ISSN: 1576-0162
DOI: http://dx.doi.org/10.33776/rem.vi64.7489

Depopulation of EU Lower-Income Regions: Can Digitalisation via Broadband Access Reduce It?

Despoblación de las regiones de bajos ingresos de la UE: ¿puede la digitalización a través del acceso de banda ancha reducirlo?

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Recibido: diciembre 2022; aceptado: junio 2023

Abstract

Depopulated rural or post-industrial areas, which are often low-income with fewer job opportunities, represent an open challenge for the European Union. Sharp demographic declines especially in Eastern and Southern Europe, due to the intra-EU migration of younger, skilled workers from these areas have become a serious obstacle to the sustainable development of many EU lower-income regions. The European Parliament highlights the gap in ICT connectivity among other reasons.

This paper aims to provide empirical evidence, by applying Panel Data Analysis, that digitalisation of European NUTS-2 regions with lower incomes via Broadband Access may contribute to reversing negative demographic trends.

Keywords: Depopulation, Digitalisation, European Union, Lower-income Regions, Broadband, Panel Data Analysis.

Resumen

Las zonas rurales despobladas o postindustriales, que suelen ser de bajos ingresos y con menos oportunidades laborales, representan un desafío abierto para la Unión Europea. Las fuertes caídas demográficas, especialmente en Europa del Este y del Sur, debido a la migración dentro de la UE de trabajadores más jóvenes y calificados de estas áreas, se han convertido en un serio obstáculo para el desarrollo sostenible de muchas regiones de la UE con bajos ingresos. El Parlamento Europeo destaca la brecha en la conectividad de las TIC, entre otras razones.

Este artículo tiene como objetivo proporcionar evidencia empírica, mediante la aplicación de análisis de datos de panel, de que la digitalización de las regiones europeas NUTS-2 con ingresos más bajos a través del acceso de banda ancha puede contribuir a revertir las tendencias demográficas negativas.

Palabras clave: despoblación, digitalización, Unión Europea, regiones de bajos ingresos, banda ancha, análisis de datos de panel.

JEL Classification/ Clasificación JEL: J11, O33.

1. Introduction

Despite the EU-27 population already representing an ever-shrinking proportion of the global population, down from 11.68 per cent in 1960 to 5.8 per cent in 2019, this indicator is expected to be smaller still at just 4.35 per cent in 2057. Eurostat's general projections predict that the EU-27 population will grow much more slowly than in the past, peaking at 525 million persons in 2044, before declining to 416.1 million by 2100. In addition, it is noteworthy to mention the sharp decline in live births from around 6.69 million in 1960 to 4.15 million in 2019 and the natural population decrease by about 0.5 million that year. Thus, the live birth decline and the increase in longevity are dramatically reshaping the age profile of the EU population: it is forecasted that the EU-27 median age (43.7 in 2019) will have reached 48.2 years by 2050.

As can be observed from the above-mentioned EU Demographic Outlook, Eurostat's population forecasts are not encouraging: it is expected that both rural and urban regions may face population losses in the future. In this regard, the EU is facing a major demographic challenge, which is acknowledged and should be tackled by using a holistic and science-based approach in order to redress the negative natural demographic balance of recent years.

Besides general negative demographic trends in EU-27 it is noteworthy that rural and post-industrial areas as well as remote territories are much more vulnerable in regard to depopulation than industrialised centres and capitals due to such obvious reasons as a lower level of income, difficulties in accessing public services in education, healthcare, transport, housing, entertainment, lack of integration with other regions, digital development and job opportunities. In this regard, a gap between capital/metropolitan regions and more peripheral areas, with 78 per cent of the European population living in urban areas or functional urban areas, and benefit from quality services in energy, transport, and digital connectivity was highlighted in the Report of the European Parliament. Currently, rural regions account only for 28 per cent of Europe's population and this number is predicted to keep falling dramatically. Therefore, the European Parliament insists that the EU initiatives such as cohesion and agricultural policies directed to rural areas should be further strengthened by promoting better coordination of policy initiatives that enhance youth employment, entrepreneurship, and digitalisation. In this respect, the intention of the Commission to accelerate the roll-out of high-capacity broadband infrastructure bound to improve the quality of life in sparsely populated and rural territories is fully supported by the European Parliament.

Referring to the importance to develop the broadband infrastructure highlighted by the Commission and European Parliament, in this paper we provide empirical evidence that our key digital variable Broadband Access has a positive effect on population growth crude rate at the regional (NUTS-2) level in the EU for the lower-income regions by Appling Panel Data Analysis, aimed to offer various suggestions for reversing negative demographic trends in these areas.

The remainder of the paper is structured as follows. In the next section, we provide a literature review with respect to demographic and digital trends. We then present the selection of the data sample and the description of the econometric methodology based on Panel Data Analysis. The next section empirically investigates the correlation between population growth crude rate and Broadband Access in conjunction with other determinate factors such as birth, death, and unemployment rates in selected NUTS-2. The final section provides conclusions.

2. Literature review

In the Report of the European Parliament (2021) the following important drivers of demographic change, which force inhabitants from the abovementioned areas to leave, and discourage others from moving there are highlighted: poor infrastructure, including a lack of fast broadband internet and a lack of transport networks, high levels of youth unemployment, fewer job opportunities, particularly in positions requiring higher education, and also in general for women, a lack of public and private services, difficulties in access to health services, fewer education, utilities, and social services opportunities, making it more difficult to adapt to technological change, a lack of cultural venues and leisure activities and finally, the impact of climate change and natural hazards related to it on depopulation.

Although migration by non-EU citizens has allowed the EU to mitigate population loss in recent years Europe keeps experiencing population aging and declining birth rates, affecting the dependency ratio and having negative effects on workforce growth. It was also mentioned in the Report that internal migration patterns from east, south, and central regions to northern and north-western regions mostly involve young, educated and skilled workers creating preconditions for the pattern of ‘inner peripheralisation’ and serious imbalance between EU regions.

Even though the geographical trends depend on many factors, and it is difficult to cover and connect all of them the poor infrastructure, including a lack of fast broadband internet and a lack of transport networks undoubtedly plays a pivotal role in the economic and social development of the regions. And if the transport network typically implies more costly and longer-term investment projects, the roll-out of high-capacity broadband infrastructure appears to be a more accessible objective established by the European Commission, especially if it is deployed in enough support of European Funds. Broadband Access in more isolated regions with low population denticity might increase its connectivity by means of digital communication technologies.

Numerous analyses and research on digital communication technologies have amply demonstrated increased efficiency and reduced coordination costs for globally dispersed activities (Poulter et. al., 2019; Dattée et. al., 2018; Furlonger and Uzureau, 2019). For this reason, when examining digitalization and its relationship with economic, social, and territorial development, special attention is paid to considering the existence of digital inequalities and their repercussions.

If social exclusion has previously been associated mainly 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). Thus, 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". However, according to OECD (2020), many countries lack broadband access within their regions and the digital divide has become especially apparent since the global pandemic COVID-19.

Extant studies related to broadband adoption in relation to the urban and rural digital divide can be found (Oyana, 2011; Pereira, 2016; Rendon Schneir and Xiong, 2016). Recent research points out that profit-based discrimination occurs in isolated and remote regions with a high percentage of low-income minorities in comparison to large metropolitan areas (Oyana, 2011). In this regard, Reddick et al. (2020) stress the inverse relationship between infrastructure costs and broadband access is most evident when we take into consideration factors such as population density, availability of similar services, and the level of broadband speed and performance.

Due to the lower-economic status of residents in rural areas, residents are less likely to adopt broadband access due to affordability (Grubesic, 2004; Mingliu and Wolff, 2004), and consequently, providers will not enter the market in these areas in many cases because the prospect for high-profit margins is too low to merit entry (Prieger, 2003). Moreover, in rural areas, distance has a chilling effect on potential service providers and exacerbates a large disparity in broadband performance (Riddlesden and Singleton, 2014). As the result, low population density and high deployment costs discourage private investments, creating little or no commitment to connecting areas and thereby excluding smaller towns and rural areas from full-fledged digitalization (Reddick et al., 2020).

In this regard, Gruber et al. (2014) highlight that the economic benefits that would derive from the achievement of the objectives of the 2020 Digital Agenda for Europe outweigh the costs of investment while showing that the economic benefits mostly spill over to users and to the national economy and thereby stress the rationale for public subsidies in the roll-out of broadband networks. Should governments pursue regional policies that provide financial support for broadband access this could go far to bridge the digital divide (Glass and Stefanova, 2010). And as if to prove it Houngbonon and Liang (2018) empirically confirm the positive impact of broadband diffusion on poverty reduction highlighted by Whitacre et al. (2014). The authors argue that high-speed broadband availability reduces income inequality in spite of skill complementarity, with a greater effect in less densely populated areas. The results obtained by them are in line with Czernich et al. (2011), who find a positive impact of broadband infrastructure on income per capita. But Canzian et al. (2015) find a positive impact of broadband diffusion on firm performance, especially in rural areas while Briglauer et al. (2019) a positive effect on depopulation reduction in rural areas.

The geographical gaps in broadband access have attracted researchers' attention in North America (see research Yvus and Boland, 2015, Canada; Feld, 2019, US; Ameh et al., 2020, US; Reddick et al., 2020, US;), Australia (for example, the case study by Lane et al., 2016), and Asian countries (see studies provided by Arai et al., 2012, Japan and by Ye and Yang, 2020, China), as well as European countries (see, for instance, papers by Choudrie and Dwivedi, 2006, UK; by Czernich, 2014, Germany; by Salemink et al., 2017, Netherlands; by Ruiz and Esparcia, 2020, Spain and Hasbi and Bohlin, 2022, Sweden).

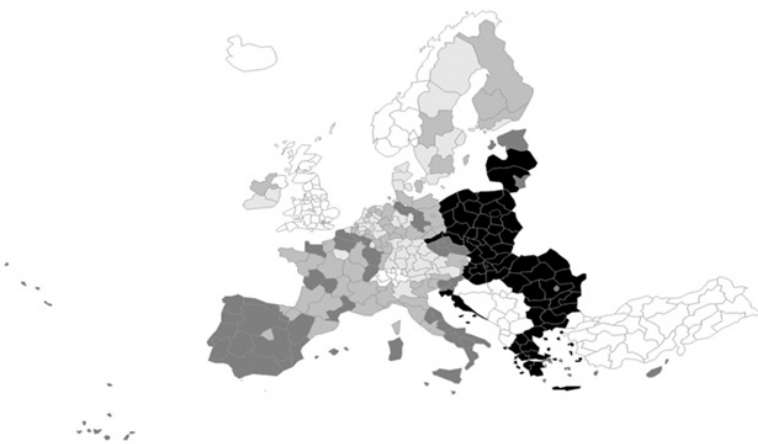
As for geographical coverage, some authors provide empirical evidence of the digitalization process via Broadband access at the local level (see, for example, the case study of San Antonio by Reddick et al., 2020) or in one country (see study case in the UK by Choudrie and Dwivedi, 2006; Czernich, 2014, Germany or Hasbi and Bohlin, 2022, Sweden) while others focus on one particular region (see, for example, a case study in Valencia region, NUTS-2, Spain by Ruiz and Esparcia, 2020 or case study of the Western Downs Region, Australia by Lane et at., 2016) or on several regions (see, for instance, the EU NUTS-2 research by Crespo and Uljan, 2021). Although our research also embraces the EU NUTS-2, however, we focused on the regions under the criteria of lower population density and lower incomes established in accordance with the importance of these indicators for the development of more vulnerable regions. The data sample and the methodology are described in the next section.

3. Data and model

We have worked with unbalanced panel data made up of 242 EU NUTS-2 regions during 2006-2019. Our hypothesis is that digitalisation via Broadband Access may have a positive impact on population growth crude rate in less populated EU regions with lower incomes in terms of GDP per capita. This impact is not observed or is not significant when we consider all regions. Likewise, we are aware that this approach is not exempt from endogeneity problems to the extent that population growth can have, in turn, a positive effect on Internet access. In any case, saving the possibility of possible biases, we want to verify the possibility of a positive and significant relationship, even if it is biased.

Figure 1 shows the distribution, by quartile, of GDP per capita in the EU in 2019, for the 239 NUTS-2 regions, with the regions in black being those that are below the first quartile (25 per cent of the regions with the lowest GDP per capita) and in light gray those that are above the third quartile (25 per cent of regions with the highest GDP per capita).

Figure 1. NUTS-2 regions below the EU average in terms of GDP per capita (2019)



Source: Own elaboration based on Eurostat data.

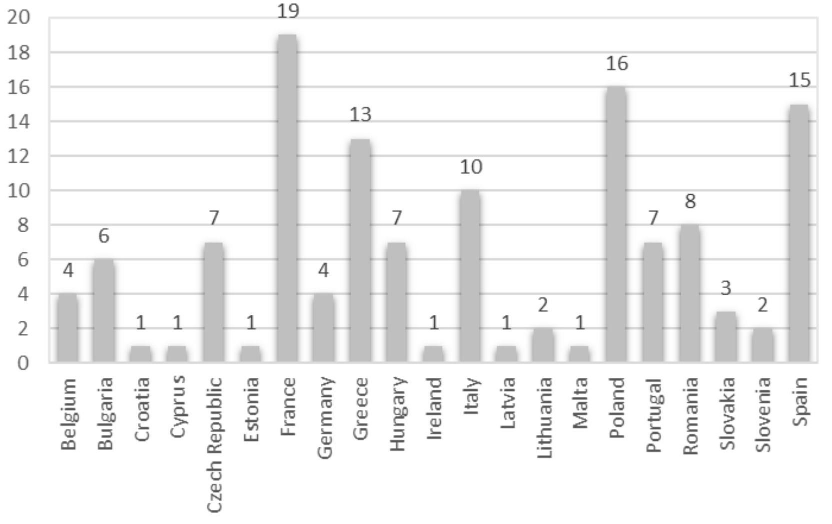
Figure 2 shows the number of NUTS-2 regions included in each country, ordered from lowest to highest GDP per capita.

It can be seen that the countries with the largest number of regions situated below the EU average in terms of GDP per capita are France, Poland, and Spain. Similarly, figures 3 and 4 refer to the population density.

It can be verified that although the regions with the lowest income level are focused on the Eastern and South part of Europe (see Figures 1 and 2), the same does not occur with the regions with the lowest population density, where there is not as much concentration (see Figures 3 and 4). It is worth mentioning that the countries of Northern and Western Europe have the highest proportion of NUTS-2 regions below the average in the panel.

Depending on the type of “unobservable” heterogeneity in the static panel, the consistency of the estimator can be guaranteed either with the fixed effects estimator, also called the “within” estimator, or with the random effects

Figure 2. Number of NUTS-2 regions below the EU average in terms of GDP per capita (2019)

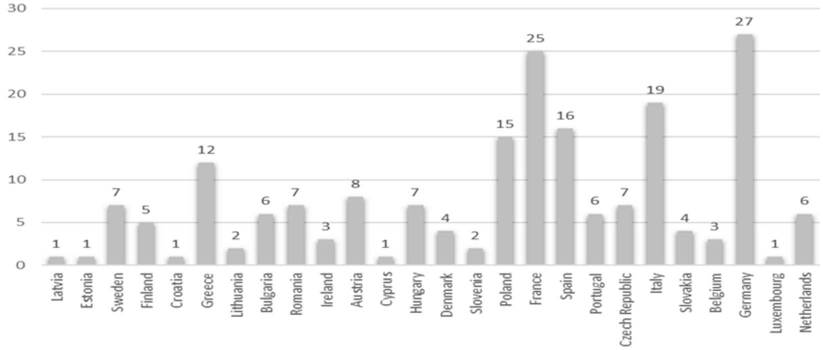


Source: Own elaboration based on Eurostat data.

Figure 3. NUTS2 regions below the EU mean in Population Density (2019)

Source: Own elaboration based on Eurostat data.

Figure 4. Number of NUTS2 regions below the mean in Population Density (2019)



Source: Own elaboration based on Eurostat data.

estimator (Wooldridge, 2010 and Hill et al., 2018). Alternatively, the so-called "between" estimator is also consistent but not asymptotically efficient. This estimator works with the mean values of the data panel variables (Johnston and Dinardo, 1997). In order not to consider other more complex problems that may be present in the data panel, such as non-stationarity in the time series and the presence of spurious correlations, we have preferred to work with the mean values of the variables involved over time. That is why in this paper we applied the "between" estimator to the following econometric model:

$$\overline{GROWTH}_i = a + b\overline{DIGITAL}_i + c\overline{NATGROWTH}_i + d\overline{UNEMPLOY}_i + \varepsilon_i \quad (1)$$

Where the variable (GROWTH) is the rate of population change, while the variable (DIGITAL) represents the digitalization given by the percentage of the population with access to broadband internet (BROADBAND). The variable (NATGROWTH) controls natural population changes, made up of the variable (BIRTHS) that represents the percentage of births and the variable (DEATHS) that measures the percentage of deaths. Finally, the unemployment rate (UNEMPLOY) has been included, which controls population movements associated with labour market conditions.

4. Empirical analysis and results

To verify this main hypothesis of the research, two different samples have been considered: a first that includes regions situated below EU-27 average under the criteria of GDP per capita and with the population density below EU-27 average; a second sample is made up of all available regions. Based on the data availability provided by the Eurostat the first sample includes 65 regions and the second is made up of 169 regions.

Using as a sample the mean values of the 65 NUTS2 regions with GDP per capita and population density levels below the mean in the EU panel (see figure 5), the between-groups estimator (OLS) is applied to ensure the consistency of panel data.

Figure 5. EU NUTS-2 regions with below-average GDP and population density

Country	Obs.
Austria	1
Belgium	3
Bulgaria	6
Croatia	1
Czech Republic	7
Estonia	1
France	8
Hungary	7
Italy	1
Latvia	1
Lithuania	2
Portugal	4
Romania	7
Slovakia	3
Slovenia	2
Spain	11
All	65

Source: Own elaboration based on Eurostat data.

Observing Figure 5 we can conclude that the countries with the largest number of regions in the sample are Spain, France, Romania, Hungary, Czechoslovakia, and Bulgaria. On the other hand, some countries such as Italy, Austria, Croatia, Estonia, and Latvia include only one region. Likewise, in the period considered and filtered by more unfavourable conditions in terms of GDP per capita and Population Density, there are countries with positive average population growth such as Belgium, Austria, Italy, Lithuania, or Slovenia, while the rest of the countries have experienced a decline in population. It is important to take into account the information used temporally and transversally for the calculation of average growth by country.

Table 1 shows the results of the Model estimation (1) on the regions with lower incomes in terms of GDP and lower population density.

Observing the results of Table 1, we can conclude that the broadband variable is clearly significant once the natural movements of the population and the incidence of labour market conditions on migratory flows are discounted. All coefficient signs meet our expectations (for instance, the negative sign observed in both unemployment (UNEMPLOY) and deaths (DEATHS)). The presence of autocorrelation between regions has been corrected by including an AR(1) autoregressive term.

Figure 6 shows the different point clouds associated with each of the explanatory variables together with the estimated regression line using the sample with regions below EU average in terms of income and population

Table 1. "Between estimator" model (least square)

Dependent Variable: GROWTH

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BROADBAND	0.343963	0.086019	3.998701	0.0002
BIRTHS	10.16034	4.567961	2.224262	0.0300
DEATHS	-9.938102	2.812253	-3.533857	0.0008
UNEMPLOY	-0.251737	0.119240	-2.111178	0.0391

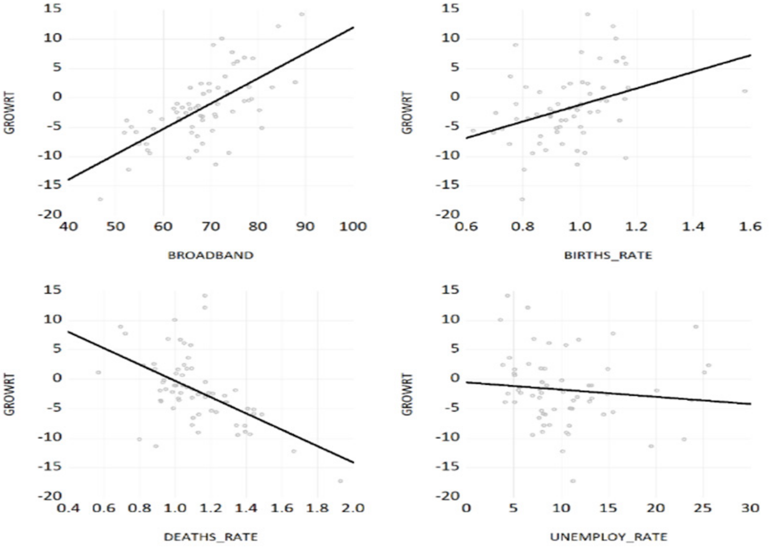
Note: The spatial correlation between regions is corrected with a stationary AR (1) term (ρ = 0.76). R^2 = 0.728950. Durbin-Watson = 2.36.

density. As can be seen, the smallest dispersion is present in the BROADBAND variable if we compare it with the rest of the model variables. The annex contains the descriptive statistics of all the variables in the sample (table a1) as well as an analysis of simple correlations (table a2).

On the other hand, Table 2 shows the results of the Model estimation (1) on all EU NUTS-2 regions available in Eurostat data base, i.e. without the filtration under the criteria of GDP and population density. Full estimation details are given in the annex (see tables a3 and a4).

As we can observe in Table 2, using all the available NUTS-2 regions, the digitization measured through broadband access would not be relevant when explaining migratory flows in the regions.

Figure 6. Clouds of points for the most disadvantaged regions



Source: Own calculations.

Table 2. "Between estimator" model (least square)

Dependent Variable: GROWTH

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BROADBAND	-0.016787	0.048206	-0.348240	0.7281
BIRTHS	6.838283	1.571791	4.350632	0.0000
DEATHS	-23.24807	1.613046	-14.41253	0.0000
UNEMPLOY	-0.413615	0.076387	-5,414751	0.0000

Note: The spatial correlation between regions is corrected with a stationary AR (1) term. (ρ = 0.44). R^2 = 0.672650. Durbin-Watson = 2.27.

5. Conclusions

Investments in ICT infrastructures are a high priority for the European Union´s Regional Policy since it has the potential to reduce distances between users and to attract highly skilled workers in order to avoid the digital divide and ensure digital cohesion. The importance of striving towards an equal and parallel deployment of these technologies is particularly evident in most disadvantaged or lowest income regions, isolated regions and regions in industrial transition inasmuch as it reduces the gap of attractiveness and digital divide and thus contributes to reversing negative demographic trends.

Our starting hypothesis is that digitalisation through Broadband Access has a positive impact on the population growth crude rate in less populated and lower income EU regions in terms of GDP per capita, aware of potential endogeneity issues which will be considered in future analyses. The empirical study developed in this paper verifies this hypothesis by showing that the use of Broadband is clearly significant when considering the sample with regions below the EU average in terms of income and population density.

Although the analysis considers a reduced treatment of the panel, when working with the mean values, the consistency of the estimator is guaranteed and reinforces the idea of a high correlation between population movements and digitalisation via Broadband access, compared even with other variables of immediate impact such as natural movements due to births or deaths. This idea is reinforced by the corresponding graphs that show the conditioned analysis through point clouds, showing a high correlation in the case of Broadband.

In other words, our analysis shows that the unequal use of digital technologies between the different territories that make up the European Union, explained in large part by the difficulty of accessing them, in our study referred to networks with sufficient Broadband access, reveals an important part, or at least one of the elements that influence the population growth crude rate in these areas.

The foregoing assumptions lead to further reflection on the importance of the impact of technological changes, associated with digitalisation processes with regard to the demographic phenomenon of depopulation of the most vulnerable geographical areas, which, generally, tend to coincide with rural areas, peripheral areas or with accessibility difficulties, characterized by lower-income levels and lower population density.

The lack of high-quality communication infrastructures in more vulnerable territories in contrast with those that enjoy better socioeconomic conditions and location supposes a technological gap, which hinders both daily life and the business environment and provokes the brain drain from these less developed EU regions.

That is why the implementation of both public and private programs for territorial digitalisation, via Broadband extension in areas with lower population density and lower income aimed at facilitating Broadband services for individuals, the self-employed, SMEs, non-profit entities, and municipalities, could have a significant influence on the change in the depopulation trends. Although the problem of basic access to Broadband 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 mobilisation of European Social Fund and Just Transition Fund resources to a greater extent in concert with national and local investment in order to tackle the digital gap and digital exclusion is required. It is also worth mentioning that EU countries and local authorities have a key role in responding to demographical challenges. In this sense, both the Recovery and Resilience Facility and REACT-EU (Recovery Assistance for Cohesion and the Territories of Europe), both under a new instrument Next Generation EU, they can contribute significantly to reversing negative demographic trends in most vulnerable areas at a post-pandemic recovery time.

Finally, it is worth highlighting the increased spread of teleworking during the COVID-19 crisis that may prove to be a useful tool to reverse depopulation trends in lower-income regions. Unfortunately, in this paper, we found it impossible to include the effect of Covid-19 on the population growth crude rate due to the Eurostat's data limitations.

In further research it is planned to consider other variables associated with digitalisation such as frequency of Internet use, interaction with public authorities through Internet, e-commerce use, etc. However, the variable collection related to digital trends provided by Eurostat on the regional level is very limited.

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Annex

Table A1. Descriptive statistics

	GROWTH	BROADBAND	BIRTHS	DEATHS	UNEMPLOY
Mean	-1.78	73.11	0.99	1.02	9.08
Median	-2.31	73.50	0.96	1.01	7.87
Maximum	14.20	94.90	3.95	1.93	27.16
Minimum	-17.25	46.71	0.62	0.30	2.53
Std. Dev.	5.90	11.01	0.28	0.20	5.09
Skewness	0.33	-0.25	6.27	0.16	1.46
Kurtosis	3.49	2.24	60.64	5.68	4.87
Jarque-Bera	1.86	5.88	34650.83	72.54	119.58
Probability	0.39	0.05	0.00	0.00	0.00
Sum	-116.00	12429.16	236.99	244.14	2162.10
Sum Sq. Dev.	2226.93	20487.02	18.68	9.32	6137.39
Observations	65	170	239	239	238

Table A2. Correlation analysis

Covariance Analysis: Ordinary

Sample: 1 242

Included observations: 65

Balanced sample (listwise missing value deletion)

Correlation	GROWTH	BROADBAND	BIRTHS	DEATHS	UNEMPLOY
GROWTH	1				
BROADBAND	0.660559	1			
BIRTHS_RATE	0.326326	0.27771	1		
DEATHS_RATE	-0.535536	-0.555575	-0.375986	1	
UNEMPLOY_RATE	-0.11182	-0.071468	0.030502	-0.38256	1

t-Statistic	GROWTH	BROADBAND	BIRTHS	DEATHS	UNEMPLOY
GROWTH	-----				
BROADBAND	6.983488	-----			
BIRTHS_RATE	2.740135	2.294512	-----		
DEATHS_RATE	-5.033302	-5.303564	-3.220609	-----	
UNEMPLOY_RATE	-0.893147	-0.568716	0.242215	-3.286477	-----

Probability	GROWTH	BROADBAND	BIRTHS	DEATHS	UNEMPLOY
GROWTH	-----				
BROADBAND	0.0000	-----			
BIRTHS_RATE	0.0080	0.0251	-----		
DEATHS_RATE	0.0000	0.0000	0.0020	-----	
UNEMPLOY_RATE	0.3752	0.5716	0.8094	0.0017	-----

Table A3. "Between estimator" model (least square).
Lower-income and less populated regions

Dependent Variable: GROWTH
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 1 242
Included observations: 65
Convergence achieved after 23 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.9061	8.6873	-1.3705	0.1758
BROADBAND	0.2852	0.0826	3.4532	0.0010
BIRTHS	8.1331	3.8433	2.1162	0.0386
DEATHS	-12.8832	3.1044	-4.1499	0.0001
UNEMPLOY	-0.2927	0.1277	-2.2925	0.0255
AR(1)	0.7396	0.0698	10.5895	0.0000
SIGMASQ	9.0444	1.6884	5.3567	0.0000

R-squared	0.7360	Mean dependent var	-1.7846
Adjusted R-squared	0.7087	S.D. dependent var	5.8988
S.E. of regression	3.1837	Akaike info criterion	5.5218
Sum squared resid	587.8891	Schwarz criterion	5.7559
Log likelihood	-172.4570	Hannan-Quinn criter.	5.6141
F-statistic	26.9508	Durbin-Watson stat	2.2354
Prob(F-statistic)	0.0000		
Inverted AR Roots	0.7400		

Table A4: "Between estimator" model (least square). All regions

Dependent Variable: GROWTH
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 1 242
Included observations: 169
Convergence achieved after 23 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.5253	4.8247	4.8760	0.0000
BROADBAND	-0.0168	0.0482	-0.3482	0.7281
BIRTHS	6.8383	1.5718	4.3506	0.0000
DEATHS	-23.2481	1.6130	-14.4125	0.0000
UNEMPLOY	-0.4136	0.0764	-5.4148	0.0000
AR(1)	0.4370	0.0630	6.9422	0.0000
SIGMASQ	12.2109	1.2804	9.5371	0.0000

R-squared	0.6727	Mean dependent var	2.3413
Adjusted R-squared	0.6605	S.D. dependent var	6.1257
S.E. of regression	3.5691	Akaike info criterion	5.4315
Sum squared resid	2063.6430	Schwarz criterion	5.5612
Log likelihood	-451.9637	Hannan-Quinn criter.	5.4841
F-statistic	55.4805	Durbin-Watson stat	2.2737
Prob(F-statistic)	0.0000		
Inverted AR Roots	0.4400		