PRACE NAUKOWE UNIWERSYTETU EKONOMICZNEGO WE WROCŁAWIU
RESEARCH PAPERS OF WROCŁAW UNIVERSITY OF ECONOMICS 2019, vol. 63, nr 2
ISSN 1899-3192
e-ISSN 2392-0041

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SOCIO-ECONOMIC DISPARITIES BETWEEN RURAL BOROUGHS AS A FUNCTION OF THEIR PERIPHERAL LOCATION

ZRÓŻNICOWANIE SPOŁECZNO-GOSPODARCZE GMIN WIEJSKICH JAKO FUNKCJA ICH ODLEGŁOŚCI OD OŚRODKÓW MIEJSKICH

DOI: 10.15611/pn.2019.2.04
JEL Classification: O18, R11, R50

Summary: We carry out an analysis of rural areas in Poland on the LAU2 level. The research reveals significant heterogeneities among rural boroughs. The deconcentration hypothesis holds only for rural boroughs within 40 km of large towns. The remaining peripheral rural boroughs are subject to adverse demographic and development pressures, with limited infrastructure stock and public services availability. The strong differentiation between rural boroughs indicates the need for a reconsideration of the criteria for regional cohesion policies.

Keywords: regional disparities, convergence process, peripheral rural boroughs.

Streszczenie: W niniejszym opracowaniu przedstawiona została analiza obszarów wiejskich w Polsce na poziomie LAU2. Badania przeprowadzone na podstawie wskaźników zrównoważonego rozwoju ukazują znaczną niejednorodność gmin wiejskich. Hipoteza o dekoncentracji potwierdzona została dla gmin wiejskich położonych w promieniu 40 km od dużych miast. Pozostałe, peryferyjne gminy wiejskie podlegają niekorzystnym trendom demograficznym i rozwojowym, skutkującym ograniczoną dostępnością infrastruktury i usług publicznych w tych samorządach. Zaprezentowane silne zróżnicowanie gmin wiejskich wskazuje na potrzebę weryfikacji kryteriów przyznawania środków w ramach regionalnych polityk spójności.

Słowa kluczowe: zróżnicowanie regionalne, proces konwergencji, peryferyjne gminy wiejskie.

1. Introduction

In 2015, 27% of Europe's population lived in rural areas according to a United Nation's report. In the case of Central European EU members, this ratio was significantly higher – for the last ten years it has remained at 40% [UN 2015,

pp. 38, 50, 233]. In principle, inhabitants of rural areas are subject to several pressures, such as depopulation, the income gap and infrastructure scarcities. Particularly in developing countries, there is a clear gap between rural and urban areas (to the detriment of rural areas), reflected by measures of living standards and the availability of social infrastructure, for example in the fields of education and health care [OECD 2016, p. 20].

Importantly, a general regularity is noticeable that the increase in urbanization is associated with a higher level of economic development of the country, and at the same time with a growing gap between the affluence of urban and rural areas. Although the direction of this relationship (its causality) is not always clear and the paths of income growth vary between countries, urban areas are clear centres of economic activity characterized by higher incomes [UN 2015, p. 34].

However, it should be noted that the key here may not be the rural character of a given entity but its geographical location. According to the deconcentration hypothesis, which states that the population moves to rural areas for lifestyle and quality of life reasons, while retaining urban employment through rural-to-urban commuting, up to a specific distance the proximity of an urban area exerts a positive influence on a rural borough (RB). This phenomenon is possible due to the diminishing cost of distance and is additionally propelled by the increasing negative externalities within urban areas. The theory dates back to such quantitative studies as [Wardwell 1980] and [Long 1981]. A broad review of studies on agglomeration economies, and interdependencies between urban and rural areas as well the significance of peripheral location is presented by [Gruber, Soci 2010]. Several pieces of research based on the New Economic Geography or the core-periphery setup, in general support the hypothesis of the advantages of agglomeration proximity on rural areas.

The occurrence of this type of phenomenon is confirmed by research on the performance of regions with a different profile (below NUTS-3 level). [Dijkstra et al. 2015] showed that in the EU specifically the rural remote regions and the urban regions were more vulnerable to the crisis which started in 2007-2008. The city-led growth pattern which prevailed before the crisis, was also inverted as a result of the crisis. The relative beneficiaries during that period were the intermediate regions and the rural regions adjacent to municipal areas. In another study [Townsend, Champion 2014] reported that the costs of recession in 2008 in the UK, evaluated by employment levels, were to a greater extent borne by peripheral local governments, both urban and rural. The analysis of rural areas in Poland on the LAU2 level by [Kluza, Rafał 2018] confirmed the existence of two distinctive profiles of rural boroughs – systematically depopulated and financially stressed peripheral boroughs and rural boroughs adjacent to large municipalities, which undertook skillful free rider strategies. The latter limited their own provision of public goods such as healthcare, and education on the one hand and, on the other, attracted residents and businesses at the cost of the neighbouring municipalities.

Several pieces of research present the relative importance of geography and institutions for economic development at a subnational level – see a recent study and literature review in [Mitton 2016]. Moreover, geographic location exerts an influence on the entrepreneurial and innovation characteristics of a given area. Studies conducted by [Artz et al. 2016] show direct positive agglomeration effects (including adjacent rural areas) on the entry of new firms to the market.

[Partridge et al. 2010] show the interdependencies between urban and rural boroughs in Canada and how the agglomeration economies can spill over to surrounding areas. Their findings support the deconcentration hypothesis. For rural areas within commuting distance, urban employment is a key source of population retention and growth. In addition, the job growth is negatively correlated with rural areas' remoteness. For Canada, the commuting distance, which supports the deconcentration hypothesis, amounts to up to 120 km (but with the mean distance of 61 km). Similarly, [McArthur et al. 2010] model the spatial unemployment disparities in Norway. The study shows that they grow sharply when the distance between two regions exceeds 80 km. [Renkow, Hoover 2000] showed that for rural areas in North Carolina, US, the 35 miles distance (60 km) is the boundary of a different character of the migration behaviour of residents. Up to 35 miles, these areas constitute the direct labour backing for urban areas thanks to work commuting. A subsequent study by [Renkow 2003] for rural and urban areas in North Carolina showed that one-half of new metropolitan jobs and one-third of new rural jobs were filled by in-commuters. [Lewin et al. 2013] demonstrate that over the last decades the commuting linkages grew stronger in the core-periphery setup. At the same time, the sales and purchases of goods and related business activities have gradually declined, leading to mainly labour and demographic interactions between the core and periphery. Thus, the commuting effects on employment have gained in importance.

Confirmation of the deconcentration hypothesis has a number of implications - in particular, it means that all rural areas cannot be treated homogeneously in regional policies as they have deeply distinctive socio-economic profiles depending on their location. Thus, the "one size fits all" approach in the EU allocation policies, which is derived from the fact that the eligibility and financial allocations for the regional policies are largely determined on the NUTS-2 level may lead to the stimulation of stronger regions at the expense of weaker regions. Problems of this nature are confirmed by a number of studies on the effectiveness of the cohesion policy (see [Fratesi, Wishlade 2017]).

The majority of research shows the positive impact of the EU regional policies, emerging over different time horizons. A recent study by [Jakubowski 2018] showed both the β and σ convergence for the EU regions in 2004-2014. A broad review of research is presented in [Dall'Erba, Fang 2017]. The authors also provide an explanation of why the results of different studies are so differentiated. Heterogeneity comes from, among others, the period examined, the control of endogeneity, and the

presence of several regressors other than Structural Funds. They point out that "more attention could be given to locally weighted estimates of the funds… to provide coefficient estimates for every single region, as opposed to the average impact for the entire sample" [Dall'Erba, Fang 2017, p. 831].

Several examples of evidence of regional convergence do not equal the confirmation of regional policy effectiveness. [Gagliardi, Percoco 2017] carried out research on the heterogeneous local responses to the 2000-2006 European Cohesion Policy. The analysis was undertaken at NUTS-3 level, which allowed to show that specific areas that should not be eligible for the policy support, as characterized by the 75% of the EU average GDP per-capita threshold, received the funds because the eligibility criterion was applied at a broader geographical scale (based on NUTS-2 typology). Such an "inadequacy" had vital implications for some regions. Specifically, it was beneficial for rural areas close to city centres. Due to a combination of such factors as support of the EU funds, geographical location and availability of space to accommodate the flow of people and new activities, they outperformed not only more dispersed rural areas but urbanized and suburbanized areas as well.

In this paper, we intend to deepen the knowledge on factors which lay behind the performance of various rural regions, in such fields as disparities in income, infrastructure stock, employment and demographics, taking into account their location from major urban centres, namely the capital cities of Polish provinces. Acquiring information on significant differences in the profiles of rural areas is the key to designing and implementing well-tailored policies supporting regional convergence.

Analyses in this paper are carried out for the LAU-2 territorial typology by Eurostat (corresponding to the former NUTS-5 level), which encompass over 1500 rural boroughs in Poland. Using this approach, we intend to contribute to the existing literature by showing the changing socio-economic profiles of rural areas as a function of their geographical location. The aim of the research is to verify up to what distance the positive spillovers between agglomeration and rural boroughs take place, being consistent with the deconcentration hypothesis, and, consequently, what distance causes the negative socio-economic effects to emerge in rural areas.

The rest of this paper is organized as follows. First, we describe the modelling approach used in this research. The RBs are described by several indicators reflecting the sustainable development framework. Then we design logit models which are suitable tools for estimating binary dependent variables, in this case describing what the probabilities are that certain socio-economic indicators are interrelated with an RB located at a specific distance from the large urban area. The models allow to indicate the specific distance values for which certain socio-economic disparities emerge in RBs.

2. Modelling approach

The quantitative analysis in this paper is conducted for all RBs in Poland. Econometric modelling is conducted with the use of the logistic regression. Logit models are dedicated and widely used for modelling the discrete dependent variables (see e.g. [Verbeek 2002, Chapter 7]. In our case, we model a binary variable i.e.:

$$Y_i = \begin{cases} 1, if\ a\ rural\ borough\ satisfies\ a\ specific\ condition\ (i.e. distance) \\ 0, otherwise \end{cases}$$

The conditions analysed for the rural boroughs are presented in Part 3. The logistic function has the following form:

$$p_i = P(Y_i = 1|X_i; a) = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}},$$

where: Z – a linear function such that $Z_i = a_0 + a_1X_{1i} + a_2X_{2i} + \cdots + a_kX_{ki} + \varepsilon_i$,
i – number of observations,
X_k – independent variables (socio-economic characteristics of rural boroughs),
$k = 1, 2, \ldots, n$ – number of variables,
a_k – coefficients & a_0 – constant.

Logit is the logarithm of the odds ratio $\frac{p_i}{1-p_i} = e^{Z_i}$ i.e.:

$$ln\frac{p_i}{1-p_i} = lne^{Z_i} = Z_i = a_0 + a_1X_{1i} + a_2X_{2i} + \cdots + a_kX_{ki} + \varepsilon_i.$$

There are two primary ways of interpreting the model's results. The sign of a_k coefficient reflects the impact's direction of the independent variable on the probability of $Y = 1$. The impact magnitude of a given variable change on obtaining the probability of 1 by the dependent variable is measured by a marginal effect, defined as:

$$\frac{\partial p_i}{\partial x_{ki}} = \frac{\partial \frac{e^{Z_i}}{1+e^{Z_i}}}{\partial x_{ki}} = a_k p_i(1-p_i).$$

In this research we analyse the socio-economic properties of rural boroughs with respect to their distance to a provincial capital. The distance reflects the distance between the centre of the respective provincial capital and the centre of the RB (location of its authorities). Typically, inhabitants of such RBs are spread in an area of +/–20 km around the RB centre. In the designed models the analysed distance is reflected by the Euclidean distance between the two centres.

In order to capture the socio-economic disparities of rural boroughs, we refer in this research to the framework of development sustainability – see [UN 1987, p. 16] and [UN 2007]. Specific indicators for analysing rural development are presented, for example, in [Adamowicz, Smarzewska 2009; Silva et al. 2017; Kluza, Rafał 2018]. The indicators used in this research are shown in Table 1.

Table 1. Variables used in modelling

Variable	Description
Demographics	
pop_dynamic	Population dynamic for the 2012-2016 period
pop_pre_prod	Share of the population at pre-working age in total population (2016)
pop_post-prod	Share of the population at post-working age in total population (2016)
pupils_in_popul	Pupils in primary schools per 1000 inhabitants (2015)
Business and Labour	
firms_pc	Business registered in REGON per 1000 inhabitants (2016)
salary	Gross salary – compared to national average (Poland = 100); data for the counties (2015)
unempl	Share of the registered unemployed in the working age population (2016)
Social and Infrastructure	
apartments_pc	Dwellings completed per 1000 inhabitants (2016)
HealthBasic	Health out-patient entities per 10 thousand population (2016)
house_aid_pc	Housing aid transfers per 1000 inhabitants (2015)
kind_garten	Children of age 3-6 years covered by preschool education (2014)
pupils_per_school	Pupils per class in primary schools (2015)
SocialAid	% of community social assistance recipients in total population (2015)
sewer	Persons using sewage system as % of total population (2015)
water	Persons using water supply system as % of total population (2015)
Local Government Financials	
Rev_pc	LG current revenue per capita (2016)
Debt_pc	LG debt per capita (2016)
Exp_pc	LG current expenditures per capita (2016)
Invest_avg_pc	LG capital expenditures per capita (average for 2014-2016)
Environmental	
forest	Share of forest areas in the total area of rural borough (2016)
water_usg	Consumption of water in households from water supply systems per capita in m^3 (2016).
tourist*	Number of bed places in tourist facilities (2016). The scale: 0 for 10 beds and less; 0.2 for <11; 100) beds; 1.0 for <101; 500) beds; 2.0 for <501; 5000) beds; 3.0 for over 5000 beds

* The 'tourist' variable was standardised into five brackets due to its high coefficient of variation (503%).

Data sources: all statistics are from Central Statistical Office of Poland (GUS) except for indictors reflecting 'Local Government Financials' which are taken from the Ministry of Finance.

We employ two approaches using the logit models to capture the relationship between the distance variable (Y) and the socio-economic properties of RBs. Approach 1 is based on the comparison of characteristics of eight models where $Y = 1$ for a different distance parameters d between a provincial capital (PC) and an administrative centre of a given RB. The distance parameter d is defined as $d \geq (10\text{km} \cdot i + 10\text{ km})$ where i is the model number from 1 to 8. That means that for model 1 in this approach $Y = 1$ is satisfied for all RBs located no closer than 20 km

from the PC (covering 93% of RBs), for model 2 $Y = 1$ is satisfied for all RBs no closer than 30 km (covering 85% of RBs), and so on up to model 8 where $Y = 1$ is satisfied for all RBs no closer than 90 km (covering the furthest 8% of RBs). All the RBs in the subsequent models are subsets of RBs in the models with a lower i parameter.

Approach 2 is based on the results of the models derived in Approach 1. Their outcomes allow to split the RBs into two disjunctive sets only, which disclose different socio-economic characteristics of RBs depending on parameter d. The two approaches delivered models which were statistically significant and with high accuracy ratios. The selected results are presented in Part 3 and the Appendix.

3. Discussion of the results

From the presented variables (see Table 1), 11 variables were selected – those that meaningfully described the characteristics of peripheral RBs. The selection was carried out based on statistical significance analysis of individual variables and Akaike's Information Criterion. These variables corresponded in particular to demographic characteristics such as population growth, percentage of pupils in primary schools, share of the population at pre-working and post-working age in the total population, variables reflecting economic conditions such as salary level, number of registered companies per inhabitant, and variables reflecting quality of social and communal infrastructure such as children of age 3-6 years covered by preschool education, persons using the water supply system as a % of total population, health out-patient entities per 10 thousand population, local government financials measured by total revenues per capita and share of forest areas in the total area of the rural borough.

The analysis of the results of the estimation for the models from Approach 1 reveals the changing profile of rural boroughs depending on the degree of their peripheral location. The strongest marginal effects for variables, i.e. the impact of a given variable on the probability that a given RB is an under-pressed peripheral RB, occur in the case of units located a minimum of 40 km from a provincial capital (see Table 2).

Limiting the sample to RBs with a distance of no less than 50 km-60 km increases the strength of some of the marginal effects, whereas this happens at the expense of losing the statistical significance of selected variables. This indicates the potential existence of a border distance that causes rural communes to suffer from their peripheral location, where for $d \geq 70$km the marginal effects visibly shrink. The fitness of the model is weakening if we consider only RBs located over 90 km from a provincial capital. To some extent this may be the effect of the small size of this group – less than 8% of all RBs.

Table 2. Summary of results for Approach 1 – marginal effects of statistically significant variables

Distance from a provincial capital:	≥20km	≥30km	≥40km	≥50km	≥60km	≥70km	≥80km	≥90km
salary			–0.003	–0.006	–0.010	–0.010	–0.005	–0.003
pop_change	–0.459	–2.907	–4.120	–4.548	–5.156	–4.606	–2.684	–1.161
pupils_in_popul		–0.003	–0.005	–0.006	–0.007	–0.008	–0.004	–0.002
kind_garten	–0.001		–0.001‡	–0.003		–0.001	–0.002	–0.002
firms_per_capita	–0.001	–0.002	–0.002	–0.002		0.002	0.001	0.001
forest			0.003	0.003	0.002	0.001	0.001	0.000‡
water	–0.001	–0.002	–0.002	–0.003	–0.002	–0.001	–0.001	0.000‡
pop_pre_prod	0.004	0.027	0.035		0.021‡	0.033		
pop_post_prod	0.004	0.009	0.012‡		–0.015	–0.010‡	–0.009	–0.004‡
Rev_pc	0.022	0.075	0.105	0.156	0.152	0.033	0.021	0.011
HealthBasic	–0.002	–0.010	–0.025	–0.026	–0.021	–0.014		
% of all RBs	93%	85%	73%	58%	42%	27%	15%	8%

Note: '‡' denotes variables with significance between 10-20%; skipped values denote insignificance.

Source: own calculations.

Further modelling (Approach 2) showed that the critical distance affecting the change of the rural borough profile amounts to a minimum of 40 km distance between the centre of the respective provincial capital and the location of the RB administrative authorities. In practice this encompasses a population of RBs typically living within 20-60 km Euclidean distance from the centre of a provincial capital. Such peripheral RBs have a number of characteristics that clearly discriminate them from non-peripheral entities.

From the demographic perspective, peripheral RBs are characterized primarily by the unfavourable trends of population change as well as their lower share of population of working age. In addition, the proportion of children attending primary education in schools is lower. From the perspective of indicators describing economic activity, these RBs are characterized by a lower level of salaries and a lower number of enterprises per 1000 inhabitants. Similarly, the variables describing the level of social and public infrastructure reveal an unfavourable picture. The percentage of children aged 3-6 years covered by preschool education is lower than in RBs close to large cities. Likewise, health services are relatively less accessible and the percentage of people using the water supply system is lower as well. In general, these areas are more covered by forests, which reflects their peripheral and non-industrial profile - see Table 3.

All these phenomena occur despite the slightly higher average revenue per capita of the peripheral RBs, which indicates that support instruments are already present there. Theoretically, this reflects the situation similar to the less developed Italian regions, where relatively larger spending from EU structural funds did not translate into a levelling of long-term differences in productivity compared to Northern and Central Italy [Aiello, Pupo 2012].

Table 3. Characteristics of RB with $d < 40$ km and $d \geq 40$ km; direction of the relationship and its marginal effect

	Variable	RBs within 40 km distance (27% RBs)	RBs above 40 km distance (73% RBs)	Marginal effect (absolute value)
Demographics	pop_change	+	–	4.120
	pop_pre_prod	–	+	0.035
	pop_post_prod	–	+	0.012
Business & Labour	firms_pc	+	–	0.002
	salary	+	–	0.003
Social & Infrastructure	kind_garten	+	–	0.001
	pupils_in_popul	+	–	0.005
	HealthBasic	+	–	0.025
	water	+	–	0.002
RB Financials	Rev_pc	–	+	0.105
Environment	forest	–	+	0.003

Source: own calculations.

What is important is that the described circumstances concern more than 70% of rural boroughs in the case of Poland, which indicates the importance of the discussed characteristics. They are inhabited by approximately 68% of the population of rural boroughs, which accounts for 19.3% of the population of Poland. Thus the topic of adjusting the instruments of regional policies is important here, so that on the one hand the funds are directed to genuinely under-pressed territories and, on the other hand, they were not a forceful support implemented irrespectively of its outcome.

4. Conclusions

The research extended the findings of [Dijkstra et al. 2015] and [Gagliardi, Percoco 2017] on the heterogeneous profile of rural areas and the privileged position of those close to large towns. The conducted analyses confirm that geographic location proves to be the substantial differentiating factor for rural boroughs. We found that such rural boroughs perform better than peripheral rural boroughs from the demographic, business and infrastructure perspective, which confirms the deconcentration hypothesis for Poland, similarly to the studies for other countries presented in [Renkow, Hoover 2000; McArthur et al. 2010; Partridge et al. 2010; Marek et al. 2017]. The deconcentration hypothesis works for Poland for a 40 km distance between the centres of the two administration entities, which translates into a 20-60 km distance to the provincial capital for the RB's inhabitants.

The peripheral RBs (with $d \geq 40$km) are systematically depopulated and suffer from several negative spillovers created by adverse trends in demographics, limited infrastructure stock and public services' availability. The peripheral rural boroughs require support from regional policies, otherwise the negative tendencies may autonomously deepen. The exception from this group are the most distant RBs with a touristic profile (with $d \geq 90$km), which are more entrepreneurial and thus the magnitude of negative effects is not as strong there as in other peripheral rural boroughs. The strong differentiation of the RB profiles presented in this study indicates the need to revise the eligibility criteria in regional cohesion policies (see also similar conclusions in [Dall'Erba, Fang 2017] and [Gagliardi, Percoco 2017]), in particular to design mechanisms differentiating support depending on the profile of the individual entity, instead of the current very uniform NUTS-2 criteria. This study indicates that the appropriate level is LAU-2 (former NUTS-5) accompanied by additional criteria like the location and urban/rural profile of a given entity.

Ignoring the described differences between the subcategories of local governments creates the risk of channelling support to less effective uses in the context of regional development. This study showed, however, that peripheral rural boroughs have already received substantial financial support, which turns out to be insufficient to trigger convergence to more developed RBs. This confirms the findings of [Aiello, Pupo 2012] for Italian regions, that even long-term transfers of structural funds may not level the differences in development between the regions. Thus, the key policy question which still requires an answer, is to what extent should additional funds be continuously channelled to peripheral RBs, or what are the boundaries for effective regional support. This is the main direction of future research.

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APPENDIX

Approach 2 – Logit regression results for the rural boroughs located close to a provincial capital ($d < 40$ km), $n = 1513$; omitted incomplete observations: 46; Dependent variable (Y): $d < 40$ km

	Coefficient	Stand. error	z	p-value	Marginal effects
Const	0.490966	1.90443	0.2578	0.79656	
Salary	0.0148771	0.00699228	2.1276	0.03337**	0.0027522
pop_change	22.2725	3.74578	5.9460	<0.00001***	4.12032
pupils_in_popul	0.0290315	0.00981063	2.9592	0.00308***	0.0053707
kind_garten	0.00705108	0.00517721	1.3619	0.17321	0.00130442
firms_per_capita	0.0117138	0.00349479	3.3518	0.00080***	0.002167
Forest	–0.0139461	0.00396126	–3.5206	0.00043***	–0.00257998
water_	0.00940156	0.0036949	2.5445	0.01094**	0.00173925
pop_pre_prod	–0.187048	0.069904	–2.6758	0.00746***	–0.0346032
pop_post_prod	–0.0652142	0.0411831	–1.5835	0.11330	–0.0120644
Rev_pc	–0.567318	0.134536	–4.2169	0.00002***	–0.104952
HealthBasic	0.135123	0.0334264	4.0424	0.00005***	0.0249972

McFadden R-squared	14.5%		Adjusted R-squared	13.1%
Adjusted Accuracy Ratio:	69.6%		Akaike criterion	1545.800
Likelihood ratio test: Chi-square(11) = 257.854 [0.0000].				

Source: own calculations.