

DO PUBLIC SERVICES SUSTAIN RURAL COMPETITIVENESS? DEMOGRAPHIC EVIDENCE FROM BULGARIA'S PREDOMINANTLY RURAL DISTRICTS

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ABSTRACT

Aim: This study examines whether the provision of key public services, specifically healthcare and early childhood education, supports human development and territorial competitiveness in Bulgaria's predominantly rural districts, which experience some of the most severe demographic decline in the EU. **Methods:** A balanced panel of regional data covering 21 predominantly rural NUTS 3 districts over 2022–2024 is analyzed using entity fixed-effects regression with clustered standard errors. Five models are estimated with natural growth rate, death rate, and birth rate as dependent variables, incorporating health service supply, early childhood education provision, and economic and infrastructure controls. The Hausman specification test confirms the suitability of the fixed-effects estimator. **Results:** Health and early childhood education services influence demographic outcomes through distinct structural channels. Specialist physician density mitigates the mortality-driven decline, while kindergarten teacher density, identified as the strongest predictor, positively affects both fertility and mortality channels. This finding aligns with its function as an indicator of community vitality and a facilitator of parental labor force participation. Average annual wages emerge as the primary economic predictor of natural growth rates. The full model accounts for 78.9% of the within-district variation. **Conclusions:** Public service investment constitutes a necessary but insufficient condition for territorial competitiveness. The findings offer district-level empirical evidence supporting place-sensitive funding for rural early childhood education and the proactive deployment of primary healthcare in demographically distressed regions of Bulgaria.

Key words: rural competitiveness, human development, public services, panel data

JEL codes: O15, R11, I15, I21

INTRODUCTION

Rural areas across Europe face multiple structural disadvantages that constrain economic opportunities, reduce demographic vitality, and limit access to public services. These three interdependent processes collectively undermine rural competitiveness and long-term viability

(European Commission [EC], 2021; Organisation for Economic Co-operation and Development [OECD], 2025). The most severe demographic decline is observed in remote, non-metropolitan areas with aging populations (EC, 2021). The trend is not only demographic; it also reflects a structural change in the human capital base, which is essential for territorial competitiveness.

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Bulgaria exemplifies this trajectory within the EU. Data from the National Statistical Institute of Bulgaria (NSI, 2022–2024) indicate that the 21 predominantly rural NUTS 3 districts analyzed in this study recorded an average natural growth rate of -21.5% . These statistics place rural Bulgaria among the most demographically distressed regions in Europe and raise critical questions about the sustainability of territorial competitiveness and community viability amid ongoing depopulation. The provision of public services emerges as a key factor, serving not only as a welfare mechanism but also as a structural determinant of rural areas' ability to retain and attract the human capital necessary for economic activity and social reproduction (Lehtonen, 2021; OECD, 2025).

This study examines how the provision or absence of key public services shapes human development trajectories in rural Bulgaria and, consequently, the conditions for rural competitiveness. It contributes to the literature in several ways. First, it provides district-level panel evidence on the relationship between human development and public services in rural Bulgaria. Second, it frames this relationship within a competitiveness perspective, arguing that service provision is a structural input to territorial capacity to attract, retain, and reproduce human capital, a dimension often overlooked in rural development research, which typically treats service access as a welfare outcome rather than a determinant of competitiveness. Third, the study uses entity fixed-effects regression with clustered standard errors to control for unobserved district-level heterogeneity, yielding more credible within-district estimates than cross-sectional analyses. Fourth, it differentiates the effects of health services and education supply on three demographic outcomes: the natural growth rate, the death rate, and the birth rate. This approach enables more nuanced policy interpretations.

Based on the theoretical framework and the empirical context, the study advances the following research hypotheses:

- H1: Higher physician density is negatively associated with death rates in predominantly rural Bulgarian districts.
- H2: Higher kindergarten teacher density is positively associated with birth rates and the overall natural growth.

- H3: Average annual wages are a stronger predictor of natural growth rates than any single public service supply variable, implying that service investment is a necessary but not sufficient condition for demographic stabilization.

LITERATURE REVIEW

Human development, capabilities, and competitiveness

Human development, as defined within the capabilities tradition, entails expanding individuals' choices and freedoms across health, education, and economic participation. This process is fundamentally shaped by the conditions in which people live (Sen, 1999; Nussbaum, 2011; UNDP, 2023). Sen's (1999) capabilities approach provides the theoretical foundation for linking human development to public services, recognizing that individual freedoms depend not only on personal endowments but also on the social, institutional, and material environment, known as conversion factors. In rural areas, these conversion factors are particularly influenced by the availability, accessibility, and quality of services such as healthcare and education. Nussbaum (2011) further develops this framework by identifying a threshold of central human capabilities, including life, health, and access to knowledge, that represent the minimum requirements for a dignified and productive existence. Additionally, Alkire (2005) highlights that geographic location significantly affects the realization of capabilities and, consequently, the human capital base essential for territorial development.

The concept of territorial competitiveness serves as the analytical link between individual-level capabilities and broader issues of rural viability. In contrast to firm-level competitiveness, territorial competitiveness denotes a region's sustained ability to attract and retain a productive population, foster income growth, and adapt to structural changes over time (Storper, 1997; OECD, 2025). Storper (1997) describes regions as nexuses of untraded interdependencies, including shared learning environments, conventions, and institutional arrangements, whose quality determines a territory's capacity to retain and develop the human capital necessary for ongoing economic per-

formance. Within this framework, public services are not solely welfare mechanisms; they are structural components that support a territory's economic and social viability. The OECD (2025) identifies human capital and service accessibility as essential enabling conditions for rural competitiveness, and without investment in these areas, rural territories cannot leverage their unique assets or engage in broader economic transitions.

Public services, demographic decline, and rural viability

Public services are defined as those rendered in the public interest, grounded in a social consensus that they should be universally accessible regardless of ability to pay or geographic location (EC, 2021). Rural areas face structural disadvantages in public service provision due to lower population density, greater geographic dispersion, and reduced local fiscal capacity (OECD, 2025). Lower density leads to smaller facilities that operate below economies of scale, raising per-user costs and persistently complicating the recruitment and retention of qualified personnel, a dynamic that worsens under fiscal restraint (López-Torres & Prior, 2022). These challenges are partly attributable to lower wages and limited career opportunities in rural areas compared with urban centers (Brezzi & Luongo, 2016; Eurostat, 2023). Empirical research shows that inadequate access to public services both causes and sustains rural depopulation (Stockdale, 2006; Woods, 2010; Copus et al., 2011). The withdrawal or deterioration of health facilities and schools diminishes the attractiveness of rural areas for families and working-age individuals, prompting outmigration and further reducing the capacity for service investment. This process creates a self-reinforcing cycle, termed inner peripheralization by Copus et al. (2011). The EC's communication entitled "Long-term vision for rural areas" identifies a decline in access to public services as a primary driver of outmigration and reduced attractiveness for potential in-migrants with families (EC, 2021). Lehtonen (2021) provides empirical evidence that the closure of a single primary school can accelerate depopulation in surrounding communities beyond what demographic trends alone would predict.

Within this broader context, the supply of health services and early childhood education are two particularly significant channels. Higher physician density, particularly the availability of general practitioners (GPs), has been shown to reduce preventable mortality and mitigate demographic decline in rural high-income settings (Hokenstad & Roberts, 2011). Population aging, especially pronounced in rural Bulgaria, increases expenditure needs even as the population base supporting them shrinks. Eurostat (2023) estimates that demographic change accounts for approximately one quarter of projected increases in health spending across EU member states. Early childhood education holds a central position in the human capital literature. Heckman (2006) demonstrates that the rate of return on human capital investment is highest in early childhood and that reductions in early investment have lasting effects on lifetime productivity. Access to pre-school education also facilitates parental labor force participation, influencing household fertility decisions and demographic trajectories (Heckman, 2006; Nussbaum, 2011). In rural Bulgaria, declining enrollment and reduced kindergarten staffing have created a feedback loop: fewer children undermine the viability of local services, and the withdrawal of these services further discourages young families from remaining. This mechanism has been identified across Central and Eastern Europe (Copus et al., 2011). Both channels, therefore, link service provision not only to immediate welfare outcomes but also to the long-term human capital base necessary for competitive rural regions.

DATA AND METHODOLOGY

Territorial classification and sample

This analysis focuses on the 21 predominantly rural NUTS 3 districts of Bulgaria, identified using the OECD two-step territorial typology, which classifies territorial units by population density thresholds and the share of the population living in rural units (Dijkstra & Poelman, 2014; OECD, 2025). Limiting the analysis to rural districts ensures that the estimated relationships between public service supply and demographic outcomes are not confounded by

the agglomeration effects and service concentration typical of intermediate and urban territories (Storper, 1997; OECD, 2025).

Data sources and variables

Data were obtained from the National Statistical Institute of Bulgaria's (NSI) regional statistical publications for 2022–2024, yielding a panel of 63 district-year observations. This period is characterized by ongoing demographic contraction and adjustments to public service networks in response to national and global pressures. The dataset covers five domains: demographics, health, early childhood education, labor market, and infrastructure. Three dependent variables capture distinct aspects of demographic outcomes, which the literature identifies as proximate indicators of human development trajectories and territorial viability. The natural growth rate [%] is used as the primary measure of demographic dynamics and serves as the most direct indicator of long-term population sustainability, which underpins territorial competitiveness. The death [%] and birth [%] rates are analyzed separately to distinguish the mechanisms through which public services influence outcomes: supply-side constraints on births, primarily through early childhood education and family support services, and demand-side pressures on mortality, primarily through health services.

The independent variables are organized into two categories that reflect the empirical channels identified in the literature. Public service supply variables include physicians, GPs, and hospital beds in the health domain, as well as children enrolled in kindergarten and kindergarten teachers in the early childhood education domain. Health service variables are expressed as rates per 10,000 population to control for district size; hospital beds are normalized in the same way. Early childhood education variables are expressed as children enrolled per 1,000 population and kindergarten teachers per 100 enrolled children, respectively, the latter capturing staffing intensity rather than raw supply. All continuous variables are entered into the models in their original metric, since the within-district variation over the three-year panel is modest and any transformation would further compress the already limited variance. Control variables

include average annual wage [BGN], agricultural employment share [%], and paved roads share [%], which capture the broader economic and infrastructure context. Prior research has identified these factors as independent determinants of rural demographic dynamics (Copus et al., 2011; Brezzi & Luongo, 2016).

Econometric framework

The empirical strategy employs an entity fixed-effects panel regression to leverage within-district variation in public service supply and demographic outcomes during the 2022–2024 period, while accounting for all time-invariant unobserved district-level heterogeneity. The baseline estimating equation is specified as follows:

$$Y_{it} = \alpha_i + \beta_1 HEALTH_{it} + \beta_2 EDU_{it} + \beta_3 CONTROLS_{it} + \varepsilon_{it}$$

In this specification, Y_{it} denotes one of the three dependent variables for district i in year t . The term α_i represents the district-specific fixed effect, which captures time-invariant unobserved heterogeneity, such as geographic isolation, historical institutional legacies, and cultural norms that may independently influence demographic outcomes. *HEALTH* and *EDU* are vectors of public service supply variables in the health and early childhood education domains. *CONTROLS* is a vector of economic and infrastructure control variables, and ε_{it} is the error term. Standard errors are clustered at the district level to account for arbitrary within-district serial correlation across the three time periods, a necessary precaution given the panel's short temporal dimension (Angrist & Pischke, 2009). However, because the panel includes only three time periods ($T = 3$), inference based on cluster-robust standard errors should be interpreted with caution, as their finite-sample properties may be less reliable in short panels. Fixed effects are preferred over random effects based on the Hausman test and the F-test for joint entity significance. Five models are estimated: health-only (M1), education-only (M2), and full specifications with natural growth rate (M3), death rate (M4), and birth rate (M5) as dependent variables, all incorporating entity fixed effects. Because the panel covers only three years, time fixed effects are excluded to preserve degrees of freedom. Consequently, the estimated coefficients should be interpreted primarily as short-run within-district associ-

ations rather than long-term structural effects. Variables related to institutional capacity and education provision are likely to evolve gradually over time, implying that some substantive effects may not be fully observable within the panel's limited temporal horizon. Common temporal shocks are not explicitly controlled for; their potential influence is acknowledged as a limitation of the short panel design.

RESULTS

Descriptive statistics

Descriptive statistics highlight the severity and structural nature of the demographic challenges in rural Bulgaria (Table 1). The mean natural growth rate of -21.5% masks significant cross-district variation, ranging from -35.9% to -10.8% . This variation demonstrates that the conditions for sustaining territorial competitiveness differ even within predominantly rural areas. Average death rates of 29.5% , which are more than three times the average birth rate of 8.0% , indicate that excess mortality, rather than low fertility alone, is the primary driver of natural population loss. This finding has direct implications for determining

which public service channels are most relevant for policy intervention. The aging index reveals a population structure in which the population above working age outnumbers the population below working age by nearly four to one.

Health service provision varies significantly across districts, with physician density ranging from 25.1 to 80.3 per 10,000 population. The strong negative correlation between the number of children enrolled and the aging index supports the self-reinforcing process of inner peripheralization described by Copus et al. (2011). Districts with fewer young children are also those with the oldest populations, and withdrawing early childhood services from these districts is likely to accelerate rather than simply mirror demographic decline.

Correlation analysis

The natural growth rate is significantly correlated with GPs per 10,000, children enrolled per 1,000 population, average wage, and the aging index. The negative correlation with GP density is consistent with the hypothesis that GPs are more densely deployed in districts with more adverse demographic profiles, anticipating the endogeneity concern addressed

Table 1. Descriptive statistics for 21 rural districts in 2022–2024 ($N = 63$)

Variable	Mean	SD	Min	Max
Population (total)	157,090.97	64,319.11	70,542.00	291,852.00
Natural growth rate [%]	-21.51	5.07	-35.89	-10.78
Birth rate [%]	7.99	1.35	5.11	12.50
Death rate [%]	29.50	4.52	20.10	42.76
Aging index	396.01	39.23	271.95	491.27
Physicians per 10,000 population	36.73	10.11	25.09	80.30
General practitioners per 10,000 population	6.02	1.15	3.08	8.55
Hospital beds per 10,000 population	74.26	22.60	43.19	135.19
Children enrolled per 1,000 population	31.61	2.72	24.94	37.12
Kindergarten teachers per 100 children	9.18	0.99	7.40	11.11
Employment rate [%]	27.06	4.72	20.82	39.96
Agricultural employment share [%]	5.48	2.98	1.52	12.95
Average annual wage [BGN]	18,610.86	2,735.14	13,833.00	25,190.00
Paved roads share [%]	98.62	1.51	95.01	100.00
Waste collection coverage [%]	67.34	46.38	0.00	100.00

Data are pooled observations for 21 predominantly rural NUTS 3 districts.

Source: National Statistical Institute of Bulgaria.

Table 2. Pairwise correlation matrix

	NGR	PHY	GPs	BED	CHILD	TEACH	WAGE	AGRI	ROAD	AGE
NGR	1.000	−0.168	−0.441***	−0.175	0.549***	−0.260**	0.312**	−0.138	0.210*	−0.509***
PHY	−0.168	1.000	0.672***	0.693***	0.011	−0.250**	0.229*	−0.156	0.024	−0.066
GPs	−0.441***	0.672***	1.000	0.596***	−0.021	−0.134	−0.041	−0.106	−0.426***	0.126
BED	−0.175	0.693***	0.596***	1.000	−0.075	−0.253**	0.138	−0.447***	−0.039	0.201
CHILD	0.549***	0.011	−0.021	−0.075	1.000	−0.444***	0.225*	−0.003	−0.065	−0.671***
TEACH	−0.260**	−0.250**	−0.134	−0.253**	−0.444***	1.000	−0.232*	0.337***	0.102	0.591***
WAGE	0.312**	0.229*	−0.041	0.138	0.225*	−0.232*	1.000	−0.069	0.097	−0.144
AGRI	−0.138	−0.156	−0.106	−0.447***	−0.003	0.337***	−0.069	1.000	0.231*	−0.089
ROAD	0.210*	0.024	−0.426***	−0.039	−0.065	0.102	0.097	0.231*	1.000	−0.200
AGE	−0.509***	−0.066	0.126	0.201	−0.671***	0.591***	−0.144	−0.089	−0.200	1.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; $N = 63$.

NGR – natural growth rate; PHY – physicians per 10,000; GPs – GPs per 10,000; BED – hospital beds per 10,000; CHILD – children enrolled per 1,000 population; TEACH – kindergarten teachers per 100 children; WAGE – average annual wage; AGRI – agricultural employment share; ROAD – paved roads share; AGE – aging index.

Source: Authors' own estimation.

in the regression. The strong negative correlation between children enrolled and the aging index confirms that districts with fewer young children are also those with the most aged populations, reflecting the self-reinforcing nature of demographic decline. The health service variables demonstrate moderate positive correlations, particularly between physicians, GPs, and hospital beds. These correlation values remain below commonly accepted thresholds for severe multicollinearity (<0.8), and they should be considered when interpreting the magnitude and significance of individual coefficients in the regression models. All the above-described results of the correlation analysis are presented in detail in Table 2.

Regression results

The results demonstrate that public service supply influences demographic outcomes in rural districts through distinct health and education channels, aligning with the theoretical framework outlined in the “Literature review” section. The regression results are presented in Table 3.

The health-only specification (M1) explains 33.7% of within-district variation in the natural growth rate.

Physician density and GP density have statistically significant but opposing effects. The positive coefficient for physician density and the negative coefficient for GP density indicate a distinction between specialist capacity, which correlates with improved health outcomes and moderated demographic decline, and primary care deployment, which in this sample is concentrated in districts with the most adverse demographic profiles. This pattern suggests a reactive rather than preventive allocation of healthcare resources.

The education-only specification (M2) is jointly insignificant, accounting for less than 1% of within-district variation. This finding requires cautious interpretation, as it highlights a fundamental tension between the study's identification strategy and the temporal dynamics of education services. The fixed-effects estimator utilizes within-district variation over a three-year period; however, kindergarten enrollment and staffing are slow-moving variables that adjust incrementally in response to demographic trends rather than exhibiting abrupt annual changes. Consequently, the within-district variation available for identification in this limited timeframe is insufficient to detect the long-term human capital effects that Heckman (2006) and Nussbaum

Table 3. Panel fixed-effects regression results for dependent variables: natural growth rate (M1–M3), death rate (M4), birth rate (M5)

Variable	M1	M2	M3	M4	M5
Physicians per 10,000 population	1.5895*** (0.4677)		0.7655** (0.3730)	−0.7366** (0.3483)	0.0282 (0.0677)
General practitioners per 10,000 population	−8.7651*** (2.1462)		−3.5221** (1.6040)	3.3883** (1.3904)	−0.1366 (0.4513)
Hospital beds per 10,000 population	−0.2663 (0.2351)		−0.0796 (0.1421)	0.0834 (0.1268)	0.0043 (0.0348)
Children enrolled per 1,000 population		0.1694 (0.6409)	0.1783 (0.3550)	0.0393 (0.2993)	0.2154** (0.0839)
Kindergarten teachers per 100 children		−0.5951 (0.5435)	4.0957*** (0.6669)	−3.4200*** (0.6431)	0.6800*** (0.2235)
Average annual wage [BGN]			0.0011*** (0.0001)	−0.0011*** (0.0001)	−0.0000 (0.0000)
Agricultural employment share [%]			2.8189** (1.3259)	−2.6882** (1.2129)	0.1257 (0.2543)
Paved roads share [%]			−0.3043 (1.4076)	0.0970 (1.3025)	−0.2027 (0.1776)
Constant	−7.3694 (12.3592)	−21.4015 (19.3355)	−71.6325 (141.0286)	86.0570 (129.6734)	14.0329 (17.1716)
Dependent variable	Natural growth rate		Death rate		Birth rate
Observations	63	63	63	63	63
N (districts)	21	21	21	21	21
Within R ²	0.337	0.009	0.789	0.816	0.520
F-statistic (robust)	6.60	0.19	15.92	18.80	4.60
F p-value	0.001	0.831	0.000	0.000	0.001
Entity FE	yes	yes	yes	yes	yes
Hausman test	–	–	$\chi^2(8) = 313.6***$	–	–

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Clustered standard errors (entity level) in parentheses. All models include entity fixed-effects. Hausman test ($\chi^2(8) = 313.6$, $p < 0.001$) confirms fixed effects over random effects for M3.

Source: National Statistical Institute of Bulgaria (2022–2024) and authors' own estimation using linear models.

(2011) attribute to early childhood investment. This limitation is not a methodological flaw but rather a structural characteristic of the data – while the fixed effects design is effective for controlling unobserved heterogeneity, it is not well suited to identifying effects that develop over extended periods. Importantly, this constraint implies that the null result in M2 cannot confirm or refute the existence of a genuine demographic effect of education services within districts. Any such effect, if it exists,

likely operates over a period longer than three years and cannot be captured with the current panel. Future research utilizing longer time series or policy-induced variation in kindergarten provision would provide more credible within-district identification of this mechanism.

The full specification (M3) yields a within-district R^2 of 0.789 and is jointly highly significant. This result shows that the combined effects of health services, early childhood education, and economic controls

explain most of the within-district demographic variation. The most prominent finding is the large, positive, and significant effect of kindergarten teacher density on the natural growth rate ($\beta = 4.096$, $p < 0.001$). This is the strongest estimated effect in the model and remains robust after controlling for health and economic variables. Additionally, average annual wage and agricultural employment share are significant, indicating that economic conditions independently influence demographic dynamics and must be accounted for to isolate the effects of service provision.

The decomposition into mortality and fertility channels in M4 and M5 yields the most theoretically informative results. In the death rate model (M4), both physician and kindergarten-teacher densities significantly reduce mortality. The effect of kindergarten-teacher density likely operates through intergenerational pathways linking early childhood service availability to maternal health behaviors and household stability. In the birth rate model (M5), health service variables are not significant, whereas both children enrolled per 1,000 population and kindergarten-teacher density have positive, significant effects. This asymmetry supports the interpretation presented in the literature review: health services primarily influence mortality, consistent with Hokenstad and Roberts (2011), while early childhood education primarily affects fertility, as described by Heckman (2006) and Nussbaum (2011), by lowering the opportunity cost of childcare and signaling to families that the community maintains the institutional conditions necessary for a viable future. Panel evidence for Eastern European countries confirms that physician density has a significant positive effect on life expectancy, with each additional doctor per 10,000 inhabitants associated with a gain of approximately 0.09 years at birth (Țarcă et al., 2024). Collectively, these findings indicate that the human development–public services relationship in rural Bulgaria operates through two structurally distinct but equally important pathways, each with direct implications for territorial competitiveness and long-term rural viability.

DISCUSSION

The nexus: public services, human development, and competitiveness

The empirical findings reinforce the conceptual framework outlined in the literature review. The finding on kindergarten-teacher density emerges as the most robust and substantively significant result in the analysis. This variable remains positive and significant across all three dependent variable models, even after introducing economic controls that account for substantial within-district variation. Multiple mechanisms may explain this effect. Sufficient kindergarten staffing signals community vitality and institutional support for young families, thereby reducing incentives to out-migrate and enhancing the district's attractiveness as a place to live. This mechanism aligns with the signaling logic identified by Lehtonen (2021) in the context of primary school closures. Furthermore, accessible pre-school care alleviates the childcare burden on working-age parents, facilitates the formation of dual-income households, and lowers the opportunity cost of childcare. This is the channel through which Heckman (2006) and Nussbaum (2011) identify early childhood investment as a determinant of fertility decisions. The identification of this effect within a three-year panel window indicates that signaling and stabilization mechanisms operate immediately. This finding has direct policy relevance, as it suggests that improvements to rural kindergarten staffing may yield demographically observable effects within a single planning cycle.

The divergent effects of physician and GP densities highlight a structural issue in the allocation of primary healthcare, which appears to follow a reactive rather than a preventive logic. The presence of specialist physicians mitigates demographic decline through the mortality channel, whereas increases in GP density within districts are linked to worsening natural growth rates. This pattern suggests that primary care resources are concentrated in the most demographically distressed areas, rather than being deployed preventively. This distinction is significant for policy, as it indicates that simply increasing the number of rural GPs is insufficient without reforming the incentive structures that guide

their deployment. This insight is particularly relevant to primary healthcare reform in Central and Eastern European contexts, where the reactive concentration of services in distressed areas has been widely documented (Rodríguez-Pose, 2018; Chrobocińska, 2023).

The observed wage effect shows that public service provision cannot substitute for economic development. In the natural growth rate model, average annual wages have the largest coefficient, indicating that labor market conditions independently influence demographic outcomes and that service investment operates within a broader economic context. This finding aligns with evidence that rural depopulation is primarily driven by differences in economic opportunities between urban and rural areas (Stockdale, 2006; Woods, 2010).

Cross-district heterogeneity and disadvantages

Analysis of 2022–2024 district data indicates a pronounced spatial concentration of demographic and service disadvantages. Districts with the most negative natural growth rates are primarily located in northern Bulgaria. These areas have experienced persistent outmigration for decades, and the combination of below-average wages, elevated aging indices, and limited healthcare provision perpetuates cycles of inner-peripheralization (Copus et al., 2011). This spatial pattern aligns with broader evidence of regional polarization in Central and Eastern Europe, where peripheral territories have consistently lagged behind metropolitan cores since EU accession (Rodríguez-Pose, 2018; Chrobocińska, 2023).

In contrast, districts in central and eastern Bulgaria have less adverse natural growth rates. This trend is partly attributable to younger demographic profiles and stronger economic ties with regional urban centers. The mountainous southern districts represent an intermediate case. Although these areas report some of the lowest GP densities and wages in the sample, their demographic outcomes are not the most severe. This suggests that factors not captured in the model, such as community cohesion, lower outmigration rates, and distinct cultural influences on fertility, may partially mitigate structural service deficits. This heterogeneity highlights the need for differentiated rural policy interventions.

Policy implications

The findings have significant implications for rural policy in Bulgaria and, more broadly, for service-based rural development strategies across Central and Eastern Europe. Three key priorities are identified from the results.

First, kindergarten staffing should be treated as a strategic demographic instrument rather than a residual welfare provision. Implementing a differentiated funding formula for staffing that compensates rural kindergartens for the higher per-child costs of small-scale operations, similar to the place-sensitive funding adjustments proposed by the OECD (2025), would address the structural fiscal fragility that often leaves rural early childhood services the first to face municipal budget cuts. López-Torres and Prior (2022) show that this vulnerability generates compounding long-run efficiency losses in the education sector. The fertility channel result in M5 indicates that such investment would yield relatively rapid effects, making it both demographically effective and politically feasible.

Second, the observed reactive deployment pattern for GP density underscores the need for a proactive primary healthcare placement strategy. Introducing rural practice allowances, postgraduate training subsidies, and medical infrastructure to mitigate professional isolation would collectively support a shift towards the deployment of preventive primary care, addressing mortality risk before it appears in demographic data. The EC's communication entitled "Long-term vision for rural areas" identifies healthcare access as a fundamental component of rural attractiveness (EC, 2021), and the present findings offer district-level empirical support for this policy measure.

Third, the dominance of wages as the primary economic predictor of demographic outcomes shows that public service investment alone is insufficient for sustainable rural development. Integrated rural development strategies that combine service investment with economic diversification, digital infrastructure, and support for entrepreneurship are necessary to create the economic conditions under which service improvements can lead to sustained

demographic stabilization. This integrated, place-based approach is identified by both Storper (1997) and the OECD (2025) as the foundation of territorial competitiveness.

CONCLUSIONS

This study investigates the relationship between public service provision, human development, and territorial competitiveness in 21 predominantly rural NUTS 3 districts of Bulgaria, utilizing a balanced panel of NSI administrative data for 2022–2024 and employing entity fixed-effects regression. Three principal findings are identified, providing empirical answers to the three research hypotheses advanced in the “Introduction” section.

H1 is confirmed. Specialist physician density is negatively and significantly associated with death rates across all model specifications, supporting the theoretical expectation that healthcare supply mitigates mortality in demographically distressed rural districts. The additional finding that GP density has a positive coefficient, consistent with reactive concentration rather than protective provision, refines H1, underscoring that the mortality-reducing effect is specific to specialist, not generalist, supply.

H2 is confirmed and extended. Kindergarten-teacher density is positively associated with both birth rates and the overall natural growth rate, as hypothesized. However, the finding that it also operates through the mortality channel was not anticipated by H2 as originally formulated, thereby strengthening the policy case for investment in early childhood education beyond what the hypothesis implied.

H3 is confirmed. Average annual wages remain the dominant predictor of natural growth rates across all models, showing a more statistically robust and consistent association than any individual public service variable. This affirms that service provision is a necessary but not sufficient condition for demographic stabilization.

Taken together, the three hypotheses are empirically supported, and the pattern of results is internally consistent – public services shape demographic trajectories through specific channels, with healthcare

affecting mortality and kindergarten provision affecting both fertility and mortality. However, these effects operate within a broader economic context in which wage levels set the overall direction of natural population change.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The following limitations should be acknowledged. The panel covers only three years, which constrains the identification of effects operating through longer-run human capital and institutional channels and makes it impossible to include time-fixed effects without sacrificing degrees of freedom. This has two specific consequences for the fixed-effects estimates. First, the estimator relies solely on within-district annual variation across three time points, which may be insufficient to identify slow-moving processes such as the long-term returns to early childhood investment documented by Heckman (2006); this structural constraint provides the most plausible explanation for the jointly insignificant education-only model (M2). Second, because common temporal shocks cannot be partialled out via time-fixed effects without an unacceptable loss of degrees of freedom, developments coinciding with the 2022–2024 window, such as post-pandemic adjustments in healthcare staffing or macroeconomic volatility, may influence the estimated coefficients. Readers should therefore interpret coefficient magnitudes with caution, while the direction and significance of the principal findings remain more robust given their consistency across multiple specifications. A further limitation concerns potential spatial dependence between neighboring districts. Because Bulgaria's rural NUTS 3 districts share administrative boundaries, healthcare catchment areas, and labor markets, demographic and service outcomes in one district may be correlated with those in adjacent units. The present analysis does not apply spatial econometric methods; this choice is justified by the short temporal dimension, which limits the power of spatial specification tests, and by the primary goal of within-district rather than cross-district identification. The clustered standard errors adopted at the dis-

district level do not fully account for between-district spillovers. Future research covering a longer panel should consider spatial lag or spatial error models to assess the robustness of these findings to spatial dependence. The restriction to NUTS 3 district-level data prevents assessment of intra-district heterogeneity between village, small town, and isolated settlement types, a limitation that future research exploiting municipal-level data could address. While entity fixed effects control for time-invariant confounding, potential reverse causality between service deployment and demographic outcomes cannot be fully resolved without instrumental variables; policy shocks that differentially affected district-level service allocations represent a promising avenue for identification in future work. Finally, the model specification is constrained by the domains available at the NUTS 3 level: data on public expenditure by service category, digital infrastructure penetration, and secondary education quality would substantially enrich both the theoretical and empirical architecture of the analysis.

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CZY USŁUGI PUBLICZNE WSPIERAJĄ KONKURENCYJNOŚĆ OBSZARÓW WIEJSKICH? DOWODY DEMOGRAFICZNE Z PRZEWAJAJĄCO WIEJSKICH OKRĘGÓW BUŁGARII

STRESZCZENIE

Cel: W badaniu analizowano, czy dostępność kluczowych usług publicznych, w szczególności opieki zdrowotnej oraz edukacji wczesnodziecięcej, wspiera rozwój kapitału ludzkiego i konkurencyjność terytorialną w przeważająco wiejskich okręgach Bułgarii, które należą do obszarów dotkniętych jednym z najgłębszych procesów depopulacji w Unii Europejskiej. **Metody:** Analizie poddano zbilansowany panel danych regionalnych obejmujący 21 przeważająco wiejskich okręgów NUTS 3 w latach 2022–2024. Zastosowano modele regresji z efektami stałymi dla jednostek przestrzennych (ang. *entity fixed effects*) oraz grupowanymi błędami standardowymi. Oszacowano pięć modeli, w których zmiennymi zależnymi były: przyrost naturalny, współczynnik umieralności oraz współczynnik urodzeń. W modelach uwzględniono zmienne opisujące dostępność usług zdrowotnych i edukacji wczesnodziecięcej, a także czynniki ekonomiczne i infrastrukturalne. Test specyfikacji Hausmana potwierdził zasadność zastosowania estymatora efektów stałych. **Wyniki:** Usługi zdrowotne oraz edukacja wczesnodziecięca oddziałują na procesy demograficzne za pośrednictwem różnych mechanizmów strukturalnych. Dostępność lekarzy specjalistów przyczynia się do ograniczania niekorzystnych zmian demograficznych związanych z wysoką umieralnością, natomiast liczba nauczycieli przedszkolnych, będąca najsilniejszym predyktorem w modelu, oddziałuje korzystnie zarówno na poziom urodzeń, jak i na ograniczanie umieralności. Wynik ten jest zgodny z funkcją tego wskaźnika jako miernika żywotności społeczności lokalnej oraz czynnika ułatwiającego rodzicom uczestnictwo na rynku pracy. Przeciętne wynagrodzenie roczne okazało się najważniejszym ekonomicznym determinantem przyrostu naturalnego. Pełny model wyjaśniał 78,9% zróżnicowania wewnątrz badanych okręgów. **Wnioski:** Inwestycje w usługi publiczne stanowią warunek konieczny, lecz niewystarczający do wzmacniania konkurencyjności terytorialnej. Uzyskane wyniki dostarczają empirycznych dowodów na poziomie okręgów, przemawiających za ukierunkowanym terytorialnie finansowaniem edukacji wczesnodziecięcej na obszarach wiejskich oraz za proaktywnym rozwijaniem podstawowej opieki zdrowotnej w regionach Bułgarii dotkniętych niekorzystnymi procesami demograficznymi.

Słowa kluczowe: konkurencyjność obszarów wiejskich, rozwój kapitału ludzkiego, usługi publiczne, dane panelowe