.8	15.1	5.4	10550	7.1	36.8	12.2
7	Cyprus	CY00	69.0	70.6	24.3	9.1	23262.5	2.9	39.4	
8	Germany	DE23				3.5	36962.5	5.1	24.6	
9	Germany	DEB2				3.6	27337.5	2.4	26.3	
10	Denmark	DK03	84.8	90.2	66.6	6.0	42631.25	2.4	29.6	12.1
11	Denmark	DK04	87.0	92.2	69.7	5.6	43250	4.0	34.2	12.2
12	Denmark	DK05	84.6	90.0	65.5	6.2	40050	3.1	29.4	13.4
13	Spain	ES22	72.8	75.3	40.9	11.1	29031.25	2.3	41.9	8.8
14	Spain	ES24	71.0	72.9	38.7	13.1	25862.5	2.7	35.6	15.1
15	Finland	FI19	81.7	84.8	50.2	8.1	34393.75	4.0	38.5	
16	Finland	FI1C	90.5	91.6	50.8	8.0	34068.75	4.1	37.2	13.2
17	Finland	FI1D	80.0	83.0	48.9	9.5	31637.5	4.2	35.8	15.7
18	Finland	FI20	64.2	64.2			43956.25		31.7	
19	France	FRI1	81.3	88.8	56.6	8.6	28712.5	3.3	30.6	
20	France	FRJ2	80.5	87.7	56.9	7.7	29112.5	5.2	38.0	
21	Ireland	IE05	89.3	91.3	64.7	9.4	57768.75	8.0	42.0	16.4
22	Italy	ITC2	59.3	67.8	27.6	6.3	37106.25		15.0	9.1
23	Italy	ITH1	63.2	72.4	26.7	3.3	42787.5	1.8	14.5	7.7
24	Italy	ITH2	66.6	72.5	29.7	5.0	36375	3.0	17.9	9.9
25	Lithuania	LT01	84.5	84.9	47.7	6.3	18518.75	5.8	53.2	15.3
26	Sweden	SE12	88.0	91.8	65.2	8.2	37506.25	4.5	35.5	16.3
27	Sweden	SE21	85.4	90.1	58.8	6.6	37468.75	2.2	30.8	15.4
28	Sweden	SE22	87.8	92.4	63.5	9.0	37962.5	5.0	39.4	18.9
29	Sweden	SE23	88.4	92.2	63.5	7.1	42093.75	4.2	37.2	15.7
30	Sweden	SE31	83.9	88.2	60.0	8.0	35343.75	2.4	29.2	17.5
31	Sweden	SE32	85.5	90.9	61.8	7.4	38200	3.5	31.9	17.5
32	Sweden	SE33	86.7	90.9	61.3	7.1	41575	3.1	35.3	15.3
	Average		77.8	82.2	49.9	6.7	35318.4	3.8	31.6	13.6

Note. Means values in the data panel.

Source: Own elaboration based on Eurostat data.

TABLE A5 Analysis of correlations with NATGROWRT (less developed).

	Country	NUTS2	Correlation with NATGROWRT				p-value			
			BROAD	INTERNET	E-COM.	UNEMPLOY	BROAD	INTERNET	E-COM.	UNEMPLOY
1	Bulgaria	BG31	0.36	0.36	0.21	−0.20	0.10*	0.10	0.27	0.22
2	Bulgaria	BG32	0.29	0.29	−0.27	0.54	0.16	0.15	0.21	0.01***
3	Bulgaria	BG33	0.13	0.18	−0.32	0.54	0.33	0.28	0.17	0.01***
4	Bulgaria	BG34	0.30	0.41	0.16	0.37	0.15	0.07*	0.32	0.07*
5	Bulgaria	BG42	0.31	0.35	0.11	0.49	0.14	0.11	0.38	0.02**
6	Spain	ES42	0.67	0.64	0.21	−0.06	0.00***	0.00***	0.27	0.41
7	Spain	ES43	0.63	0.51	0.28	−0.21	0.00***	0.02**	0.21	0.21
8	Spain	ES61	0.76	0.84	0.21	−0.16	0.00***	0.00***	0.27	0.28
9	Croatia	HR03	0.65	0.36	0.23	0.20	0.00***	0.10	0.25	0.23
10	Hungary	HU21	0.32	0.47	0.12	0.46	0.15	0.05*	0.36	0.03**
11	Hungary	HU22	−0.30	−0.36	−0.56	−0.03	0.18	0.12	0.03**	0.45
12	Hungary	HU23	0.27	0.47	−0.26	0.45	0.20	0.06*	0.22	0.03**
13	Hungary	HU31	0.11	0.12	−0.15	0.10	0.37	0.36	0.34	0.35
14	Hungary	HU32	0.02	0.35	−0.15	0.20	0.47	0.13	0.33	0.22
15	Hungary	HU33	−0.06	0.02	−0.17	0.27	0.42	0.47	0.31	0.15
16	Italy	ITF2	0.62	0.19	0.49	−0.23	0.00***	0.25	0.06*	0.19
17	Italy	ITG2	0.63	0.44	−0.05	−0.30	0.00***	0.04**	0.44	0.12
18	Lithuania	LT02	−0.10	−0.18	−0.81	0.31	0.46	0.43	0.08*	0.20
19	Portugal	PT16	0.73	0.07	−0.16	0.01	0.00***	0.41	0.32	0.48
20	Portugal	PT18	0.50	0.14	0.04	0.34	0.02**	0.31	0.45	0.09*

(Continues)

TABLE A5 (Continued)

	Country	NUTS2	Correlation with NATGROWRT				p-value			
			BROAD	INTERNET	E-COM.	UNEMPLOY	BROAD	INTERNET	E-COM.	UNEMPLOY
21	Romania	RO11	0.22	0.38	0.16	0.36	0.25	0.11	0.32	0.07*
22	Romania	RO12	0.23	0.20	−0.12	0.48	0.24	0.27	0.37	0.02**
23	Romania	RO21	0.20	0.47	−0.09	0.07	0.27	0.06*	0.40	0.40
24	Romania	RO22	0.22	0.34	0.19	0.47	0.25	0.14	0.29	0.02**
25	Romania	RO31	0.41	0.40	0.05	0.30	0.09*	0.10*	0.44	0.12
26	Romania	RO41	0.40	0.45	−0.06	−0.23	0.09*	0.06*	0.43	0.19
27	Slovenia	SI03	0.59	0.59	−0.62	0.72	0.07*	0.07*	0.06*	0.00***
28	Slovakia	SK03	0.06	0.03	−0.63	0.48	0.42	0.46	0.01**	0.02**
29	Slovakia	SK04	0.23	0.01	−0.41	0.42	0.21	0.48	0.10*	0.04**

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Source: Own elaboration based on Eurostat data.

TABLE A6 Analysis of correlations with NATGROWRT (more developed).

			Correlation with NATGROWR				p-value			
	Country	NUTS2	BROAD	INTERNET	E-COMM.	UNEMPLOY	BROAD	INTERNET	E-COM.	UNEMPLOY
1	Austria	AT12	0.54	0.46	−0.04	−0.14	0.02**	0.04**	0.46	0.30
2	Austria	AT21	0.64	0.57	0.32	−0.24	0.00***	0.01**	0.21	0.18
3	Austria	AT22	0.35	0.28	0.15	0.02	0.10	0.17	0.36	0.47
4	Austria	AT32	0.30	0.20	−0.07	−0.42	0.15	0.24	0.43	0.04**
5	Austria	AT33	0.38	0.41	0.10	−0.01	0.09*	0.07*	0.41	0.49
6	Bulgaria	BG41	0.24	0.28	0.00	0.28	0.21	0.17	0.50	0.14
7	Denmark	DK03	0.57	0.40	0.15	−0.16	0.01**	0.07*	0.33	0.28
8	Denmark	DK04	0.50	0.53	−0.23	−0.26	0.03**	0.02**	0.26	0.17
9	Denmark	DK05	0.18	0.10	−0.57	−0.34	0.27	0.37	0.02**	0.09*
10	Spain	ES22	0.75	0.53	0.29	−0.07	0.00***	0.02**	0.19	0.40
11	Spain	ES24	0.67	0.46	0.23	0.01	0.00***	0.04**	0.25	0.48
12	Finland	FI1C	0.10	0.07	−0.05	0.14	0.39	0.42	0.45	0.30
13	Finland	FI1D	0.74	0.74	−0.06	0.71	0.00***	0.00***	0.43	0.00***
14	Ireland	IE05	0.94	0.05	0.58	0.96	0.00***	0.48	0.24	0.00***
15	Italy	ITH1	0.68	0.54	−0.03	−0.41	0.00***	0.01***	0.47	0.05**
16	Italy	ITH2	0.61	0.38	0.12	−0.35	0.00***	0.07*	0.37	0.08*
17	Lithuania	LT01	0.59	0.16	−0.68	0.06	0.23	0.43	0.18	0.44
18	Sweden	SE12	0.31	0.25	−0.31	0.07	0.18	0.20	0.18	0.39
19	Sweden	SE21	0.33	0.01	0.44	0.14	0.16	0.49	0.08*	0.30
20	Sweden	SE22	0.45	0.29	0.05	0.05	0.08*	0.17	0.45	0.42
21	Sweden	SE23	0.41	0.64	0.22	0.39	0.10	0.00***	0.26	0.06*

(Continues)

TABLE A6 (Continued)

	Country	NUTS2	Correlation with NATGROWR				p-value			
			BROAD	INTERNET	E-COMM.	UNEMPLOY	BROAD	INTERNET	E-COM.	UNEMPLOY
22	Sweden	SE31	0.31	−0.09	−0.14	−0.22	0.17	0.38	0.35	0.20
23	Sweden	SE32	0.02	0.05	0.23	−0.38	0.48	0.44	0.25	0.06*
24	Sweden	SE33	0.41	0.37	0.20	0.41	0.10	0.10	0.28	0.05**

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Source: Own elaboration based on Eurostat data.

TABLE A7 Analysis of correlations with CNMIGRATRT (less developed).

			Correlation with CNMIGRATRT				p-value			
	Country	NUTS2	BROAD	INTERNET	E-COM.	UNEMPLOY	BROAD	INTERNET	E-COM.	UNEMPLOY
1	Bulgaria	BG31	−0.41	−0.46	−0.21	0.60	0.10*	0.04**	0.27	0.00***
2	Bulgaria	BG32	−0.09	−0.27	0.15	−0.26	0.16	0.18	0.34	0.15
3	Bulgaria	BG33	−0.05	−0.15	0.06	−0.44	0.33	0.31	0.44	0.03**
4	Bulgaria	BG34	−0.16	−0.55	−0.34	0.02	0.15	0.01**	0.15	0.47
5	Bulgaria	BG42	−0.40	−0.47	−0.27	−0.48	0.14	0.04**	0.22	0.02**
6	Spain	ES42	0.57	0.56	−0.34	−0.94	0.00***	0.01***	0.15	0.00***
7	Spain	ES43	0.52	0.34	−0.01	−0.83	0.00***	0.10	0.49	0.00***
8	Spain	ES61	0.23	0.35	−0.17	−0.92	0.00***	0.10*	0.31	0.00***
9	Croatia	HR03	0.29	0.26	0.22	0.06	0.00***	0.19	0.27	0.42
10	Hungary	HU21	−0.42	−0.51	−0.34	−0.71	0.15	0.04**	0.15	0.00***
11	Hungary	HU22	−0.53	−0.70	−0.06	−0.67	0.18	0.00***	0.43	0.00***
12	Hungary	HU23	−0.20	−0.41	0.61	−0.25	0.20	0.09*	0.02**	0.16
13	Hungary	HU31	−0.38	−0.30	0.13	−0.74	0.37	0.17	0.36	0.00***
14	Hungary	HU32	−0.18	−0.07	0.56	−0.08	0.47	0.41	0.03**	0.38
15	Hungary	HU33	0.14	0.07	−0.06	−0.26	0.42	0.42	0.43	0.16
16	Italy	ITF2	0.43	0.26	0.35	0.23	0.00***	0.16	0.14	0.18
17	Italy	ITG2	0.25	0.32	0.64	0.22	0.00***	0.11	0.01***	0.20
18	Lithuania	LT02	0.51	0.58	0.98	−0.25	0.46	0.24	0.00***	0.25
19	Portugal	PT16	−0.08	−0.05	0.49	−0.68	0.00***	0.43	0.06*	0.00***
20	Portugal	PT18	0.08	−0.27	−0.30	−0.61	0.02**	0.16	0.19	0.00***
21	Romania	RO11	0.16	−0.10	−0.10	0.48	0.25	0.38	0.39	0.02**

(Continues)

TABLE A7 (Continued)

	Country	NUTS2	Correlation with CNMIGRATRT BROAD	INTERNET	E-COM.	UNEMPLOY	p-value BROAD	INTERNET	E-COM.	UNEMPLOY
22	Romania	RO12	0.35	0.14	−0.17	0.48	0.24	0.34	0.31	0.02**
23	Romania	RO21	−0.07	−0.09	−0.04	0.60	0.27	0.39	0.45	0.00***
24	Romania	RO22	0.00	0.03	−0.29	−0.21	0.25	0.47	0.20	0.21
25	Romania	RO31	0.18	0.00	−0.37	0.22	0.09*	0.50	0.13	0.20
26	Romania	RO41	0.28	−0.02	0.28	−0.33	0.09*	0.48	0.21	0.09*
27	Slovenia	SI03	−0.08	−0.08	0.20	−0.79	0.07*	0.44	0.34	0.00***
28	Slovakia	SK03	−0.01	−0.08	−0.67	0.40	0.42	0.39	0.01***	0.05*
29	Slovakia	SK04	0.13	0.01	−0.51	0.31	0.21	0.49	0.05**	0.11

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Source: Own elaboration based on Eurostat data.

TABLE A8 Analysis of correlations with CNMIGRATRT (more developed).

	Country	NUTS2	Correlation with CNMIGRATRT BROAD	INTERNET	E-COMM.	UNEMPLOY	p-value BROAD	INTERNET	E-COM.	UNEMPLOY
1	Austria	AT12	−0.26	−0.24	−0.48	0.51	0.19	0.21	0.09*	0.01**
2	Austria	AT21	−0.39	−0.33	−0.49	0.64	0.08*	0.13	0.09*	0.00***
3	Austria	AT22	−0.46	−0.26	−0.74	0.33	0.04**	0.19	0.00***	0.09*
4	Austria	AT32	−0.72	−0.45	−0.40	0.02	0.00***	0.05**	0.14	0.47
5	Austria	AT33	−0.39	−0.17	−0.04	0.12	0.08*	0.28	0.46	0.32
6	Bulgaria	BG41	0.11	0.14	0.59	0.25	0.36	0.32	0.02**	0.17
7	Denmark	DK03	−0.30	−0.29	−0.15	−0.45	0.15	0.16	0.34	0.03**
8	Denmark	DK04	0.03	−0.23	−0.31	−0.58	0.46	0.22	0.18	0.00***
9	Denmark	DK05	−0.28	−0.41	−0.20	−0.42	0.17	0.07*	0.28	0.05**
10	Spain	ES22	0.10	0.25	−0.02	−0.97	0.36	0.19	0.48	0.00***
11	Spain	ES24	0.35	0.26	−0.09	−0.77	0.10*	0.17	0.40	0.00***
12	Finland	FI1C	0.16	0.24	0.38	−0.25	0.33	0.26	0.14	0.17
13	Finland	FI1D	−0.18	−0.11	−0.07	−0.28	0.26	0.35	0.42	0.14
14	Ireland	IE05	0.91	0.74	0.99	−0.88	0.02**	0.13	0.00***	0.00***
15	Italy	ITH1	0.58	0.58	0.11	−0.14	0.01***	0.01***	0.37	0.30
16	Italy	ITH2	0.64	0.21	0.27	−0.42	0.00***	0.22	0.22	0.04**
17	Lithuania	LT01	0.93	0.66	−0.96	−0.08	0.01***	0.19	0.00***	0.42
18	Sweden	SE12	0.28	0.02	−0.24	−0.26	0.21	0.48	0.24	0.15
19	Sweden	SE21	0.11	−0.17	0.15	−0.43	0.38	0.29	0.33	0.04**
20	Sweden	SE22	0.32	0.01	0.39	−0.58	0.17	0.48	0.12	0.00***

(Continues)

TABLE A8 (Continued)

	Country	NUTS2	Correlation with CNMIGRATRT BROAD	INTERNET	E-COMM.	UNEMPLOY	p-value BROAD	INTERNET	E-COM.	UNEMPLOY
21	Sweden	SE23	0.16	0.26	0.05	−0.51	0.33	0.20	0.44	0.01**
22	Sweden	SE31	0.53	0.06	−0.29	−0.13	0.04**	0.43	0.19	0.31
23	Sweden	SE32	0.10	0.02	0.15	−0.36	0.39	0.47	0.34	0.07*
24	Sweden	SE33	−0.04	−0.29	0.30	−0.50	0.46	0.17	0.19	0.02**

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Source: Own elaboration based on Eurostat data.

TABLE A9 orrelations between digitalization, unemploy and instruments.

Indicators	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) BROADBAND	1.00							
(2) INTERNET	0.98	1.00						
(3) E-COMMERCE	0.82	0.85	1.00					
(4) UNEMPLOY_RATE	0.36	0.39	0.34	1.00				
(5) GDP_PC	**0.58**	**0.64**	**0.73**	**0.25**	1.00			
(6) HIGHTECH_EMP	**0.38**	**0.39**	**0.39**	**0.34**	0.48	1.00		
(7) TERTIARY_EDUC	**0.58**	**0.58**	**0.70**	**0.07**	0.65	0.58	1.00	1.00
(8) RISK_POVERTY	**0.39**	**0.41**	**0.42**	**0.58**	0.40	0.51	0.34	0.34

Source: Own elaboration based on Eurostat data.